NOAA Technical Memorandum NMFS-SEFSC-567

PROCEEDINGS
OF THE TWENTY-FOURTH
ANNUAL SYMPOSIUM ON SEA TURTLE
BIOLOGY AND CONSERVATION

22 to 29 February 2004
San Jose, Costa Rica

Compiled by:
Roderic B. Mast
Brian J. Hutchinson
Alec H. Hutchinson

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southeast Fisheries Science Center
75 Virginia Beach Drive
Miami, FL 33149 USA

January 2008

THIS PAGE INTENTIONALLY LEFT BLANK

NOAA Technical Memorandum NMFS-SEFSC-567

PROCEEDINGS OF THE TWENTY-FOURTH ANNUAL SYMPOSIUM ON SEA TURTLE BIOLOGY AND CONSERVATION

22 to 29 February 2004
San Jose, Costa Rica

Compiled by:

Roderic B. Mast
Brian J. Hutchinson
Alec H. Hutchinson

U.S. DEPARTMENT OF COMMERCE
Carlos M. Guitierrez, Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
Conrad C. Lautenbacker, Jr., Administrator

NATIONAL MARINE FISHERIES SERVICE
James W. Balsiger, Acting Assistant Administrator for Fisheries

NOTICE

The National Marine Fisheries Service (NMFS) does not approve, recommend or endorse any proprietary produce or material mentioned in this publication. No reference shall be made to NMFS, or to this publication furnished by NMFS, in any advertising or sales promotion which would indicate or imply that NMFS approves, recommends, or endorses any proprietary produce or material herein or which has as its purpose any intent to cause directly or indirectly the advertised product to be used or purchased because of NMFS promotion.

For bibliographic purposes, this document should be cited as follows:

Mast, R.B., Hutchinson, B.J., and A.H. Hutchinson, compilers. 2007. Proceedings of the Twenty-Fourth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-567, 205 p.

http://www.sefsc.noaa.gov

Technical Editor: Lisa C. Belskis

Copies of this report may be obtained from:

National Marine Fisheries Service
Miami Laboratory
Sea Turtle Program-Proceedings
75 Virginia Beach Drive
Miami, FL 33149 USA

or

National Technical Information Service
5258 Port Royal Road
Springfield, VA 22161
(800) 553-6847 or (703) 605-6000
http://www.ntis.gov

President's Report on the 24th Annual Sea Turtle Symposium San Jose, Costa Rica - February 23-27, 2004

Roderic B. Mast

Conservation International & IUCN-SSC Marine Turtle Specialist Group
2011 Crystal Drive, Suite 500, Arlington, VA 22202 USA
Email: r.mast@conservation.org

With registrants from some 78 nations alongside invited guests and local luminaries, the 24th Annual Sea Turtle Symposium filled the Herradura Hotel and International Conference Center to capacity from February 23rd to 27th, 2004 in San José, Costa Rica, making it the largest gathering of its kind in history.

Costa Rica was selected as the venue for the 24th Symposium to recognize the country's significance as the birthplace of modern sea turtle biology and conservation, and to showcase the work being done in and by Costa Rica to address what is perhaps the most burning issue in sea turtle conservation today, the vertiginous decline of the American Pacific leatherback turtle (the mascot of the 24th Symposium). Lastly, the organizers wanted to give Symposium participants a chance to experience first-hand that which provides so many of us with our ultimate source of inspiration, Nature.

> *The theme for the 24th Sea Turtle Symposium was* Sea Turtle Lifescapes, *chosen* to urge us to consider marine turtles as pieces of greater biodiversity landscapes, to discuss the niches that sea turtles fill in marine and terrestrial ecosystems, and to ponder as well their "fit" in Earth's broader Biosphere. More importantly, the 24th Symposium encourages us to analyze our own niche as powerful human components in the selfsame Biosphere, and to express our thoughts and voice our opinions about the most synergistic actions we can take as institutions, governments, a sea turtle conservation "movement", and as individuals, to assure that sea turtles thrive.

With this in mind, the organizers strove to assure the participation of a broad array of *human* partners, ranging from corporations like Intel, Gap and CoopeTarrazú Coffee, to government agencies and officials, artists and musicians, fishermen, and residents of local communities. An important theme at the 24th Symposium, beginning with the opening remarks and ending with the message of the keynote speaker, Steven Hock, was that of *synergy and organization* – the need for all of us that are part of this sea turtle "movement" to focus on the big picture, to do all we can to assure that our collective conservation impact as individuals and institutions is greater than the sum of our parts.

Capitalizing on the synergy of the Symposium itself, the organizers used this unique gathering as a focal event to leverage global media attention to "get the word out" about sea turtle and global marine conservation issues. A grant from the Moore Family Foundation helped the ISTS to bring journalists and media professionals from several countries, and the results were far better than imagined. Several major international wire services covered the event including *Reuters,* the *Associated Press,* France's *Agence France Press,* Spain's *ACAN/EFE,* and Japan's largest wire service, *Kyodo News.* Major outlets also covered the event including: *National Geographic Online, BBC Online, the Los Angeles Times,* Brazil's *Folha de Sao Paulo,* and Mexico's *Reforma.* The national media in Costa Rica was also fully engaged and the nation's leading newspapers, including *La Nación, El Heraldo, Diaro Extra* and the *Tico Times* covered the symposium, as well as national television and radio stations. Literally hundreds of millions of readers, viewers and listeners across the globe were reached with our message, with stories focused largely on the decline of the leatherback turtle in the Pacific and demonstrating to readers how they as individuals will be affected, and how they can help.

The Symposium schedule of events and session topics were designed in advance around the aforementioned theme using a scheme suggested by Nat Frazer in his article, *Concerning Those Things Which We Ought To Have Done: Reflections on the Future of Sea Turtle Research*. Seven sessions of oral presentations were designed, with three concurrent poster sessions, each with one to three chair(s) responsible for constructing a successful and productive series of presentations. Of 405 abstracts received, 112 were accepted as orals, 278 were accepted as posters (resulting in 255 posters presented), and 15 abstracts were rejected.

In order to assure broad international participation, the Symposium Travel Committee reviewed dozens of applications, and provided funding totaling $90,000 USD to 149 participants from 52 countries. We are grateful to the generosity of the Homeland Foundation, Conservation International, and the NOAA/NMFS Southeast Fisheries Science Center for making these grants possible. A portion of this year's travel support was also made available through the generosity of Disney's Wild Animal Kingdom to launch a new program – The Disney International Fellowship Award – to recognize leadership, passion, and outstanding contributions in the field of sea turtle biology and conservation.

The Annual Symposium has come a long way in the past 24 years. Under countless dutiful leaders supported by innumerable dedicated volunteers, we have evolved from a 15 person gathering in the backwaters of the Southeast US to an International Society represented by over a thousand members from nearly 80 countries. We have much to be proud of, and must keep these successes in mind as we look to the future and continue to evolve in a positive direction.

With registrants from some 78 nations alongside invited guests and local luminaries, the La Paz room of the Herradura Hotel's International Conference Center was packed to capacity for the Inaugural Ceremonies of the 24th STS on Monday, February 23, 2004. A stirring solo jazz performance by Costa Rican piano virtuoso, Manuel Obregón, was followed by speeches from the Symposium Sponsors: Minister Carlos Manuel Rodriguez (Costa Rica's Ministry of Environment and Energy-MINAE); Peter Seligmann (Chairman and CEO of Conservation International); and ISTS President, Roderic Mast. Several treaties and agreements were signed, and CCC Director David Godfrey presented the 2004 Archie Carr Award to Costa Rican sea turtle conservation pioneer, Billy Cruz.

Costa Rica was selected as the venue for the 24th Symposium for a number of reasons. First, to recognize the country's significance as the birthplace of modern sea turtle biology and conservation. Moreover, to showcase the work being done in and by Costa Rica to address what is perhaps the most burning issue in sea turtle conservation today, the vertiginous decline of the American Pacific leatherback turtle (the mascot of the 24th Symposium). Lastly, the organizers wanted to give Symposium participants a chance to experience first-hand that which provides so many of us with our ultimate source of inspiration, Nature. We were heartened to see so many people take advantage of the packaged tours provided by our travel partners, Manaca and Neotropical Expeditions, and also pleased to see how many people participated in the pre and post-Symposium events at Ostional and Playa Grande, where the olive ridleys and leatherbacks came ashore right on cue to greet us.

Roderic Mast

COMMITTEES, CHAIRS, AND KEY ORGANIZERS

Registrar	Brian Hutchinson
Conference Coordination	Clara Padilla
Program Committee	Mario A. Boza, Lisa M. Campbell, Didiher Chacón, Milani Chaloupka, Michael Coyne, Karen L. Eckert, Selina S. Heppell, Brian Hutchinson, Douglas Hykle, Sally Murphy, W. J. Nichols, David Owens, Frank Paladino, Peter C. H. Pritchard, Nat Frazer, Kartik Shanker, Roldán Valverde
Webmaster	Michael Coyne
Travel Committee	Jeffrey Seminoff (Chair), Ana Barragan (Latin America), Karen Eckert (Caribbean), Brendan Godley & Annette Broderick (Europe), Angela Formia (Africa), Nicolas Pilcher (Asia/Pacific), Alan Bolten (USA/Canada)
ISTS Historian	Barbara Schroeder
ISTS Parliamentarian	Frank Paladino
Symposium Logo & Materials	Ted Goodridge / Conservation International
ISTS Logo	Fernando Urrea / Conservation International
Media Coordinators	James Wyss, Patricia Alpizar
Auction	Rod Mast, Debbie Sobel
Resolutions	Jack Frazier
Nominations Committee	Manjula Tiwari (Chair), Ana Barragán, Brendan Godley, Mark Hamann, and Dave Owens
Student Awards	Lisa Campbell, Jeannette Wyneken, Anders Rhodin
RETOMALA XI	Carlos Mario Orrego, Laura Sarti, Claudia Ceballos, Felix Moncada, Rolando Castro
WIDECAST Meeting	Karen Eckert
Mediterranean Meeting	Dimitris Margaritoulis
West African Meeting	Jacques Fretey, Manjula Tiwari, Angela Formia
IOSEA Meeting	Nicolas Pilcher
Freshwater Turtle and Tortoise Mini-Symposium	Chuck Schaffer
Fisheries Bycatch Workshop	Martin Hall

EXECUTIVE COMMITTEE

Roderic B. Mast	President
Thane Wibbels	President Elect
Nicolas Pilcher	Past President
Edwin B. Drane	Treasurer
Kartik Shanker	Secretary

BOARD OF DIRECTORS

Milani Chaloupka	Peter Dutton
Hedelvy Guada	Dimitris Margaritoulis
Frank Paladino	Clara E. Padilla
Pamela Plotkin	Earl Possardt
Anders G. J. Rhodin	Jeffrey Seminoff
Donna Shaver	Hiroyuki Suganuma

TABLE OF CONTENTS

PART 1. ORAL PRESENTATIONS

Page #

FUTURES SESSION: SPECIAL PRESENTATIONS BY SESSION CHAIRS

GLOBAL AND REGIONAL SEA TURTLE CONSERVATION AND RESEARCH

SEA TURTLE MODELING AND PREDICTION

SEA TURTLES AND SOCIO-ECONOMICS

SEA TURTLES IN COSTA RICA: MINI-SYMPOSIUM

TECHNOLOGY AND SEA TURTLES

PART 2. POSTER PRESENTATIONS

GLOBAL AND REGIONAL SEA TURTLE CONSERVATION AND RESEARCH

POTPOURRI

SEA TURTLE ASSESSMENT AND MONITORING

SEA TURTLE MODELING AND PREDICTION

SEA TURTLES AND SOCIO-ECONOMICS

SEA TURTLES IN COSTA RICA: MINI SYMPOSIUM

TECHNOLOGY AND SEA TURTLES

PART 3. VIDEO/FILM PRESENTATIONS

POTPOURRI

SEA TURTLES AND SOCIO-ECONOMICS

SEA TURTLES IN COSTA RICA: MINI SYMPOSIUM

TECHNOLOGY AND SEA TURTLES

THIS PAGE INTENTIONALLY LEFT BLANK

FUTURES SESSION: SPECIAL PRESENTATIONS BY SESSION CHAIRS

The utility and future of social science approaches to conservation problems: Two views

Lisa Campbell

[1]Nicholas School of Environmental and Earth Sciences, Duke University, Beaufort, North Carolina, USA

To reflect on the future of social science approaches to conservation, I will first identify themes that arose in the social science sessions, and second give my thoughts on a few, but not all, of the issues. Third, I will address some of the barriers to integrating social and biological science to achieve truly interdisciplinary research.

Papers presented this week addressed the following social science subfields: economics (10 papers), environmental impacts (5), culture (4), social issues (2), education (2) and politics (1). Two overlapping themes running throughout the papers were tourism (10) and communities (25). I will focus my comments on tourism and economics, two issues that arose repeatedly and that are often linked. The link is made through the now well repeated statement, 'a turtle is worth more alive than dead.' In focusing my talk, I will address two questions that this statement raises. Question 1: worth more what? Question 2: worth more to whom?

Thoughts on economics

Many of the papers presented sought to quantify the value of different types of use. For the most part, these assessments were of gross value. This is a starting point, but in assessing economic links between people and sea turtles, there are a least four other considerations.

Per capita income and distribution of benefits: Imagine a community with 10 households. Under one scenario, an economic activity generates a total of $1000 distributed equally between the households. Under a second scenario, an economic activity continues to generate $1000, but is shared between two households only. The gross income is the same, but the distribution is not. Any changes to economic activities need to take such things into account. If change results in a skewed distribution of benefits and their increased concentration, then wide-spread community support for the change is unlikely.

Cost of living and purchasing power: There are often calls to replace extractive use of turtles with non-extractive use through tourism, and some papers suggested tourism can generate more income for households. However, the costs of living under tourism also need to be considered. Imagine that each household has a 'basket of needs' to fill in order to maintain a standard of living. Under an extractive regime, let us assume the 'basket' is filled with equal contributions from extractive activities and from cash purchases. What happens when we replace the extractive regime with non-extraction? First, assuming the 'basket' stays the same, the portion filled by purchase will have to increase, as extraction no longer plays a role. Second, tourism is almost always associated with inflation. Again, more cash will be needed to purchase goods, even if the 'basket' doesn't change. Third, tourism is often associated with increased local demand for goods and services, a phenomenon called the demonstration effect. Thus, the 'basket of needs' may increase, furthering the requirement for increased cash income. While there may be more cash in the economy, more cash will be needed to maintain and/or increase standards of living.

Reality of replacement activities: In many of the places where turtles are used consumptively (rural areas of developing countries), livelihoods are marginal. Thus, the notion that income from one activity can be replaced with income from another activity, consumptive or not, is perhaps naïve when need is high. Most people (from developing or developed countries) are interested in augmenting income rather than replacing it. It may be unreasonable to expect that economically marginalized people will have different expectations and will be willing to forfeit existing income, unless there are compelling reasons to do so.

Assumptions of rational economic man [sic]: While economic theory posits a rational economic man [sic], most people make decisions based on more than a desire to maximize individual profit. Livelihoods theorists have developed complex models, like the one used by the UK Department for International Development (DFID), to explain how people strategize to secure their livelihoods. Under the DFID model, livelihood assets include human, social, political, financial and natural capital, and people manage these to achieve a number of goals, including more income, increased well being, reduced vulnerability, increased food security, and a more sustainable use of the natural resource base. A livelihoods model forces us to consider more than just the dollar value of different economic activities, and to include, for example, their social and political relevance.

Thoughts on tourism

Tourism is a reality on many turtle beaches and is likely to continue to grow on others. There remains optimism regarding the ability of tourism to reduce more consumptive uses of marine turtles. In response to the popularity of tourism, I offer a few suggestions.

Know what you wish for: Tourism emerged as a major human activity in the post-WWII era. There is 50 years of experience with tourism, and an accompanying body of research detailing, for example, tourist behavior, host responses to tourism, destination development, environmental impacts, etc. Tourism advocates should take advantage of the existing literature and avoid re-learning the lessons of the past 50 years.

Be careful what you wish for: Much of the literature on ecotourism describes the gap between ecotourism in theory and in practice, with practice falling short of the ideal. At the 2003 World Parks Congress in Durban, South Africa, tourism was identified as one of the major threats to National Parks. While the congress also developed a set of guidelines to improve practice, and recognized tourism's potential to contribute to parks, the threat of tourism should not be ignored.

Think outside of the turtle box: Tourism's impact on the natural environment in general is often overlooked in the promotion of turtle tourism. While turtles may be amenable to people watching them on nesting beaches, they may be less amenable to wider environmental impacts, through things like increased pollution or run off associated with tourism construction. And there is a still broader scale of impacts. The ecological footprint concept was designed to measure the impact of individual lifestyles on natural resources. Calculating a footprint focuses attention on individual consumption, an exercise that can be enlightening. A simple footprint calculation (http://www.lead.org/leadnet/footprint/intro.htm) uses responses to questions in four main areas (food, transport, housing, other). My footprint, I am embarrassed to say, is 116.9% of the average American footprint. I drive seldomly and am mostly vegetarian, so I was shocked by this result. However, when I eliminated my international air travel, my footprint shrunk to a more respectable 84%. What's my point? There were 702.6 million international tourists in 2002, many of whom travel by air. Clearly, there are broader impacts of concern.

The future

I feel very strongly that we need to engage trained specialists if we want to effectively research the socio-economic context of conservation and development. On the other hand, I think we need to encourage biologists interested in socio-economic issues to continue to think and speak about them. It moves us closer to interdisciplinary approaches and brings new perspectives and ideas to the table.

This latter trend was evident at this year's meeting of Latin American specialists. I worked with the group tasked to come up with criteria for social sustainability. While most group members were trained in the natural sciences and were nervous about the assigned task, they tackled it with enthusiasm, sensitivity, and intelligence. They came up with five principles addressing equity, security/stability, institutions, participation and empowerment, and they articulated elegant and impressive statements of each principle. In encouraging us to bring in outside expertise, I don't mean to discourage this type of activity. That said…

The future is…

The next generation: Eight of 25 papers in the socio-economic sessions were presented by students. I'm not sure what the average age at the Latin American meeting was, but for the first time at a sea turtle symposium, I felt old.

The future should be…

*Collaborativ*e: The research that I and students working with me do in Costa Rica is collaborative in the sense that we seek to discuss research and its objectives with organizations in field sites, so that they are aware of our presence and intentions. In some cases, the research would be impossible without support of the organizations. Relationships develop over time, and increase the chance that our results will make a difference.

Interdisciplinary: We have an increasing number of disciplines represented at the symposium, but for the most part, this makes us multi- rather than inter-disciplinary. There are some exceptions to this, but in general, research is done in isolation. Integrating social and biological approaches within the same project will be challenging, but is increasingly required.

Economics plus: Based on my arguments above, I see it as urgent that we broaden our definition of social science to include disciplines in addition to economics, and increase rigor across these disciplines.

Engaged with theory: Currently, much of the social science work is being done at a case study level. We need to ensure that we draw on existing theory, and use our results to reinforce, re-inform, or replace this theory. It is through this exercise that we will start to be able to draw conclusions and lessons from such case studies that may be more widely applicable.

Challenges: Integrating social science and biological research on sea turtle conservation will face some challenges.

Shared objectives: When undertaking a collaboration, natural and social scientists may have different objectives. Scientists working with a charismatic species like marine turtles can act as advocates for turtle conservation without impacting on turtle behavior. The turtles don't know or care. As a social scientist studying the interaction of conservation and development in local communities, I **cannot** be an advocate for marine turtles. This would bias both my approach to the problem, and my study subjects – people. We need to understand how objectives vary before entering into collaborations.

Shared definitions of problems: The suggested ecological footprint calculator allows you to indicate the amount of land you feel should be set aside for protection and, based on your lifestyle, how possible this is. Using my original footprint estimate, and designating 12% of land for protected areas as suggested by the World Commission on Environment and Development, would require 6.3 planet earths in order for everyone to have my lifestyle. This figure makes me humble. For me, a major environmental problem is over-consumption in the western world, and as long as this is true it makes me uneasy about imposing livelihood restrictions on people living in developing countries. My interest in environmental justice informs this position, and it is one that my colleagues may or may not share.

Great expectations: In embracing inter-disciplinary approaches to conservation, we need to keep our expectations reasonable. As a researcher, my job is to understand human interactions with their natural environments, and how conservation programs may or may not affect these. I cannot 'fix' socio-economic problems, and I do not educate local people on the value of marine turtles. Entering into a collaboration where such expectations are in place would lead to disappointment and frustration for all involved.

Since I have been promoting the integration of social sciences into marine turtle conservation for 10 years now, my cautionary tone may come as a surprise to some of you. I continue to believe that interdisciplinary approaches to conservation are necessary, and I find collaborations rewarding. But we need to keep our eyes open in this new venture, to learn from our mistakes, and to capitalize on our successes.

Genetic studies for marine turtles: The next generation

Peter Dutton[1] and Nancy Fitzsimmons[2]

[1] NOAA, NMFS, Southwest Fisheries Science Center, La Jolla, California, USA
[2] University of Canberra, Canberra, ACT, Australia

-Invited Presentation- Abstract not available.

The future of global and regional sea turtle conservation and research

Karen L. Eckert and Douglas J. Hykle[2]

[1] Wider Caribbean Sea Turtle Conservation Network (WIDECAST), Nicholas School Marine Lab - Duke University, Beaufort, North Carolina, USA
[2] IOSEA Marine Turtle MoU Secretariat, Bangkok, Thailand

That marine turtles are a shared marine resource is undisputed. The developmental journeys of young turtles, as well as the migrations of adults between foraging and breeding grounds, have long been recognized. Species recovery is dependant upon our success in managing threats at biologically relevant scales, which has led to a number of bilateral and multilateral agreements that seek to expand sustainable management regimes beyond single national jurisdictions. In this context, the effectiveness of conservation and research at global and regional scales rests largely on our ability to fully utilize, and strengthen when necessary, the following:

- Global and regional treaties, intergovernmental agreements, trade regimes and policy initiatives,
- International and intercontinental partnerships, facilitated by global information tools and increasing recognition of interdependence,
- Large scale conservation and research, facilitated by advanced technologies (e.g. satellites, genetic tools),
- Habitat protection, including ecosystem level management regimes and transboundary parks, and
- Information-sharing, including training, mentoring, networking and technology transfer, at grassroots levels.

A review of international instruments reveals that the coverage of marine turtles in global and regional treaties, and other intergovernmental agreements and policy initiatives, is among the most comprehensive of any species group. Notable among them are the Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC), and two agreements under the Convention on Migratory Species (CMS) -- for marine turtles of the Indian Ocean and South-East Asia (IOSEA), and the Atlantic Coast of Africa, respectively. Regional needs being different, there is no "one size fits all" approach; however, inclusiveness is considered an important ingredient for all. The Mediterranean Sea and the Pacific Ocean are two areas where more formal arrangements might be explored.

The conservation of marine turtles in international waters has yet to be addressed adequately. There are a number of multilateral mechanisms that apply in one way or another to marine turtles and the habitats upon which they depend, including those negotiated specifically and exclusively for the benefit of regionally depleted stocks (noted above). By definition these agreements articulate obligations pertaining to territories under the jurisdiction of States; few options exist that enable us to effectively address the survival issues of marine turtles in international waters and on the high seas. What is needed is an inclusive mechanism by which species that spend a large part of their time in "the commons" are adequately protected by all relevant stakeholders.

That regional fisheries management organizations are pursuing the issue of marine turtle–fisheries interactions more vigorously is a welcome development. It is hoped that proposals being advanced within the Inter-American Tropical Tuna Commission (IATTC) with respect to gear modification and other mitigation measures will be replicated by comparable bodies in the Atlantic and Indian Oceans (the ICCAT and IOTC, respectively) and by the new Western and Central Pacific Fisheries Commission.

A number of interactive information gathering and dissemination tools designed for widespread application serve to underpin these efforts. Among them are the Marine Turtle Interactive Mapping System (IMapS) developed for CMS by UNEP-WCMC, already operational in the Indian Ocean and Australasia region; the OBIS/SEAMAP project, aiming to set up a similar system focusing initially on the Wider Caribbean Region; and the Tagging of Pacific Pelagics (TOPP) programme, seeking to shed light on migration patterns in the North Pacific. As these initiatives develop and possibly expand their geographic scope, coordination will be necessary to benefit from synergies and avoid duplication.

Global governance of these interlocking instruments, mechanisms and tools remains at challenge to be addressed in the not so distant future.

Large-scale conservation and research, often facilitated by advanced technologies (e.g., satellites, genetic tools), can meaningfully inform intergovernmental negotiations and policy action. To ensure that the best available science is accessible to intergovernmental processes, the priorities

must be to (i) establish local and regional partnerships, emphasize shared responsibilities, and promote coordinated recovery actions among range states; (ii) seek to fill information gaps in ecosystem-level processes and population dynamics; and (iii) focus on applied research portfolios that address urgent questions surrounding fisheries interactions, sustainable use modeling, and the protection of migratory corridors, among many others. These efforts will succeed only to the degree that partners at all levels respect each other and share their results.

The importance of projecting critical habitat, including ecosystem-level management regimes and transboundary parks that reflect life history realities, is often overlooked. Priorities in this regard are to (i) identify critical habitat and priority conservation areas, including corridors that span multiple national jurisdictions and the high seas; (ii) identify regionally significant assets; (iii) create marine management regimes at ecologically relevant scales; (iv) build management capacity; and (v) forge new governance patterns, especially for transboundary assets.

Important in all aspects of regional and global initiatives is an honest emphasis on information-sharing, including training, networking, mentoring and technology transfer at grassroots levels. The success of initiatives at large geospatial scales can be just as dependant upon actions taken at grassroots levels as are actions designed for implementation at strictly local levels. In both cases there must be broad awareness and consensus, if not unanimity, that particular conservation actions are appropriate and necessary. This is the least honored aspect of successful conservation.

A model program in the Wider Caribbean Region seeks to embrace all stakeholders in an effort to secure a future where humans and marine turtles can live together in balance. For more than two decades, the Wider Caribbean Sea Turtle Conservation Network (WIDECAST), with volunteer Country Coordinators in nearly 40 nations and territories, has linked expert scientists, conservationists, resource managers, resource users, policy-makers, industry groups, educators and other stakeholders together in a collective effort to develop a harmonized management framework, and to promote a regional capacity to design and implement scientifically sound sea turtle management programs.

The importance of such networking cannot be overemphasized. The Wider Caribbean Region encompasses more than four million square kilometers and is home to more than 200 million people, half of which live in habitats defined as “coastal”. In other parts of the global range of endangered and critically endangered sea turtle populations, the percentage of people living on the coast is even higher. Our experience suggests that in order for research and conservation to meaningfully contribute to the lives of people who will ultimately determine the fate of the world’s marine turtles, we must (i) create and maintain networking and outreach mechanisms; (ii) emphasize appropriate communication (e.g. a website is insufficient in areas without access to the Internet); (iii) honor transparency, the process of consensus, and the mutual sharing of expertise; (iv) develop inclusive project designs; and (v) always use the best available science (both “natural” and “social”).

In conclusion, we would define a successful future for global and regional sea turtle conservation and research using the following criteria:

- Better use of existing regional agreements by governments, and the development of new governance mechanisms where needed (e.g. for the high seas),
- Active partnership with and the engagement of the private sector (e.g. tourism, fisheries),
- Communities fully engaged in sustainable coastal management and their livelihoods improved,
- Policy and decision-makers promoting and effecting change, based on the best available science,
- Fully sensitized public (e.g. users, tourists, media),

- Critical seascapes and coastal habitats protected, including multi-jurisdictional corridors,
- Governments and NGOs actively collaborating (e.g. formal co-management agreements),
- Resources (human, monetary) available to utilize modern technologies at regional and global scales,
- Methods, protocols and resources available to monitor progress and evaluate success,
- Cross-cultural commitments to a sustainable and equitable future, … where no one is left behind.

Interdependent co-arising: the emerging harmony between sea turtle research and conservation at the dawn of the 21st century

Nat B. Frazer

Department of Wildlife Ecology and Conservation, University of Florida, Gainesville, Florida, USA

> *For a table to exist, we need wood, a carpenter, time, skillfulness, and many other causes. And each of these causes needs other causes to be. The wood needs the forest, the sunshine, the rain, and so on. The carpenter needs his parents, breakfast, fresh air, and so on. And each of those things, in turn, has to be brought about by other conditions. If we continue to look in this way, we'll see that nothing has been left out. Everything in the cosmos has come together to bring us this table. Looking deeply at the sunshine, the leaves of the tree, and the clouds, we can see the table.*
>
> *Thich Nhat Hanh (1998)*

In the passage above, Thich Nhat Hanh explains the concept of "interdependent co-arising" by which things emerge into existence due to multiple causes. Thus, there are no independent "things" in existence, since everything in existence at this moment arose interdependently as all the other "things" co-arose along with it. In thinking about the "things" that have emerged in the last 30 years or so that can enable us to carry out our research and conservation activities on behalf of sea turtles, I began wondering if we might make better use of some of them by recognizing their interdependence and deciding how to use them more effectively to meet our needs.[1]

So, what are these interdependent entities that have co-arisen amongst us? There are myriads to choose from, including legislation (local, regional, national and international), individual people, organizations, research tools and techniques (from flipper tags to biochemical techniques), and others. I choose to focus on six.

The annual international Sea Turtle Society's Symposium (ISTS), the IUCN-SSC Marine Turtle Specialist Group (MTSG), the *Marine Turtle Newsletter* (MTN), refereed journals such as *Chelonian Conservation and Biology* (CC&B), the new State of the World's Turtles (SWoT) initiative, and web-based resources such as *seaturtle.org* and *cturtle*.[2] Each of these six components enables and empowers us to do the job we need to do. None of the six came about in

[1] I am aware of taking an Eastern concept of organic-growth-emergence and imposing a Westerner sense of command-and-control onto it. Such self-contradictory dissonance results from having lived all my life in the USA while being encouraged to read anything I wanted to as a child.

[2] I also am aware of the tremendous importance of regional organizations such as WIDECAST and MEDASSET, but choose not to include them in the present work. Someone more knowledgeable than I am should address the topic of how best to coordinate regional organizations.

isolation; they co-arose interdependently, often involving some of the same people in their conceptualization and initiation. And all continue to evolve interdependently. But aside from standing back occasionally to observe the organic growth or these components, rarely have we stopped to think about how they might be integrated and used to serve us better. Have we done all we can in terms of optimizing the utility of these components in a coordinated fashion? Probably not. But with only a little thought, we can make them work better for us in a unified and coordinated approach for the betterment of sea turtle research and conservation.

The Marine Turtle Specialist Group can be used consciously initial planning and prioritizing to initiate and perhaps refine a global approach to research and conservation. They also can continue to provide expert advice to governments and NGOs that manage sea turtles. One of their main tasks should be to ensure that policy recommendations are based on the best science available. Equally important is providing guidance in prioritizing research needs. This work recently took a major step forward with the visioning meeting in Rod mast and Nick Pilcher organized in the Spring of 2004.

The *Marine Turtle Newsletter* serves us well by providing thoughtful and timely communication. It links us across the globe, reaching places that lack internet connections. For decades it has served as a forum for reflective discussion and rapid dissemination of information. And the list of recent publications is indispensable.

Where internet connections do exist, *cturtle* and *seaturtle.org* provide us with instantaneous communication to share ideas, opinions, and "breaking news." The immediacy and ease of use stimulate the release and sharing of humorous, sensitive, or deeply emotional thoughts. Anyone who has read Manjula Tiwari's bloggings will understand the benefit.

I have no doubt that SWoT will become an amazing tool. An inventory of global survey data shared for long-term monitoring purposes will have both predictable as well as unforeseen benefits. I urge everyone to participate in this global sharing of what we know for the advantage of both the turtles and ourselves.

Refereed journals such as *Chelonian Conservation and Biology* provide an outlet for critical scientific publication in a longer format than the MTN is able to provide. Such outlets are necessary for academic research, as the success of university scientists in many places depends upon their publishing in such journals. In addition to providing space for longer editorials and the publication of species-specific symposium issues, such journals also connect us with scientists who conduct research on taxa other than marine turtles, as well as on ecological and evolutionary theory.

And finally, the ISTS [Annual Symposium] is the only time and place we all can come together, face-to-face to meet and get to know each other. As primates and social animals, this is vitally important to establishing productive working relationships. Not only can we share the results of past work and work in progress, we can network to plan future work collaboratively. Most importantly, we become acutely aware that the names we read on-line or in the literature are not simply abstract labels, but are indicative of real, warm, thoughtful, interesting (and sometimes entertaining!)l human beings who share some of our deepest feelings of commitment to marine turtles, beaches and oceans.

Let's take the pieces we have created and use them more effectively to provide a unified and coordinated approach to sea turtle research and conservation, as follows:

The Marine Turtle Specialist Group should continue to define priorities for research needed to support conservation, identify geographic "hot spots" needing more conservation activity, and provide leadership in planning global approaches.

The *Marine Turtle Newsletter* can serve as a forum for thoughtful presentation of MTSG proposals and positions, including minority opinion statements and thoughtful rebuttal or commentary from people who are not MTSG members. It also should continue to (1) serve as an official organ announcing upcoming regional meetings and reporting on what happened at those meetings, (2) provide the list of recent publications, and (3) fulfill its traditional role in providing opportunities for dialogue on other issues.

Cturtle and *seaturtle.org* should continue to provide a means of instantaneous discussion and electronic submission of materials and registration for the annual symposium. In addition to disseminating MTSG proposals and position papers in the MTN, they might also be posted on cturtle for open discussion and feedback among the entire membership. *Seaturttle.org* also will continue to provide its extremely valuable services to symposium program chairs and organizers as they review papers and posters in preparation for the annual symposium.

SWoT can provide the necessary overview enabling the MTSG and others to discuss and monitor global trends in meaningful ways. As it develops, we should give careful thought as to how best to incorporate this vital information into local, regional, and global decision-making, and how to communicate the information in various formats. Perhaps periodic updates could be placed in the MTN for the benefit of those who do not have access to electronic communications.

Refereed journals such as CCB will continue to provide opportunities for longer articles, editorials and special topics symposia. They will continue to ensure the dissemination of sound science after subjection to peer review. The journals that reach a wider audience communicate with our colleagues who work with freshwater and terrestrial turtles, as well as those whose interests span an even broader range of taxa, to identify issues of common interest and/or issues requiring our collective action.

ISTS should consciously attempt to provide opportunities at the annual symposium for discussion and refining of global and regional priorities proposed by the MTSG and others. In addition to providing the only setting for face-to-face interactions among the global sea turtle community, the symposium also should strive to maintain a venue for the presentation of high quality papers and posters on sea turtle research and conservation. In the spirit of the 24th and 25th Symposia, the annual meeting should not only be a venue for reporting past accomplishments, but also a time to discuss unmet needs and plan future activities. Indeed, perhaps at the a future symposium or MTSG meeting, some time might be set aside specifically to think about how the six components might be used more effectively – both individually and in concert.

I'd like to offer some suggestions as to how we might organize our research and conservation into a conceptual framework that can help each of us to know how our own work fits into the overall picture of global sea turtle research and conservation programs. Like most science, the great majority of our work can be characterized as *descriptive*, *predictive*, or *evaluative*. Or, as I like to refer to them – Assessment and Monitoring; Prediction and Modeling; and Demonstration and Evaluation (Shearer and Frazer 1997).

By Assessment and Monitoring, I mean developing methods to assess and monitor sea turtles and the impacts of human and natural activities on them at the species level, the population level and the individual level (including cellular and biochemical aspects). Monitoring should not be restricted to monitoring numbers of turtles, but must include monitoring and assessment of health

and disease, migratory pathways, foraging areas, the nesting environment, beach status (including erosion, sand characteristics and development issues). Assessment and Monitoring also includes the study of environmental perturbations whether natural or anthropogenic.

By Prediction and Modeling, I do not mean just population modeling. I also mean modeling the processes of disease and toxicology at the level of ecosystems, species, populations, and individuals. I also include predictive socio-economic models. And also models of sea turtles' responses to environmental perturbations as well as modeling and predicting their responses to our conservation and management plans.

By Demonstration and Evaluation, I refer to showing that we truly understand the impacts of our activities on the turtles, including an evaluation of the successes or failures of conservation and education, mitigation programs, economic and urban development programs, and scientific research programs. We should establish demonstration areas where we can validate and evaluate the outcomes of predictive models. And we should evaluate the impact of our planned programs on the turtles, on people, on the habitat and on other species (such as shorebirds and mammalian predators). And based upon these evaluations we should then modify our programs through adaptive management.

We are poised to take a giant step forward in the development of sea turtle research and conservation initiatives by organizing our activities into a meaningful conceptual framework, and by using the interdependent components in a more effective manner.

References

NHAT HAHN, T. 1998. *the heart of the Buddha's teaching*. Parralax Press. Berkeley, California. 265 pp.

SHEARER, C. R. H. and N. B. FRAZER. 1997. The national environmental research park: a new model for federal land use. Natural Resources & Environment. 12(1):46-51.

A bright future for modeling and management planning: new blood, new ideas, and new insights

Selina Heppell[1] and Milani Chaloupka[2]

[1] Oregon State University, Corvallis, OR, USA
[2] Ecological Modeling Services Pty Ltd, University of Queensland, St. Lucia, Queensland, Australia

---

-Invited Presentation- Abstract not available.

The future of sea turtle assessment and monitoring

Sally Murphy[1], David Owens[2], and Frank Paladino[3]

[1] South Carolina Dept of Natural Resources, South Carolina, USA
[2] Grice Marine Laboratory, Charleston, South Carolina, USA
[3] Indiana-Purdue University, Fort Wayne, IN, USA

-Invited Presentation- Abstract not available.

A brave new ocean? Technology and the future of sea turtle research and conservation

Wallace J. Nichols

WiLDCOAST, Davenport, California, USA

-Invited Presentation- Abstract not available.

The future of sea turtle research and conservation in Costa Rica

Roldán A.Valverde and Mario A. Boza

[1] Dept of Biological Sciences, Southeastern Louisiana University, USA
[2] San Jose, Costa Rica

In order to speak of the future it is essential first to look at the recent history of sea turtle research and conservation in Costa Rica. A brief examination of this history points to the middle of the 1990s as a pivotal period in sea turtle work in Costa Rica. Before 1995 most sea turtle research and conservation activities conducted by Costa Ricans were largely in the hands of the Sea Turtle Program (STP) based at the University of Costa Rica. This high profile program administered important projects, such as the sea turtle Regional Tagging program. In 1995, an internal crisis substantially curtailed the national and international projection and programs of the STP. As a result, since 1995 the STP's main activities have focused primarily on the Ostional Wildlife Refuge. Perhaps the perceived vacuum in leadership and work left by the STP crisis led Costa Rican sea turtle workers to create in 1998 the National Sea Turtle Network (NSTN), which was officialized by the government in 2004. The NSTN is constituted of various governmental and non-governmental organizations (NGOs), as well as the University of Costa Rica and the Ostional Integral Development Association (ADIO). The main impetus behind the creation of the NSTN was to have an integrated network of specialists to more effectively protect Costa Rican sea turtle populations. Currently, the NSTN also plays an important role advising government officials on sea turtle research and conservation issues. We envision a more functionally robust STP upon which the future of Costa Rica's sea turtle research and conservation should rest. The STP mission should be to continue to identify the most salient and urgent conservation needs in the country to steer national efforts to effectively preserve sea turtle populations.

Although Tortuguero in the Caribbean and the arribada beaches, Nancite and Ostional in the Pacific, have traditionally attracted most of the attention of researchers and conservationists, over the last 15-20 years sea turtle work has spread over to many other, lesser known nesting beaches. This work has been spearheaded mostly by NGOs and focuses on conservation and education of coastal communities, Costa Ricans and tourists on the plight of our sea turtle populations. Currently, there are efforts by the Inter-American Convention for the Protection and Conservation of Marine Turtles to create an international database on nesting abundance in Costa Rica and in the Americas. The aim of this database is to identify and track over time the most important beaches in an effort to elucidate population trends and provide better protection. These efforts should mesh well with others like those of the State of the World's Sea Turtles and similar

initiatives to provide the international research and conservation community with an improved understanding of sea turtle abundance and population trends in the region.

Egg poaching, pollution, incidental fisheries, coastal development and sea level rise due to global climate change, are the most important current and future threats sea turtles face in Costa Rica. One way of protecting sea turtles is by creating protected areas. Given that a number of Wildlife Refuges have been established on the coasts over the past decade and the recent discussion to develop an international marine corridor with neighboring nations, the Costa Rican government has shown its willingness to improve protection measures. One problem these areas face, however, is the low funding and insufficient personnel that permeates the entire Costa Rican Conservation Areas (SINAC) system. In spite of these concerns, one important reason for optimism is the educational value inherent to the Conservation Areas, which should create among Costa Ricans a long lasting sense of responsibility, empowerment and desire to protect the delicate sea turtle populations and other natural resources that Costa Rica shares with the world. In addition, funding and personnel problems are currently being addressed by the "Peace with Nature" presidential initiative that looks to provide administratively and financially effective solutions to the SINAC. Given the passion of Costa Ricans to protect the environment, along with the small size of the country, grass roots conservation strategies should constitute a powerful approach to ensure the survival of Costa Rica's sea turtle populations.

Below we include brief comments about the best known beaches in the country for their historical importance and relevance to sea turtle conservation. The comments are meant to draw attention to the most salient issues with regard to the turtle populations they protect.

Tortuguero- The Tortuguero green turtle population has shown to be recovering. The relatively recent closure of the limited green turtle take for local consumption may help accelerate the recovery of this population by removing from the market meat from questionable origin. It will be important over the next few years to determine the magnitude and impact of any black market that may arise from this closure. On a larger scale, the future of the Tortuguero population may continue to focus on the training and production of an important fraction of future sea turtle biologists and enthusiasts through programs like those of the Caribbean Conservation Corporation.

Las Baulas Marine Park- As the main nesting beach for the leatherback sea turtle it will be important to continue to strengthen the mission of this Park, which is to protect this species from its forecasted extinction in the Pacific Ocean. The main threat to the nesting population appears to come from local development and poaching of eggs on beaches outside the Park. This beach is expected to continue to be a barometer for the status of this species in the region.

Nancite- The Nancite arribada assemblage has been shown to have suffered a significant decline over the past two decades. This is important because this beach has been fully protected and gone unmanaged since its discovery in 1970, which makes this beach a natural experiment. Do arribada rookeries undergo natural cycles of high and low nesting discernible only on a decadal scale? Or do arribada nesting numbers depend merely on a shift of nesting behavior regulated by an as of yet unknown (environmental?) factor(s) that leads this species to nest on other beaches? More specifically, did Nancite turtles move to another beach such as La Escobilla, in recent times? There are limited data that indicate that this exchange is real. However, future research should be aimed at determining the magnitude and significance of this exchange.

Ostional Beach- Besides providing a robust and reliable estimate of population trends for the olive ridley there are two main issues that the sea turtle community must address at Ostional. First, it is necessary to determine whether the arribada nesting population here can sustain itself

or if it will follow the same fate of the Nancite rookery. A seminal question related to this topic is; if the Ostional arribada assemblage were to decline do we have enough information to determine if it did due to an endogenous natural cause (like at Nancite) or to the egg harvest program? It is our belief that the answer to this question is no. A related question is; to what extent does the legal egg extraction program impact the ability of this rookery to sustain itself, if at all? Future efforts should be made by the research community to develop the tools that will provide the information to answer these questions. Second, it is essential to determine the success of the Ostional extraction program with respect to its original objective of discouraging egg poaching on other beaches. In other words, is this program promoting or discouraging egg poaching (of all species) in the rest of the country? Although attempts have been made in the past to answer this question much more needs to be done to draw conclusive statements on this issue. Beyond the biological problems associated with the Ostional assemblage it is important to pay special attention to the administrative issues of the Ostional Wildlife Refuge. There seems to be little doubt that the main problem of Ostional is the lack of an effective structure in the management program of this refuge. This lack of structure is likely due to the presence of 16 different stakeholders in the refuge and the Costa Rican Ministry of the Environment and Energy's lack of power due to insufficient personnel and historically perceived entitlement by the ADIO. Much respectful dialogue is still needed before stakeholders can openly and trustfully synergize their efforts toward the common goal of understanding, rationally using and protecting the olive ridley resource of which they have been trusted.

In conclusion, the future of the Costa Rican sea turtle community resides in continuing to advocate the conservation of the main nesting beaches for all species. Such efforts may be better realized in collaboration with the international sea turtle community, which may provide needed expertise and support.

GLOBAL AND REGIONAL SEA TURTLE CONSERVATION AND RESEARCH

Movements of loggerhead turtles (*Caretta caretta*) in the southeast Pacific

Joanna Alfaro-Shigueto[1], Peter Dutton[2], Denisse Parker[2], and David Montes[1]

[1] Pro Delphinus, Peru
[2] National Oceanographic Atmospheric Administration, NOAA

Loggerhead turtle (*Caretta caretta*) foraging and nesting grounds in the northern Pacific Ocean are well documented. Reports of loggerheads from the Pacific coast of South America, however, were largely anecdotal. The species has been documented in Peru and Chile only recently after the establishment of sea turtle monitoring programs. In 2001 a program to monitor sea turtle bycatch was implemented in Peru. Through a network of observers, we monitored sea turtle captures in artisanal longline fisheries at 8 ports. Observers registered the number and species of turtles captured, took standard measures, and collected tissue samples whenever possible.
During this program, we documented the presence of loggerhead turtles in Peru and found that the species was common in the area. Loggerheads were caught incidentally in the ports of Ilo (17°39'S and 71°21'W) and Morro Sama (17°59'S and 70°53'W).
In 2003, we deployed a satellite transmitter on a loggerhead that was hooked off Ilo. Transmission lasted for approximately 182 days. The animal moved between southern Peruvian and northern Chilean waters, from 18°-22°S and 72°-75°W.

Genetic analyses of tissue samples collected during the study are being conducted to identify the nesting stock from which these animals originate.
These results suggest the need to emphasize the development of conservation measures at local, regional and international levels. Our ongoing research, which includes genetic and telemetry studies and international collaboration to evaluate fishery bycatch, will provide further insights into the population status, life history and foraging ecology of loggerheads in the southeast Pacific.

Post-nesting movements of leatherbacks from Jamursba Medi, Papua, Indonesia: Linking local conservation with international threats

Scott R. Benson[1], Peter H. Dutton[2], Creusa Hitipeuw[3], Yulianus Thebu[3], Yopi Bakarbessy[4], Costant Sorondanya[4], Natalie Tangkepayung[5], and Denise Parker[2]

[1] NOAA, NMFS, Southwest Fisheries Science Center, Moss Landing, California, USA
[2] NOAA, NMFS, Southwest Fisheries Science Center, La Jolla, California, USA
[3] WWF Indonesia - Sahul Bioregional Program, Sorong, Papua, Indonesia
[4] Balai Konservasi Sumber Daya Alam - Sorong, Papua, Indonesia
[5] WWF Indonesia - Sahul Bioregional Program, Jayapura, Papua, Indonesia

---

Beaches along the northern coast of the Birdshead Peninsula in Papua, Indonesia include the largest remaining leatherback nesting sites within the Pacific Ocean region. Protection and monitoring have significantly reduced anthropogenic threats at these beaches; however, the development of effective long-term management strategies requires an understanding of threats to the population outside the breeding area. As part of a multi-national partnership between local villagers, conservation organizations, and sea turtle researchers, nine female leatherback turtles were sampled and tagged with satellite in Papua, Indonesia during July 2003. Satellite telemetry was instrumental in documenting inter-nesting intervals, variability in nest site selection, and migration patterns of post-nesting female leatherbacks. Although all nine leatherbacks moved in a northerly direction, migratory tracks were variable and indicated use of major ocean currents, including the Equatorial countercurrent and Kuroshio. During the initial three months of deployment, five tracks revealed long-range movements (up to 6400 km) to the east and northeast, through Micronesia and the Marshall Islands; three leatherbacks moved northwestward towards the Philippines; and one moved north into waters off southern Japan. Previous genetic studies have indicated a link between leatherbacks nesting on western Pacific beaches and those found in the central North Pacific and along the United States' westcoast. The tracks presented in this study provide the first documentation of leatherback movements from a western Pacific nesting beach towards eastern Pacific foraging areas and indicate the potential for interactions with international fisheries in many areas of the Pacific Ocean.

Marine protected area planning on the Great Barrier Reef: implications for marine turtle conservation

Kirstin Dobbs, Suzanne Slegers, Leanne Fernandes, and Belinda Jago

Great Barrier Reef Marine Park Authority

The objective of the Great Barrier Reef Marine Park Authority's Representative Areas Program (RAP) is to help protect 'representative' examples of all the different habitats and communities in the Great Barrier Reef Marine Park (GBRMP) in 'no-take areas,' which generally prohibit

extractive uses like fishing and collecting. Virtually the entire GBRMP is already zoned with different uses allowed for in different zones; however, less than 5% of the area is currently in 'no take areas.' A draft plan released in June 2003 proposed a minimum of 20% of the GBRMP as 'no take areas' in addition to other zone types and tools that would benefit conservation, including for turtles.

Biophysical operational principles (BOPs) were developed to guide managers in their selection of new 'no take areas.' These were applied, as far as practicable, during the RAP and the rezoning process while maximizing positive and minimizing negative impacts on local communities and stakeholders.

The BOP for important marine turtle sites was to ensure 'no take areas' included 100% of known turtle nesting sites with a high or very high priority ranking for each species and represented a minimum of 20% of each species' foraging habitat. The process of implementing these principles specifically for turtle nesting and foraging areas involved developing rules for the selection and placement of these areas. Data was sourced from the Queensland Parks and Wildlife Service's Turtle Conservation Project.The success of the RAP and the rezoning process for turtle conservation will be discussed.

Marine Turtle Conservation Act of 2004

Marydele Donnelly[1] and Earl Possardt[2]

[1] The Ocean Conservancy, Washington, D.C. USA
[2] U.S. Fish and Wildlife Service, Atlanta, GA USA

The Marine Turtle Conservation Act of 2003 (S.1210) was introduced to the U.S. Senate Environment and Public Works Committee on June 9, 2003 by Senator Jim Jeffords (I-VT). It received the full support of the Committee during markup hearings on July 28, 2003 and was passed by the full Senate on October 31, 2003. Congressman Gilchrest introduced a nearly identical bill (HR 3378) to the House Committee on Resources on October 28, 2003 and expects to hold a hearing on the bill in early 2004. The MTCA would establish a special fund to support marine turtle conservation projects in foreign countries and be administered by the Department of Interior, U.S. Fish and Wildlife Service. The emphasis of the legislation is to provide funding for the protection and management of nesting populations and nesting habitats, including research, monitoring, and law enforcement activities. Initiatives to support community outreach and funding will also be provided. Like other multinational species bills passed to date for the great apes, rhinos and tigers, and Asian and African elephants, funds will be appropriated annually.

Numbers, distribution and stock origin of sea turtles caught incidentally in the Chilean longline fishery for swordfish, 2001-2002

Miguel Donoso[1] and Peter H. Dutton[2]

[1] Instituto de Fomento Pesquero, Valparaíso, Chile
[2] NOAA - Fisheries, La Jolla, California, USA

There is concern over declining populations of Pacific sea turtles, and continued uncertainty over impacts of international fisheries on recovery efforts, particularly eastern Pacific leatherbacks and western Pacific loggerheads. We present results from a 2-year study on the incidental take of sea

turtles in the Chilean pelagic longline fishery targeting swordfish. Observers placed on 13 of the 15 boats operating this experimental fleet collected data and samples. This high level of observer coverage allows us to calculate accurate catch rates for sea turtles in this fishery, and to examine distribution and stock origin of the turtles caught. Significant findings include loggerheads of Australian stock origin. We will present data and discuss implications for conservation.

The Bermuda Turtle Project's international course on the biology and conservation of sea turtles

Jennifer A. Gray[1], Anne B. Meylan[2], and Peter A. Meylan[3]

[1] Bermuda Aquarium, Museum and Zoo, P.O. Box FL 145, FLBX, Bermuda,
[2] Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, 100 8th Ave. SE, St. Petersburg, FL 33701 USA; Research Associate, Caribbean Conservation Corporation, 4424 NW 13th St., Gainesville FL 32609 USA; Research Associate, Bermuda Aquarium, Museum and Zoo, P.O. Box FL 145, FLBX, Bermuda
[3] Natural Sciences, Eckerd College, 4200 54th Ave. S., St. Petersburg, FL 33711 USA; Research Associate, Caribbean Conservation Corporation, 4424 NW 13th St., Gainesville FL 32609 USA; Research Associate, Bermuda Aquarium, Museum and Zoo, P.O. Box FL 145, FLBX, Bermuda

---

One of the goals of the Bermuda Turtle Project (BTP) is to promote international cooperation in the study and monitoring of sea turtle populations through the sharing of knowledge and experience. To this end, the BTP offers an international course on the biology and conservation of sea turtles. The two-week course, offered free-of-charge, provides an introduction to the biology of marine turtles with an emphasis on topics that are relevant to marine turtle conservation on a local and international scale. The course consists of lectures, class discussions, a necropsy session, and ten days of fieldwork involving the capture of green turtles (*Chelonia mydas*) and hawksbill turtles (*Eretmochelys imbricata*) on their feeding grounds. The fieldwork is part of regular sampling efforts for a long-term (35-year) study of sea turtles in Bermuda waters. Each stage of the life cycle is reviewed and inter-specific comparisons made. Consideration of the impact of humans on each stage allows a complete treatment of conservation issues in a biological context. Participants are expected to lead some discussions and have the opportunity to discuss issues and methods of particular relevance to their home country. One of the objectives of the course is to give participants hands-on experience with research techniques that are useful for in-water studies, such as capture methods, tagging, measuring, collection of blood and tissue samples, and application of satellite transmitters. Over the eight years during which this course has been offered, it has served 79 students from the Caribbean and western Atlantic.

Policy options for conservation of sea turtles in the Pacific: Report on the Bellagio meeting

Theodore Groves[1], Peter Dutton[2], and Dale Squires[2]

[1] Department of Economics, University of California, San Diego, California
[2] National Marine Fisheries Service, NOAA, La Jolla, California

---

A report on the Conservation of Sea Turtles in the Pacific Ocean Meeting held in November 2003 at the Rockefeller Foundation's Conference Center in Bellagio, Italy. The meeting was convened (a) to provide the scientific and policy basis to develop elements of a pan-Pacific model treaty to

conserve and promote recovery of Pacific sea turtles and (b) to explore policy options extending beyond the biological to include social science, law, and other disciplines and establishing conservation incentives. Organized by National Marine Fisheries Service, USA, and the WorldFish Center, Malaysia, the meeting's 25 participants from both sides of the Pacific included representatives from industry, legal scholars and diplomats, conservation and sea turtle biologists, social scientists, policy analysts, officials from governments and international organizations with policy portfolios.

From flagships to beneficiaries: The Defying Ocean's End global agenda for action and its implications for sea turtles

Arlo H. Hemphill[1,2], Linda Glover[1], Roger McManus[1], and Sylvia A. Earle[1]

[1] Conservation International, 1919 M Street, NW, Suite 600, Washington, D.C. 20036
[2] Nova Southeastern University Oceanographic Center, 8000 North Ocean Drive, Dania Beach, FL 33004

The *Defying Ocean's End Conference* (DOE) was held in Los Cabos, Mexico in mid 2003, representing the culmination of a yearlong effort to develop an approach for articulating a global plan of action for marine conservation. A team of nearly 150 experts focused on developing action plans that address specific issues and outcomes, while identifying priorities and costs. The results include recommendations on global governance, fisheries reform, communications, marine protected areas/large marine ecosystems, and marine science. The Agenda for Action that resulted from the DOE process has been adopted as a global strategy by a coalition of major international NGOs.

The implications that DOE has for sea turtles suggest a partnership between the iconic image of these animals and conservation. This two-tiered relationship involves: 1) that the animals 'lend' themselves as charismatic flagships to promote the conservation of the greater marine ecosystem, and 2) that turtles become recipients of healthy seas through focused and collaborative action. Examples of how such a relationship would work include utilizing sea turtle bycatch to fuel the creation of a global fisheries reform fund, utilizing turtles in the promotion of strategically planned MPA networks, and utilizing nesting beaches as leverage on coastal development issues. In each of these cases, sea turtles would serve as catalysts to enact policy and management actions that may not be specific to turtles. However, as a component of a multi-faceted strategy, turtles would also become beneficiaries of improved practices and conservation outcomes, inclusive of processes not relying on turtles.

Developments in Indian Ocean and southeast Asian marine turtle conservation

Douglas Hykle

IOSEA Marine Turtle MoU Secretariat, Bangkok, Thailand

The *Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and Southeast Asia* puts in place a framework through which countries of the Indian Ocean and southeast Asia, as well as other concerned states, can work together to conserve and replenish depleted marine turtle populations for which they share responsibility. With a potential membership of at least 41 range states, it is arguably the most

important intergovernmental instrument through which the region's marine turtle populations will be conserved over the coming decades.
The memorandum's conservation and management plan - containing programs and 105 specific activities - focuses on reducing threats, conserving critical habitat, exchanging scientific data, increasing public awareness and participation, promoting regional cooperation, and seeking resources for implementation.
The information exchange facility provided by the memorandum's website is of particular interest to governments, NGOs and conservationists throughout the region. It offers up-to-date news, comprehensive status reports, a database of relevant projects, a GIS nesting beach mapping application, and an electronic library of useful information. A regional overview of strengths and weaknesses in implementation, knowledge gaps, and opportunities for improvement will also be presented.

Marine turtle conservation: WWF´s vision on local, regional and global challenges

Sue Lieberman[1], Alberto Abreu Grobois[2], Elizabeth McLellan [1], and Carlos Drews[3]

[1] WWF Species Program, Godalming, United Kingdom
[2] Universidad Autónoma de México, Mazatlán, México
[3] WWF Latin America & the Caribbean Program, San José, Costa Rica

---

Six of the seven species of marine turtles are threatened by extinction, brought about mainly by habitat destruction, overexploitation and incidental capture in fisheries. Since they are highly migratory, their terrestrial and aquatic requirements often span the political limits of several nations. Given their slow growth and delayed maturation, the impacts of both threats and conservation action on population levels often take decades to be revealed. A conservation strategy for marine turtles needs a long-term vision and persistence. WWF´s global vision is that marine turtles worldwide are protected and restored to healthy levels reflecting their intrinsic values, role in ecosystem functioning and benefits to people.
WWF is focusing on marine turtle conservation at all levels: local, regional and global. Local actions are necessary to mitigate direct threats, while a regional perspective is necessary to ensure coherence in these efforts across the range of the turtles' movements. Global and regional strategies include interventions at international forums and facilitating collaboration among specific range countries, to address threats of global and regional concern.
With this perspective, WWF has developed target-driven action plans for Asia-Pacific, Africa and Madagascar, and Latin America and the Caribbean. The priorities, elaborated through close consultation with local and regional stakeholders in each region, are based on the needs of each species, urgency to address threats, and synergy with conservation efforts in eco-regions. Partnerships at all levels - for example with local communities, religious and traditional leaders, other conservation organizations, industry, governments, scientific institutions and management organizations - underpin this work.

Review of exploitation, trade and management of the marine turtles of the Lesser Antilles, Central America, Colombia and Venezuela

Adrian Reuter[1] and Amie Brautigam[2]

[1] TRAFFIC North America-Mexico, Mexico City
[2] TRAFFIC International, Cambridge, UK

In response to a recommendation from the First Wider Caribbean Hawksbill Turtle Range State Dialogue Meeting, the CITES Secretariat commissioned TRAFFIC International to undertake this survey, which was conceived as a complement to the TRAFFIC North America marine turtle study *Swimming Against the Tide: Recent Surveys of Exploitation, Trade and Management of Marine Turtles in the Northern Caribbean*, published in April 2001. For each of the 26 jurisdictions concerned, this study focused on legislation, stockpiles, management initiatives and recommendations to assist conservation and enforcement initiatives.
The extreme poverty of coastal communities in many countries and the fact that this is a region (or regions) with extreme geographical, ecological, cultural, and economical diversity, is reflected in the enormous variability in the status of marine turtles and the context for their management, the legal frameworks, management regimes, and type and degree of the constraints to effective marine turtle management. This complexity is clearly a challenge for many governments in the region, who face a large number of constraints in improving their effectiveness. There are, however, some encouraging signs that governments are seeking to improve their marine turtle management. On the other hand, it is also evident that greater investment of resources – human, financial, logistical – in marine turtle management is needed if these species are not to decline further. This is the challenge these countries, along with NGOs and other interested parties, are facing if effective efforts to address the threats that continue to deplete these very depleted species are to be undertaken.

Rekindling hopes for sea turtles in the Sulu-Sulawesi Seas: Clear and present opportunities

Romeo B. Trono[1], Jose Noel B. Dumaup[2], and Renato D. Cruz[3]

[1] Conservation International - Philippines Program
[2] World Wide Fund for Nature - Philippines
[3] Protected Areas and Wildlife Bureau - Department of Environment and Natural Resources, Philippines

The Sulu-Sulawesi Seas fall within Indonesia, Malaysia and the Philippines, three of the seventeen megadiverse countries in the world. The seas are characterized by a wide array of seascapes supporting globally outstanding biodiversity and provide habitats representing the full life cycle of five species of sea turtles.
The Turtle Islands of Malaysia and the Philippines and the Derawan Islands in Indonesia harbor the largest nesting aggregations of green and hawksbill turtles in the ASEAN Region. Tag recoveries and satellite telemetry data indicate that this region is also important for sea turtles from the Pacific Islands States and Japan. Unfortunately, threats, coupled with ineffective management regimes contribute to the decline of the populations.
Recent tri-national initiatives opened new opportunities to conserve sea turtles. Through a stakeholders' process, World Wide Fund for Nature facilitated the formulation of a tri-national program to effectively address sea turtle conservation in this region. Six actions are proposed

under the program. The three governments are exploring the feasibility of establishing the world's first tri-national protected area for sea turtles to include the Turtle Islands Heritage Protected Area and the Derawan Islands. These initiatives provide a framework for regional sea turtle conservation actions and were proposed as initiatives that merit formal recognition by the signatory states of the IOSEA MoU. Effective implementation can protect approximately 10,000 nesters as well as tens of thousands representing various age groups and males of green and hawksbill turtles annually. Pursuing these initiatives requires significant resources and broader partnerships. Conservation International has engaged in the process.

Research and management of sea turtles along the indigenous owned coastline of northern Australia

Scott D. Whiting, Damian N. White, Linda Cuttriss, and Karen L. Cook

World Wide Fund for Nature, GPO Box 1268, Darwin, NT, 0801

Over 80% of the northern coastline of Australia is indigenous-owned. WWF Australia has three main projects either in place or proposed that are aimed at working in partnership with Aboriginal people to monitor turtle populations and to reduce regional threats to turtles. All projects are designed to gather scientific data but to also incorporate socio-economic issues and provide training and education to local indigenous communities. A marine debris project has been running for four years in the Northern Territory with WWF working with local Aboriginal communities to remove and categorize marine debris and to identify and record turtle species captured in discarded fishing nets. This project aims at identifying the source of the nets and working with national and international governments to identify solutions. The establishment of Aboriginal sea rangers is a new concept in northern Australia to allow indigenous people to play a greater role in natural resource management. WWF provides financial support and on ground training to aid in the establishment of turtle monitoring programs and to identify and reduce threats. The sea rangers are funded from a variety of sources. WWF Australia together with Timor Leste and WWF Indonesia have proposed projects that will take a multi-disciplinary and multi-national approach to sea turtle decline in the Arafura and Timor Seas Region of SE Asia. This involves several components including monitoring the Bali harvest, reducing the bycatch of turtles in the commercial fishing industry and reducing the level of commercial harvest of turtles through education and options for alternative livelihoods.

PHYSIOLOGY

Growth-related changes in pectoral Fe accumulation in loggerhead sea turtle (*Caretta caretta*) and its implications for diving physiology

Bojan Lazar[1,2], Maja Blanusa[3], Drako Holcer[1], Drako Holcer[2], Nada Orsolic[4], and Nikola Tvrtkovic[1]

[1] Department of Zoology, Croatian Natural History Museum, Zagreb, Croatia
[2] Blue World Institute of Marine Research and Conservation, Veli Losinj, Croatia
[3] Institute for Medical Research, Zagreb, Croatia
[4] Department of Animal Physiology, Faculty of Sciences, University of Zagreb, Zagreb, Croatia

---

Concentration of Fe was determined by a flame atomic absorption spectrometry in the liver, kidney, pectoral muscle and heart of 40 loggerhead turtles (mean CCL: 44.9 cm, SD: 12.9, range: 25.0 – 84.5). Although the highest Fe concentration was found in the liver > kidney > heart > pectoral muscle, only pectoral muscle showed significant ($r = 0.44$, $p < 0.01$) increase in Fe (μg Fe/g tissue dry weight) with growth (CCL). Significant difference in pectoral Fe was also found between individuals in the pelagic (CCL < 30 cm), post-pelagic (CCL 30-50 cm) and benthic (CCL > 50 cm) life stages ($r = 0.41$, $p < 0.01$). Although loggerhead is a breath-hold diver that primarily stores oxygen in the lungs, our results indicate increase of skeletal muscles affinity for oxygen storage with age, bounded on a Fe in the myoglobin. Considering (i) the difference in total mass of pectoral muscles between oceanic and neritic individuals, (ii) the increase in pectoral Fe concentration with growth showed in this study, and (iii) greater oxygen-binding capacity of myoglobin in comparison to hemoglobin, our results suggest the existence of a growth-related physiological adaptation of the pectoral muscles for prolonged and deeper dives.

Visual sensitivity of sea turtles

D.H. Levenson[1], S.A. Eckert[2], M.A. Crognale[3], J.F. Deegan, II[4], and G.H. Jacobs[5]

[1] Scripps Institution of Oceanography, La Jolla, CA, USA
[2] WIDECAST, Duke University, Beaufort, NC, USA
[3] University of Nevada at Reno, Reno, NV, USA
[4] California State University at Bakersfield, Bakersfield, CA, USA
[5] Neuroscience Research Institute, UCSB, Santa Barbara, CA, USA

Flicker electroretinography (ERG) was used to examine the in vivo photopic (cone-photoreceptor based) spectral sensitivities of green and loggerhead sea turtles. Both species were responsive to lights from 430 to 700 nm and both had peak sensitivity in the long wavelength portion of the spectrum (~580 nm). For loggerhead turtles, no measurable responses were obtained below about 430 nm while reliable signals were seen for green turtles at wavelengths down to 400 nm. Both species exhibited significant declines in sensitivity below 500 nm. The overall shapes of the spectral sensitivity functions were similar for the two species. These results support previous findings that sea turtles have well-developed photopic visual systems. The characteristics of these spectral sensitivity functions indicate that both species possess multiple cone photopigment types and these, in conjunction with the presence of colored oil droplets, strongly imply a capacity for color discrimination. Comparative evaluation suggests that these turtles have modified their

visual pigments from those of their terrestrial relatives to better suit the ambient conditions present in the shallow water, submarine environments that they typically inhabit..

Ontogeny of respiration in hatchling leatherbacks

Edwin R. Price[1], Frank V. Paladino[2], Kingman P. Strohl[3], Pilar Santidrian T.[4], Kenneth Klann[3], and James R. Spotila[4]

[1] University of Montana, Missoula, Montana, USA
[2] Indiana University-Purdue University, Fort Wayne, Indiana, USA
[3] Case Western Reserve University, Cleveland, Ohio, USA
[4] Drexel University, Philadelphia, Pennsylvania, USA

The hypoxic and hypercapnic nest environment places constraints on neonate turtles, which may result in special respiratory adaptations during early development. Using whole-body plethysmography, we studied the ontogeny of respiratory patterns during the first days after hatching in leatherback turtles.
Furthermore, we examined the development of the response to hypoxia and hypercapnia over the first days of life. Leatherback hatchlings exhibited changes in respiratory control that may be adaptive for an oxygen-poor nest environment.

Energetics and diving activity of female leatherbacks (*Dermochelys coriacea*) during the internesting period

Bryan P. Wallace[1], Frank V. Paladino[2], Stephen J. Morreale[3], and James R. Spotila[1]

[1] Drexel University, Philadelphia, PA, USA
[2] Indiana-Purdue University, Fort Wayne, IN, USA
[3] Cornell University, Ithaca, NY, USA

The distinctive gigantothermic metabolism of leatherback turtles (*Dermochelys coriacea*) allows them to exploit the widest geographical and thermal range of any reptile. However, metabolic studies have been restricted to nesting females, and so do not adequately characterize normal activity and energy expenditure of adult leatherbacks. The overall cost of migration to and from the nesting grounds, making multiple clutches and coming onto land to deposit them in the sand must be high, so quantification of the energy expenditure and diving activity of the inter-nesting period will clarify an important component of the leatherback reproductive energy budget. Last season, we calculated the first field metabolic rate (FMR) for a free-swimming sea turtle at Parque Las Baulas, Costa Rica, using the doubly labeled water method (DLW). Because the metabolic cost of the other phases of the overall nesting process exact a high energetic demand, leatherbacks should conserve energy during the inter-nesting period and allocate it to egg production. This season (2003-2004), we repeated the experiment with an increased sample size and we also analyzed diving activity of the turtles using archival data loggers and satellite transmitters to describe relationships between diving patterns (dive duration, surface interval time, dive depths, bottom time, etc.) during the inter-nesting period and FMRs and water turnover. These results will elucidate the reproductive energy budget of leatherback turtles and will have applications to leatherback energetics and activity and their unique physiology and metabolism.

SEA TURTLE ASSESSMENT AND MONITORING

A contrasting stock composition in two hawksbill foraging areas off the Yucatan Peninsula (Mexico) is revealed by mtDNA dloop sequences

F. Alberto Abreu-Grobois[1], Irazema González[1], Carmen Bolán[2], Alejandra García-Gasca[2], Raquel Briseño-Dueñas[3], Vicente Guzmán[4], Mauricio Garduño[5], Carlos Diez[6], Robert van Dam[7], and Peter Dutton[8]

[1] Laboratorio de Genética, Unidad Académica Mazatlán, Instituto de Ciencias del Mar y Limnología, UNAM, Apdo. Postal 811, Mazatlán, Sinaloa, MEXICO 82000
[2] Unidad Mazatlán, Centro de Investigación en Alimentación y Desarrollo, Apdo. Postal 711, Mazatlán, Sinaloa, MEXICO 82000
[3] Banco de Información sobre Tortugas Marinas (BITMAR), Unidad Académica Mazatlán, Instituto de Ciencias del Mar y Limnología, UNAM, Apdo. Postal 811, Mazatlán, Sinaloa, MEXICO 82000
[4] Delegación Campeche, Dirección General de Vida Silvestre, SEMARNAT, Av. Héroes del 21 de Abril s/n, Playa Norte, Cd. del Carmen, Campeche, MEXICO
[5] Delegación Yucatán, Dirección General de Vida Silvestre, SEMARNAT, Mérida, Yucatán MEXICO
[6] Departamento de Recursos Naturales y Ambientales, PO Box 9066600, San Juan, Puerto Rico 00906-6600
[7] *Chelonia* Incorporated, PO Box 9020708, San Juan 00902-0708, Puerto Rico
[8] National Marine Fishery Service, Southwest Fisheries Center, PO Box 271, La Jolla, CA USA 9203

Given the geographic scope of the sea turtles' developmental and migratory behavior, information on numbers and proportions of different stocks aggregating on foraging grounds (FGs) is crucial to our understanding of the species' spatial structure and may provide clues on how biological and environmental factors help to shape these patterns. Molecular tags have proven useful in demonstrating that aggregations at FGs are non-randomly drawn from a range of source populations, and that their proportions may be affected by the relative sizes of sources, distance between sources and FGs, and prevailing surface current patterns in the region. We used mtDNA dloop sequences in a Bayesian estimate of hawksbill stock composition at two FGs in the Yucatán Peninsula coast (Mexico); one off Yucatán (Ría Lagartos-Las Coloradas) and another composed of four sites in front of Campeche (Boca de Puerto Real, Sabancuy, Chenkán, and Punta Xen). The combined hawksbill rookeries in the peninsula represent the largest assemblage for the species in the Atlantic basin. Whereas preliminary results indicate essentially a single-stock contribution (98%; 94-100% C.I.) by local (whole peninsula) sources to the Campeche FG, and a total of only five haplotypes (h=0.41, pi=0.001), local rookery contribution to the Yucatán FG though lower (82%; 71-92% C.I.) was still predominant, with a total of nine haplotypes, greater genetic diversity (h=0.57, pi=0.003); and contributions from at least four additional stocks in the region. The most plausible explanation for the contrasting results implicates a combination of very high local stock abundances and prevailing oceanic surface current patterns.

Do loggerhead turtles homogeneously mix in the western Mediterranean?

Carlos Carreras[1], Marta Pascual[2], Luis Cardona[1], Gloria Fernández[3], Manu San Félix[4], and Alex Aguilar[1]

[1] Department of Animal Biology, Faculty of Biology, University of Barcelona, Avda. Diagonal 645, E-08028 Barcelona, Spain.
[2] Department of Genetics, Faculty of Biology, University of Barcelona, Avda. Diagonal 645, E-08028 Barcelona, Spain.
[3] Fundación Marineland, C/Garcilaso de la Vega, 9 E-07181 Costa d'en Blanes, Calvià, Spain
[4] Marine Biology Laboratory, Department of Zoology, Faculty of Biology, University of Valencia, C/ Dr. Moliner 50 E -46100 Burjasot (Valencia), Spain

---

The western Mediterranean is an important developmental habitat for the loggerhead turtle (*Caretta caretta*). The genetic composition of immature individuals occurring off three islands of the Balearic archipelago (Western Mediterranean) was assessed using the D-loop control region of the mitochondrial DNA. Haplotype composition strongly indicated a contribution of the Atlantic nesting sites, while evidence for contribution from the eastern Mediterranean was weaker. Genetic separation was found between Formentera and the northern islands (Mallorca and Minorca, also called Gimnesies), suggesting different migratory inputs. These results were compared with those previously reported from the Madeira, Azores and Lampedusa foraging grounds, which are also located between the Atlantic and Mediterranean putative nesting sites. Samples from the Gimnesies were not genetically different from those from the Azores or Madeira, supporting the Atlantic origin of the turtles from the former area. On the other hand, individuals from Formentera were not different from those from Lampedusa, hence suggesting a mixed origin. These results can be explained by the pattern of sea currents in the western Mediterranean, as juvenile turtles drift passively. The entire archipelago is influenced by Atlantic water that enters trough the Strait of Gibraltar and flows eastward along the African coast. However, only the southern islands are influenced by eastern Mediterranean water that enters trough the Messina Strait, flows along the European shore, and is deflected to the southern islands at Cape La Nao (southeastern Iberian Peninsula). Study funded by EU-LIFE project 00NAT/E/7303.

First assessment of sea turtle catch rate by trawlers fishing on the central Mediterranean African shelf

Paolo Casale, Daniela Freggi, and Massimiliano Rocco

Sea Turtle Network - WWF Italia Via Po 25c 00198 Roma Italy

Sea turtle conservation requires adequate knowledge on which to base effective measures. Information about the interaction with fisheries - a major threat -, foraging areas, and population trends are particularly needed. A possible way to gather such information is through collaboration with professional fishermen. The key element in this kind of study is the estimate of catch rates from which it is possible to estimate total number of turtles captured by a fishery and, if adequately standardized, also to make spatial and temporal comparisons. The best way to collect data for calculating catch rates is through onboard observation, but this has limitations due to the high budget required. Alternatively, data can be collected directly by captains collaborating in the study. A voluntary pilot logbook program of this kind was recently launched in Lampedusa, Italy, an island bordering the African shelf in the central Mediterranean, used as a base for many trawl

vessels fishing in the area. First results support previous indications based on re-encounters of adult females tagged while nesting about the trophic importance of the area and show that juveniles frequent this area too. Comparison with standardized catch rates of other Mediterranean areas and other regions indicates a relatively high abundance of turtles in the study area.

How migratory behavior shapes gene flow and the distribution of biodiversity in marine turtles

Nancy N. FitzSimmons[1], Craig Moritz[2], Col J. Limpus[3], Kiki Dethmers[1], Jeff D. Miller[3], John Parmenter[4], Robert Prince[5], and Peter H. Dutton[6]

[1]Applied Ecology Research Group, University of Canberra, Canberra, ACT, Australia
[2] Museum of Vertebrate Zoology, Department of Integrative Biology, University of California, Berkeley, USA
[3] Queensland Parks and Wildlife Department, Queensland Environmental Protection Agency, Brisbane, Qld, Australia
[4] Department of Biology, Central Queensland University, Rockhampton, Qld, Australia
[5] Department of Conservation and Land Management Wildlife Research Centre, Woodvale, WA, Australia
[6] Southwest Fisheries Science Center, NOAA-NMFS, La Jolla, CA, USA

Marine biodiversity can be viewed from a genetic perspective that focuses on the distribution of genetic variation found at a population level. The distribution of genetic lineages results from a combination of migratory and dispersal behavior, landscape history and gene flow. Several genetic studies of marine turtles have provided new insights into migratory behavior, homing instincts, and population boundaries with resultant implications for conservation management. Recently, we have completed on-going genetic research of three species of marine turtles in Australia that have been studied using a combination of mtDNA sequencing and nuclear microsatellite analyses. This has allowed comparisons of female versus male-mediated gene flow and comparisons of species with different migratory behavior, the highly migratory loggerhead and green turtles and the coastal dwelling flatback turtle. This talk will discuss striking differences found in the genetic structure of these species, how this affects the partitioning of biodiversity within the region and the implications this has about migratory behavior and conservation management.

Fat soluble vitamins A and E as possible limiting nutrients for reproduction in *Caretta caretta* and *Chelonia mydas* nesting in the Archie Carr National Wildlife Refuge

Karen P. Frutchey, Ellen S. Dierenfeld, and Llewellyn M. Ehrhart

University of Central Florida, Orlando, FL, USA

Gaining a better understanding of marine turtle ecological physiology is an urgent priority, considering the impact such information has on conservation management plans and population health assessments. Vitamins A (retinol) and E (&alpha-tocopherol) are fat-soluble organic compounds required for the survival of higher animals. Turtles must obtain both of these nutrients through dietary intake, either directly from animal-based foods or through conversion of dietary carotenoids (vitamin A only). Both vitamins A and E have physiological roles in the reproduction

of vertebrates. The purpose of this study is to establish baseline blood values for vitamins A and E in marine turtles (*Chelonia mydas* and *Caretta caretta*) nesting in the Archie Carr National Wildlife Refuge (Melbourne Beach, Florida) and to determine whether the stress of the nesting season results in a decline in these values as the season progresses. This research is also an attempt to provide a nutritional explanation for the 2 to 3 year interval between reproductive migrations. Blood was sampled via the bilaterally located cervical sinus, using a 20 gauge, 1.5 inch needle and a vacutainer containing lithium heparin and analysis was conducted using high performance liquid chromatography. Plasma concentration of vitamin A declined significantly in *Caretta* as the nesting season progressed (R^2 = 0.098, $F_{1,158}$ = 17.26, β = -0.002, P = 0.0001); while in *Chelonia* it remained stable (R^2 = 0.021, $F_{1,77}$ = 1.62, β = 0.001, P = 0.2073). No significant change in vitamin E concentration was observed in either species as the nesting season progressed.

The conservation of marine turtles in nesting areas of Guanahacabibes Peninsula, Cuba: Six years of work

María Elena Ibarra Martín[1], Julia Azanza Ricardo[1], Rogelio Díaz Fernández[1], Georgina Espinosa López[2], Fernando Hernández[2], Students of the Faculty of Biology[2], Félix Moncada[3], and Gonzálo Nodarse[3]

[1] Marine Research Center. Havana University
[2] Faculty of Biology. Havana University
[3] Fisheries Research Center

In this paper, the results of 6 years monitoring of marine turtles in seven beaches of the Biosphere Reserve and National Park "Guanahacabibes Peninsula," Cuba are presented as well as the community work in the seven communities nearest to the marine turtles nesting areas in the peninsula. Monitoring is carried out from May to September, during the nesting season of *Chelonia mydas* and *Caretta caretta*, by university students with the supervision of specialists of the Marine Research Center. Variations are presented in the number of females´ emergences and ovipositions in each season and among the working years where a biennial reproductive cycle is evidenced for the two worked species pointing paired years (1998, 2000 and 2002) as high nesting seasons. Some aspects of nesting behavior such as emergences during a particular hour range of the night (22:00 to 2:00) and the selection of the nesting site, mainly in the vegetation zone, are presented too. Also included are the first results of physical tagging of adults in the area with around 150 females marked in 2002 and 35 in 2003, with the correspondent morphometric characterization of the marked females. Finally, analysis of all the nests that emerged during each working season was carried out, finding variations in the parameters analyzed in different years. Work with community is divided in: environmental education with schools and interaction with adults in the community, and main results of both are presented as well.

Innate and environmentally-calibrated compass orientation in loggerhead sea turtles

William P. Irwin

University of North Carolina, Chapel Hill, NC, USA

Hatchling turtles can establish a magnetic heading while swimming toward an environmental stimulus and maintain this course after the cue is removed. While this ability may aid turtles that emerge from seaward-facing beaches to maintain appropriate offshore headings, it does not account for the behavior of turtles that emerge from beaches oriented in other directions to migrate first away from land and then alter their course toward deep water. To determine whether turtles might have an innate magnetic compass sense that functions when their environmentally-calibrated compass no longer provides appropriate offshore information, or in the absence of other sensory information altogether, four groups of hatchling loggerheads were monitored in water-filled arenas during the first eight hours of their "frenzy" period. As in previous studies, turtles that initially swam toward a light source in the appropriate offshore direction (east) continued to swim east after the light was removed. However, turtles that swam toward a light source 180° opposite the offshore direction (west) initially swam west after the light was removed but altered their course after several hours and swam east. Turtles given no light cues at all were initially randomly oriented but swam eastward after several hours while control turtles given no light cues but that swam with a magnet attached to their carapace were randomly oriented throughout the test period. These results are consistent with the hypothesis that hatchling loggerheads initially set a course using environmental cues but later rely on an innate magnetic compass sense to guide them offshore.

Incidental capture of sea turtles by Peruvian medium–scale longline fisheries

Shaleyla Kelez Sara, Ximena Velez-Zuazo, and Camelia Manrique Bravo

Grupo de Tortugas Marinas - Peru / APECO

Incidental capture during fishing activities is one of the major threats to sea turtle survival. The marine habitats of Peru are used by sea turtles as feeding grounds, migratory corridors and developmental habitats. Due to this, the anthropologic interaction at sea is the principal threat to sea turtles in Peru. From January to May 2003, onboard observations in longline fishing vessels were conducted. A total of ten trips were observed, 7 were targeting dolphinfish (*Coryphaena hippurus*) and the other 3 on sharks (shortfin mako (*Isurus oxyrinchus*), smooth hammerhead (*Sphyrna zygaena*), blue shark (*Prionace glauca*), and thresher shark (*Alopias vulpinus*)). A total of 111,370 hooks were deployed in 75 sets. In 28 sets, 33 sea turtles were captured. The average catch rate for the 10 pelagic longline fishery trips observed is 0.296 turtles per 1000 hooks but 0.287 for the common dolphinfish fishery and 0.321 for the shark fishery. The species captured were eastern Pacific green turtle (*Chelonia mydas*), loggerhead turtle (*Caretta caretta*), and olive ridley turtle (*Lepidochelys olivacea*). Based on their size, the green turtles individuals can be considered juveniles and adults, the loggerheads juveniles and the olive ridleys adults. Most of the loggerhead turtles bite the hook, the green turtles either bite the hook or had the hook in their flippers and most of the olive ridleys had the hook in their flippers. The results presented here belong to the first research in this subject in Peru and intend to be the baseline for future works.

Status of the *Lepidochelys olivacea* in the Guianas: A review

Laurent Kelle[1], Benoît de Thoisy[2], Annette Arjun[3], and Yvette Merton[4]

[1] WWF Guianas
[2] Kwata
[3] GMTCS
[4] Stinasu

The coasts of the Guianas offer a great diversity of beaches welcoming three to four nesting marine turtle species. For scientific and/or historical reasons, recent monitoring and conservation efforts have been focused on the leatherback turtle (*Dermochelys coriacea*), and limited attention has been paid to other marine turtle species.

Lepidochelys olivacea has been widely studied and protected during the 60's and 70's in Suriname, and basic nest monitoring has been conducted there. These national-scale data suggest that *Lepidochelys olivacea* nests have decreased to less than 10% of their initial numbers in this country. Guyana beaches used to welcome olive ridley turtles in low numbers as suggested by historical data. In French Guiana, a local NGO initiated a monitoring program focused on this species 5 years ago that covered the whole nesting season in the east of the country. Up to 1200 nests/year have been noticed around Cayenne. This initiative has been recently reinforced by the implementation of monitoring camps on western remote beaches, allowing for the first time an assessment of the *Lepidochelys olivacea* nesting activity for the whole of French Guiana. Compiled nest numbers highlight the importance of the Guianas for the species, at Atlantic scale. An average of 2,000 to 2,200 nests per year have been noticed for the three countries during the last two years (2002-2003), with French Guiana hosting 90% of these nests.

Data about *Lepidochelys olivacea* bycatch by fisheries indicate that the species is particularly sensitive to trawling in the region. The Turtle Excluder Device is officially in use in Guyana and Suriname.

These data suggest that the main nesting ground for the olive ridley turtle in the Guianas is now located in French Guiana. No precise quantification of the current threats exists, but it is likely that the olive ridley turtle is facing inland and offshore threats poorly mitigated in the region.

A review of persistent organic pollutants in sea turtles and a need for more comprehensive health assessment studies

Jennifer M. Keller and John R. Kucklick

National Institute of Standards and Technology, Hollings Marine Laboratory, Charleston, South Carolina, USA

Sea turtles face many anthropogenic insults, but the effects of contaminants are unknown and may represent a significant threat to certain populations. Persistent organic pollutants (POPs) classically include polychlorinated biphenyls (PCBs) and pesticides, such as DDT, and have negatively affected wildlife populations, including reptiles. Data on POP concentrations in sea turtles are very limited, and virtually no data exist on the health impacts of these exposures on sea turtle populations. Since the first two publications in 1974, the field currently has a total of only 22 papers in the peer-reviewed literature. The measurements are so widely scattered across time, space, different species, and tissue types that few conclusions can be made on temporal or spatial trends. No long-term comprehensive monitoring or specimen banking programs are in place to track trends in sea turtle exposure or health. Understanding the baseline POP concentrations in

the context of overall health is important, because these chemicals are well-known reproductive, endocrine, and immune system toxicants, and freshwater reptiles exhibit exquisite sensitivity to their effects. A recent study has shown associations between POPs and health indicators (plasma chemistries) in loggerheads, as well as significantly higher POP concentrations in the blood of emaciated, lethargic turtles compared to healthy turtles. These findings emphasize the need for integrating contaminant analyses into health assessment studies in both threatened populations and those with increasing disease incidence. This paper will review the literature, identify data gaps, and address toxicity of POPs on reptiles in general with a risk assessment for sea turtles.

A magnetic map sense in juvenile sea turtles

Kenneth J. Lohmann[1], Catherine M. F. Lohmann[1], Llewellyn M. Ehrhart[2], Dean A. Bagley[2], and Timothy Swing[1]

[1] University of North Carolina, Chapel Hill, North Carolina, USA
[2] University of Central Florida, Orlando, Florida, USA

Sea turtles navigate long distances to specific geographic areas used as feeding grounds and nesting sites, but how they do so has remained a mystery for decades. To navigate to precise locations, turtles presumably require both a compass sense to maintain consistent headings and a "map" or positional sense to determine where they are relative to the goal. Turtles are known to maintain headings using the Earth's magnetic field, oceanic waves, and celestial cues, but the nature of the turtle map sense has remained unclear. It has been hypothesized, but never demonstrated, that the map is based at least partly on information derived from the Earth's magnetic field. To determine if turtles do indeed possess a magnetic map sense that facilitates navigation to specific targets, juvenile green turtles (*Chelonia mydas*) captured in their feeding grounds along the east coast of Florida, U.S.A., were tethered inside a large magnetic coil system and exposed to magnetic fields replicating those that exist at different locations along the southeastern U.S. coast. Turtles tested in a field that exists north of the capture site swam southward, whereas those tested in a field that exists south of the capture site swam northward. The results provide direct evidence that sea turtles exploit subtle spatial variations in the Earth's magnetic field to facilitate navigation toward distant, specific, geographic targets. In addition to helping turtles navigate to feeding areas, the magnetic map sense may be used by adult turtles to navigate to nesting sites.

Where do the Italian loggerhead turtles come from?

Fulvio Maffucci and Flegra Bentivegna

Stazione Zoologica

Loggerhead turtles (*Caretta caretta*) are common inhabitants of the Italian coastal waters, which are utilized mainly as feeding habitat. Despite the likely mixed composition of the Italian population and the unknown Atlantic contribution, to our knowledge no attempts to determine the possible origins of these turtles have been done. In this study we examined mitochondrial DNA control region sequences to determine the origin of 120 turtles stranded dead or alive between 2001 and 2002 along both the Tyrrhenian and the Adriatic coasts. No differences were detected between these two regional groups (exact test of population differentiation, $p>0.05$), which were,

therefore, combined in the subsequent analysis. The assessment of the stock composition of the Italian population was carried out using "Bayes", a Bayesian Stock-Mixture Analysis Program. The haplotype frequency gathered from our specimens were compared to those from a baseline sample composed of the major nesting Mediterranean populations of Greece, Cyprus and Turkey and the Atlantic mixed population around the Azores and Madeira islands. Our results showed that the Turkish rookery contributes less than those from Greece and Cyprus to the mixed Italian population. These results are supported by the data obtained in a previous satellite tracking study on the intra-Mediterranean migrations of loggerhead turtles. A small but significant proportion (around 6%) of our sample carried a haplotype that is typical only for the Atlantic population, suggesting that Atlantic specimens could utilize this costal habitat both for feeding and for overwintering.

Sea turtle surfacing behavior and aerial census: Has Virginia's (USA) sea turtle population been overestimated?

Katherine L. Mansfield and John A. Musick

Virginia Institute of Marine Science, PO Box 1346, Gloucester Point, Virginia, USA

The Chesapeake Bay serves as a seasonal foraging habitat for thousands of juvenile loggerhead (*Caretta caretta*) and hundreds of juvenile Kemp's ridley (*Lepidochelys kempii*) sea turtles. Estimates from aerial surveys indicate that maximum turtle densities occur during the spring as turtles migrate into the bay. Turtles are visible to aerial observers only when swimming at the water's surface; historically, a correction factor is applied to density estimates accounting for turtles below the observable surface. This factor is based on percent time turtles spend at surface during the summer and fall (5.3%, Byles 1988), not the spring.

Surfacing behaviors of three juvenile Kemp's ridleys and six juvenile loggerheads were determined in 2002-2003 by radio/sonic telemetry. All turtles were continuously tracked up to 24 hours post-release. Among turtles tracked in the spring (n=5), mean time spent at the surface was 9.91% +/- 2.95% SD (range=7.07%-12.7%)—higher than the historic correction factor. Springtime migration behavior and/or colder, stratified water temperatures may account for these increased surfacing times. Circular point statistics indicate that turtles tracked in the spring exhibited directed movement—unlike summer foraging turtles. In 2003, two turtles were tracked through a rare summer coastal upwelling event. Surface temperatures were 23-25º C; bottom temperatures were 9-11º C. These turtles spent over 30% of their time at the surface.

These data imply that turtles spend more time at the surface during the spring months and are therefore more likely to be counted during aerial surveys. If so, historic sea turtle populations have been overestimated.

Seasonal migrations of juvenile sea turtles from North Carolina, USA

Catherine M. McClellan and Andy Read

Duke University Marine Lab, Beaufort, NC, USA

Several juvenile sea turtle species forage in the sounds of North Carolina, USA during the summer. Little is known about the movements of these turtles during the rest of the year, after migration out of the sounds in the fall when temperatures begin to drop. Often,

known individuals re-appear in these waters during subsequent summers. An essential component in conserving these individuals is identifying what other habitats they frequent and threats they encounter along the way. Biotelemetry is an excellent way of shedding light on these mysteries. In the fall of 2002 and 2003, we obtained 45 juvenile sea turtles (loggerhead, green, and Kemp's ridley) from pound nets and instrumented them with satellite transmitters. Seven of these turtles were re-captures from previous years while three had been caught earlier the same year. Most turtles migrated out of the sounds through several inlets between October and November. Three distinct destinations were revealed by satellite tracks: off shore North Carolina, near shore Florida, and the Grand Banks. Using remote and transmitter sensors we examined correlations between individual movements and oceanographic features. Individual variation in this study provides intriguing insights into life history, ontogenetic shifts, and implications for conservation management.

The hawksbill turtle (*Eretmochelys imbricata*) in Florida

Anne Meylan and Anthony Redlow

Florida Fish & Wildlife Conservation Commission, 100 8th Avenue SE, St. Petersburg, FL, USA

Within the continental United States, hawksbill turtles (*Eretmochelys imbricata*) occur on a regular basis only in the waters of Florida and Texas. Information on the distribution of various life history stages in Florida is gleaned from observations of live turtles at sea, in-water capture projects, incidental captures, cold-stunning events, museum records, and stranding data. There were 379 hawksbill strandings recorded in Florida between 1980-2002, 46% of which involved live turtles and 46% of a size presumed to be associated with the pelagic habitat. Stranding data suggest that waters off of the Florida Keys and the southeastern coast of Florida serve as a dispersal corridor for post-hatchling hawksbills hatched elsewhere in the Gulf of Mexico and Caribbean Sea. There is evidence that developmental habitat exists for hawksbills in some areas of the state. Based on statewide surveys from 1979 to 2003, the only nesting activity by hawksbills occurs at very low-levels in the Florida Keys and along the southeastern coast as far north as Volusia County. Hawksbills in Florida appear to be disproportionately affected by oil pollution. Other threats documented by the Florida Sea Turtle Stranding and Salvage Network include entanglement, disease, entrapment in cooling water intake structures, incidental capture in fisheries gear, and boat-related injuries. The occurrence of numerous hawksbill hybrids in Florida is discussed.

The genetic composition of Florida's Indian River Lagoon: Its significance as a juvenile foraging ground for the western Atlantic loggerhead turtle

Joshua S. Reece, L.M. Ehrhart, and C.L. Parkinson

University of Central Florida

Loggerhead sea turtles (*Caretta caretta*) recruit to juvenile feeding areas at approximately 5-10 years of age (47-74 cm straight-line carapace length; Witzell et al., 2002). The Indian River Lagoon (IRL) on the east coast of central Florida is a significant juvenile feeding ground for sea

turtles in Florida. Over 40% of Florida's nesting occurs on the nearby beaches of Brevard County. Genetic markers provide a basis for estimating the contributions of various nesting beaches to the juvenile population in the IRL. Since 1995, we have collected 130 blood samples for DNA analysis on the genetic composition of juvenile loggerhead turtles in the IRL. We have documented the presence of 6 previously described and 1 novel mtDNA haplotype. Employing Bayesian statistics for mixed stock analysis, we were able to estimate the contributions of major nesting beaches to the juvenile population of the IRL. We also test the hypothesis that juveniles originally hatched within adjacent Brevard County would be more likely to recruit to the IRL. Results suggest local beaches did not unequally contribute to the IRL juvenile population, even when compared to populations several hundred kilometers away. Results indicate that the IRL population consists of juvenile loggerheads from all of Florida, and is thus an important feeding area for the entire western Atlantic, as 80-90% of all nesting is located along the Florida coastline (Encalada et al., 1998).

Do some loggerheads nesting in Florida have an oceanic foraging strategy? An assessment based on stable isotopes

Kimberly J. Reich[1], Karen A. Bjorndal[1], Alan B. Bolten[1], and Blair E. Witherington[2]

[1] Archie Carr Center for Sea Turtle Research and Department of Zoology, Box 118525, University of Florida, Gainesville, Florida 32611-8525, USA.
[2] Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, Melbourne, Florida 32951 USA

Relative abundances of naturally occurring stable isotopes have been used increasingly to study trophic relationships, diet, habitat use, and movements of animals in both marine and terrestrial systems. In this study, we used stable isotope analysis to investigate the diets and habitats (neritic vs oceanic) of adult female loggerheads prior to migrating to their nesting beaches. Samples were collected from turtles nesting at four locations on the Atlantic coast of Florida at the beginning of the 2003 nesting season. Turtles were measured and tagged, and a sample of epidermis was collected for stable isotope analysis. Analyses of stable carbon ratios of the turtles sampled (n = 194) indicate that a substantial number of turtles exhibit a stable carbon signature characteristic of an oceanic foraging strategy. Relative abundances of stable nitrogen indicate that turtles exhibiting an oceanic strategy consume a diet spanning more trophic levels than turtles feeding in neritic habitats. Turtles exhibiting an oceanic foraging strategy were significantly smaller than turtles feeding in neritic habitats.

Why older ladies are better

Richard D. Reina[1], James R. Spotila[2], and Frank V. Paladino[3]

[1] Monash University, Clayton, VIC 3800 Australia
[2] Drexel University, Philadlephia PA, 19104 USA
[3] Indiana-Purdue University, Fort Wayne IN, 46805 USA

For 10 years we intensively PIT-tagged female leatherback turtles as they nested at Parque Nacional Marino Las Baulas, Costa Rica. We collected data on turtles' nesting frequency, internesting period, clutch size and hatching success of their eggs. With the passage of time we have differentiated with increasing confidence between remigrant turtles and those nesting for the

first time. We analyzed nesting data from the past five years to determine if differences existed between remigrants and turtles nesting for the first time. We found that in all five seasons the remigrant turtles began nesting earlier in the year, laid more clutches, and laid them closer together in time than the new turtles. In some seasons remigrants laid significantly more eggs per clutch than new turtles, but hatching success was not different. Our data showed that remigrant turtles were 25 to 40% more productive than new turtles, if the number of eggs laid is used as the measure of productivity. On the basis of these results we propose that we cannot consider female leatherbacks to be simply 'adults' and infer an equality of contribution to the population as a whole, but rather must conclude that there are distinct components to the adult female population. The older adult females make a proportionally greater contribution to recruitment into the population than younger adult females and thus they may be considered more reproductively valuable. We will discuss our results in the context of differential conservation strategies and the evolution of old age in vertebrates.

The North Atlantic Oscillation drives the leatherback nesting season in French Guiana

Philippe Rivalan, Anne-Caroline Prevot-Julliard, and Marc Girondot

Laboratoire d'Ecologie, Systématique et Evolution, UMR 8079 CNRS, ENGREF et Université Paris-Sud XI, 91405 Orsay Cedex, France

---

The number of nests laid per season is commonly used as an index of population size in marine turtle research. This assumes that the reproductive investment is constant over years. Therefore, the understanding of the proximal causes that drive reproductive investment is a key parameter in the dynamics in sea turtle populations. In this study, we considered the number of nests laid per female as an index of reproductive investment, based on tagging data and nest counts from Awa:la-Ya:lima:po beach (French Guiana) between 1979 and 2003. We showed that individual reproductive investment was significantly negatively related to the North Atlantic Oscillation (NAO) winter index, lagged by three years. Independently, we also show that the length of the nesting season was also significantly negatively correlated to NAO index lagged by three years. We propose that the North Atlantic Oscillation effect is mediated by sea surface temperatures at the feeding grounds as identified by stranding reports and satellite tracking. Therefore, since reproductive investment is related to environmental variations driven by climate, we suggest that care must be taken when using the number of nests as a population index.

The Matura Beach leatherback sea turtle nesting colony in Trinidad: Results of 13 years of conservation and 5 years of tagging turtles

Dennis Sammy[1], Stephen Poon[2], Scott A. Eckert[3], and Nadra N. Gyan[2]

[1] Nature Seekers, Toco Main Road, Matura, Trinidad, W.I.
[2] Forestry Division Wildlife Section, St. Joseph, Trinidad
[3] WIDECAST, Duke University Marine Lab, 135 Duke Marine Lab Road, Beaufort, NC. 28557

The southern Caribbean island of Trinidad has long been known to support nesting by Critically Endangered (cf. IUCN) leatherback sea turtles. As recently as the 1980s, uncontrolled killing of gravid females for meat and sport continued unabated. Conservation activities began in 1990 with

the development of a co-management arrangement between a community group (Nature Seekers), based on the east coast village of Matura, and the Government of Trinidad's Forestry Division/Wildlife Section. The Wider Caribbean Sea Turtle Conservation Network (WIDECAST) was invited to serve as scientific advisor to the initiative. In 1990, the primary nesting beach was protected by law; soon thereafter poaching was eliminated. Reflecting the ongoing commitment of stakeholders to the project, Nature Seekers initiated an identity-tagging program in 1999 to evaluate population size and status, as well as to better understand where the adult females may reside when not in Trinidad's waters. Results of this tagging program confirm that Trinidad supports one of the largest leatherback nesting populations that remain in the world, and by comparing current data to historical information it appears that the population may be growing. Tagging results also demonstrate close linkages between this nesting population and others in the region, as well as with foraging habitats in the North Atlantic.

Assessing the status of sea turtles under the IUCN Red List criteria: Assumptions, caveats, limitations, and a call for more demographic data

Jeffrey A. Seminoff[1] and F. Alberto Abreu Grobois[2]

[1] NOAA-National Marine Fisheries Service, La Jolla, California, USA
[2] Instituto de Ciencias del Mar y Limnologia - UNAM, Mazatlan, Sinaloa, Mexico

---

Understanding the status of wildlife species is fundamental to their conservation. For sea turtles, management decisions regarding common themes like bycatch reduction and nesting beach protection as well as more sensitive issues such as sustainable harvest and indigenous use clearly require information on the status of individual populations being impacted. Although few would argue this point, consensus regarding the most appropriate status assessment technique has been elusive. At a global level, the World Conservation Union's Red List Program generates status assessments; identifying a species' 'extinction risk' based, for example, on past vs. present abundance across its entire geographic range. However, many scientists feel that the lack of spatial resolution inherent in global assessments precludes our ability to make the best-informed management decisions at local and regional levels. This incongruity has resulted in considerable debate regarding the utility of Red List Assessments for sea turtles. Moreover, despite the widespread acceptance of the listings, and their importance in conveying the urgency and scale of conservation problems to the public and policy-makers, Red List Assessments and the implications of their results remain poorly understood. In this presentation, we outline the Red List Assessment procedure and discuss why the issues of spatial and temporal scale are critical. Using the recent Marine Turtle Specialist Group's sea turtle assessments as examples, we will describe the assumptions, caveats, and limitations associated with the IUCN Red List widely distributed species criteria and identify the important aspects concordant with both the Red List's objectives and regional conservation goals.

Bioko Island (Equatorial Guinea): An important nesting site for sea turtles in central Africa

Jesús Tomás[1], Javier Castroviejo[2], and Juan A. Raga[3]

[1] Cavanilles Research Institute, University of Valencia, Valencia, Spain, and Facultad de Ciencias Humanas y de la Educación, Fundación Agrupación EDETANIA, Godella, Valencia, Spain
[2] Fundación de Amigos del Coto de Doñana , Panamá nº 6 41012-Sevilla , Spain
[3] Cavanilles Research Institute, University of Valencia, Valencia, Spain

Sea turtles are seriously threatened in the Gulf of Guinea due to human-related activities. Assessing nesting rookeries in this area is essential to application of conservation measures. We surveyed 19.35 km of black sand nesting beaches of green turtles, leatherbacks, olive ridleys and hawksbills in two nesting seasons in South Bioko, Equatorial Guinea. Over 555 (347-1437) green turtle nesting females were estimated through the mean number of nests (2.99± 1.82) laid by 196 turtles tagged in the 1996/97 nesting season. Estimated number of nesting leatherbacks ranged from 114 to 168 in this season, and the other two species were less abundant. No tagging program was developed in the 1997/98 nesting season, but the number of nests laid (1257) compared with that of the previous season (1671) indicated no substantial change in green turtle population size. A slight increase in nesting leatherbacks occurred in this season (estimated range= 156-230). Another survey made in 2000/01, within the Bioko Diversity Protection Program, detected no noticeable changes in the numbers of nests of greens, olive ridleys and hawksbills but an unexpected significant increase of leatherbacks. Data of the last survey must be interpreted with care due to different sampling effort. Nonetheless, this nesting area seems to host one of the most important nesting areas for green sea turtles on the Atlantic coast of Africa, being also important for leatherbacks. Data on nesting season duration, turtle size, nest site selection and inter-nesting interval of Bioko turtles are also compared with those from other nesting beaches.

Close and often: Migratory and breeding behavior of male hawksbill turtles

Robert P. van Dam[1], Carlos E. Diez[2], and Luis Colon[3]

[1] Chelonia Inc, PO Box 9020708, San Juan, Puerto Rico 00902
[2] Departamento de Recursos Naturales y Ambientales, Puerto Rico
[3] Universidad de Puerto Rico, Arecibo, Puerto Rico

Data on the behavior of breeding male hawksbill turtles measured through satellite telemetry, time-depth recorders, and recapture records are presented. Male hawksbill behavior and migration patterns contrast sharply with those of female turtles of the same population.

Changes in emergence location of loggerhead sea turtles resulting from construction of offshore breakwaters

Kunihiro Watanabe[1], Satoquo Seino[2], and Takaaki Uda[3]

[1] Ocean Research Institute, The University of Tokyo, Tokyo, Japan
[2] Graduate School of Arts and Science, The University of Tokyo, Tokyo, Japan
[3] Public Works Research Center, Tokyo, Japan

The impact of shore protection facilities on nesting loggerhead turtles was assessed along the Kamoda coast of Japan. We evaluated the potential influence of nearshore currents on emergence location by analyzing patrol records of turtle nesting, making flow observations, and performing numerical simulations. About 50 years of nesting records showed that an area rarely used by females had become a more frequently used nesting area after the construction of offshore breakwaters (between 1981 and 1984). Before the construction, the frequency of female emergence from that area was 5.4% of the whole. However, after the construction of the offshore breakwaters, it increased to 20.2%. Flow observations indicated an apparent relationship between current flow and emergence location. Turtles tended to emerge from the area where the along shore current velocity decreased. The current velocities along the emergence area were mostly less than 2.0 cm/s. Numerical simulations were conducted under conditions with and without the offshore breakwaters for estimating the historical changes in nearshore currents. The results of the simulation showed that the offshore breakwater clearly obstructed the nearshore current, and generated a new area where the flow velocity decreased. That location coincided with the location of increased female emergence. These results indicated that nearshore current was probably an important factor causing the changes in turtle emergence location. Our results also indicate that current might be one of the important factors for female sea turtles when selecting emergence locations.

Assessment of sea turtle foraging areas in the Galapagos Islands

Patricia M Zárate[1], Jeffrey A Seminoff[2], and Peter H Dutton[2]

[1] Charles Darwin Research Station, Santa Cruz Island, Galapagos Islands, Ecuador
[2] National Marine Fisheries Service, Southwest Fisheries Science Center, La Jolla, California, USA

Important green turtle foraging areas were identified by Green and Hurtado in the 1970's; however, these areas have not been evaluated or monitored for more than 23 years. We present results of a study that we carried out between February 2003 and February 2004 to survey sea turtles at four index sites, Punta Espinosa (Fernandina Island), Bahía Elizabeth and Caleta Derek (Isabela Island) and Punta Núñez (Santa Cruz Island). These sites correspond to those from previous work for which baseline data exist. We captured, measured, stomach lavaged, tagged and tissue sampled turtles in order to conduct comprehensive studies of these foraging populations, including demographics, diet, genetic stock composition, and migratory behavior. We encountered juvenile and adult green (mostly) and hawksbill turtles. For greens, algal diet was determined, primarily green algae comprising *Ulva spp*. We found a variety of *Chelonia* morphotypes, in terms of color and shape. A significant finding was re-discovery of the "yellow turtle" that we found to be more prevalent than previous studies and at one site (Punta Núñez) they appeared in higher numbers than the common green morphotype. Over the 80 % of "yellow"

turtles caught in this site were non-reproductive adults. Hawksbills were only found in Punta Núnez (Sta. Cruz Island) during the cold season. Some sites, such as Caleta Derek, appear to represent resting areas for a large number of green turtles, as opposed to those where turtles actively grazed.

SEA TURTLE MODELING AND PREDICTION

Oceanic-stage loggerheads exhibit compensatory growth in response to their stochastic environment

Karen A. Bjorndal[1], Alan B. Bolten[1], Thomas Dellinger[2], Cláudia Delgado[2], and Helen R. Martins[3]

[1] Archie Carr Center for Sea Turtle Research and Department of Zoology, University of Florida, USA
[2] Centro de Ciências Biológicas e Geológicas, Universidade da Madeira, Portugal
[3] Departamento de Oceanografia e Pescas, Universidade dos Azores, Portugal

---

Compensatory growth is accelerated growth that may occur when an organism that has grown at a reduced rate as a result of sub-optimal environmental conditions is exposed to better conditions. Compensatory growth is considered an adaptation to variable environments. Although documented thoroughly under captive conditions, compensatory growth has rarely been studied in wild populations. In their first years of life, oceanic-stage loggerhead sea turtles have relatively little control over their geographic position or movements and thus have an extremely stochastic lifestyle with great variation in food availability and temperature. This environmental variation results in variable growth rates. We evaluate somatic growth functions of oceanic-stage loggerheads from the eastern Atlantic based on skeletochronology that allowed us to assign age to each individual. We demonstrate that oceanic-stage loggerheads exhibit compensatory growth based on three analytical approaches. As a result of compensatory growth, variation in size-at-age in these juvenile loggerheads is substantially reduced. Thus, size is a better predictor of age than expected based on variation in growth rates. Compensatory growth decreases with age, apparently as loggerheads gain greater control over their movements.

West Atlantic green turtle population modeling workshop

Alan B. Bolten[1] and Milani Chaloupka[2]

[1] Archie Carr Center for Sea Turtle Research and Department of Zoology, University of Florida, Gainesville, Florida 32611 USA
[2] Ecological Modelling Services Pty Ltd, PO Box 6150, University of Queensland, St. Lucia, Queensland, 4067 Australia

---

The West Atlantic Green Turtle Population Modeling Workshop was held 22 – 24 October 2003 on Grand Cayman, British West Indies. The workshop was funded through the Cayman Turtle Farm and organized by Alan Bolten, Milani Chaloupka, and Ken Hydes. The objective of the

workshop was to launch the West Atlantic Green Turtle Modeling Initiative to foster better insight into the population dynamics of the regional green turtle metapopulation. Milani Chaloupka presented a stochastic simulation model of green turtle dynamics in the West Atlantic that he had developed for the workshop. The model was based on demographic information derived for this stock from published material and gray literature. The simulation model was designed to support robust evaluation of the effects of habitat-specific competing mortality risks on stock and substock-specific viability. This is a substock-, sex- and ageclass-structured model linked by density-dependent, correlated and time-varying demographic processes that are subject to environmental and demographic stochasticity. Workshop participants reviewed the model and identified research needed to improve the parameters in the model. Unpublished sources of data were identified, and collaborative data analyses were planned. A collaborative initiative to compile tag return data for the region was planned to define the spatial structure of the West Atlantic green turtle metapopulation. A listserv discussion group has been established to foster communication within the group. A follow-up workshop is planned for 2005.

Conservation genetics of the East Pacific green turtle (*Chelonia mydas*) in Michoacan, Mexico

Omar Chassin-Noria[1], Alberto Abreu-Grobois[2], Peter H. Dutton[3], and Ken Oyama[4]

[1] Centro Multidisciplinario de Estudios en Biotecnologia, UMSNH, Morelia, Michoacan, Mexico
[2] Alberto Abreu-Grobois, Instituto de Ciencias del Mar y Limnologia UNAM, Mazatlan, Sinaloa Mexico
[3] NOAA-NMFS Southwest Fisheries Science Center 8604 La Jolla Shores Drive. La Jolla CA 92038.
[4] Centro de Investigaciones en Ecosistemas, UNAM, Morelia, Michoacan, Mexico

---

The main continental nesting rookeries of the East Pacific green turtle (EPGT), *Chelonia mydas*, on the Michoacan (Mexico) coast suffered drastic population declines following intense exploitation in the 1960s-1970s with annual abundance of nesting females plummeting from about 25,000 to an average of about 1,400 between 1982-2001. Analyses of data from three nDNA microsatellite loci and 400 bp mtDNA control region sequences from a total of 123 nesting females sampled from four Michoacan rookeries found no evidence of population sub-structuring. The recent order of magnitude reduction in the population size shows no apparent impact on genetic diversity in either control region sequences (overall h = 0.48; p = 0.0036) or microsatellite loci (overall Na = 20.8; Hexp = 0.895). Our estimates of annual effective female population size (Nef; from Theta =2Ne.mu) of 1.9-2.3 x 103, in spite of being an order of magnitude below historical records, appear to be sufficient to allow recovery of this population without significant loss of genetic diversity. These findings highlight the importance of continued conservation to reverse the decline of this population before it becomes vulnerable to genetic erosion.

Comparing mortality risks with "adult equivalents" based on reproductive value

Selina S. Heppell[1], Larry Crowder[2], and Melissa Snover[3]

[1] Oregon State University, Corvallis, OR, USA
[2] Duke University Marine Lab, Beaufort, NC, USA
[3] Pacific Marine Environmental Laboratory, Pacific Grove, CA, USA

While elasticity analysis of sea turtle life histories has provided important insights into the relative impacts of survival rate change, it does not allow a comparison of mortality factors that affect a set number of individuals. For example, how might we assess the relative risk from a fishery that kills thousands of juvenile turtles each year with boat strikes that kill hundreds of adults each year? We have developed a measure called "adult equivalents" to scale takes of juvenile turtles to an equivalent number of adults, based on the ratio of juvenile and adult reproductive value. Reproductive values can be calculated from an age-structured population matrix. They represent the current and future reproductive contribution of an individual, based on its current age, probability of reaching adulthood, and adult fertility. Although we have limited information on survival and growth rates for many sea turtle populations, the reproductive value ratios are relatively robust to uncertainty. We verified the method with stochastic population models for loggerheads and Kemp's ridleys. Adult equivalents are now being incorporated into the new recovery plans for sea turtles, and may be applicable to risk prioritization in a wide range of listed species.

Nest density and hatching success of the olive ridley (*Lepidochelys olivacea*) sea turtles in Playa La Flor, Nicaragua

Shaya Honarvar[1] and Eric P. van den Berghe[2]

[1] University of Pennsylvania, Philadelphia, Pennsylvania, USA
[2] Ave Maria College, San Marcos, Carazo, Nicaragua

The primary reason for egg loss in olive ridley sea turtles is overcrowding during arribadas. This overcrowding results in large numbers of "double nests" when subsequent nesting turtles inadvertently dig up previous nests (NMFS and U.S. FWS, 1998). Such populations may have reached the local egg-carrying capacity in the sand, possibly leading to long-term declines (Arauz, 1995). Moreover, previous investigation at playa La Flor has shown that the survivorship of double nests is lowered (Von Mutius, 2000). Here, we test whether density-dependent mechanisms decrease the nest survivorship at playa La Flor. We selected three 10x10m experimental plots on the beach and manipulated them by removing all double nests in order to theoretically maximize hatching. Also, three control plots were chosen that receive no manipulation. In each plot, 20 nests per arribada are located by the triangulation method and used to calculate the survivorship in that plot by counting the number of hatchlings and excavating each nest. By comparing results for arribadas ranging in size from 500 to 20,000+ turtles, the nest density and the total number of hatchlings are used to find the optimal nest density with the corresponding maximum number of hatchlings. Subsequently, the egg-carrying capacity of the beach is calculated. This study is ongoing with results from two arribadas still pending. However, thus far it appears that specific removal of double nests may significantly increase hatching rates

in experimental sectors of the beach. This will aid us for planning better conservation strategies and management plans for this species.

Models in action: Fishery management assisted by modeling programs

Irene Kinan[1], Christofer Boggs[2], and Donald Kobayashi[2]

[1] Western Pacific Regional Fishery Management Council, Honolulu, Hawaii
[2] National Marine Fisheries Service – Pacific Islands Fishery Science Center, Honolulu, Hawaii

Court orders in November 1999 severely restricted the Hawaii-based longline fishery due to its interactions with sea turtles, and by March 2001 the swordfish component of the fishery was effectively closed. This closure motivated NOAA Fisheries and the Western Pacific Fishery Management Council to work towards gear modifications and technological solutions to reduce bycatch, and research to better understand migratory sea turtles. Fishery results from the Atlantic after three years of experiments show promise that circle hooks in combination with mackerel bait reduce loggerhead interactions by 92% and leatherback interactions by 67% while increasing swordfish catch rates of up to 30% on commercial longline boats targeting swordfish. In the mean time, Generalized Additive Models (GAMS) have been developed using detailed catch and effort, logbook and observer data for the Hawaii-based fleet to assess the impact of a range of management alternatives. In addition, stochastic simulation models were used to assess conservation strategies and their impacts to sea turtle populations. This combination of models was employed to design a new "demonstration" swordfish fishery for the Hawaii-based longline fleet. A fishery based on the innovative results of fishery experiments, improved gear technology, sea turtle migratory data, and implementation of five off-setting conservation measures. The results of these models and effects of conservation measures to relevant sea turtle populations are presented.

Growth rates of juvenile green turtles (*Chelonia mydas*) from three developmental habitats along the east central coast of Florida

Stacy A. Kubis[1], Llewellyn M. Ehrhart[2], and Milani Chaloupka[3]

[1] WIDECAST
[2] Univeristy of Central Florida
[3] University of Queensland

Growth rates were determined for juvenile green turtles (*Chelonia mydas*) in three developmental habitats along the east central coast of Florida. Data were collected over twenty-years at the Indian River Lagoon site, thirteen years at the Sabellariid worm rock reef site and nine years at the Trident Submarine Basin site. Straight carapace length (SCL) measurements were used to calculate mean annual growth rates. Additionally, length-weight relationships were determined for each study site.

Significant differences in growth rates were observed among study sites and among size classes within sites. A non-monotonic pattern, or single peak in growth rates, was observed at all three sites. Juvenile green turtles from the Indian River Lagoon site grew significantly faster than those from the Sabellariid worm rock reef site and the Trident Submarine Basin site. The length-weight relationships for juvenile green turtles from the Indian River Lagoon and Sabellariid worm rock

reef sites were nearly identical. The length-weight relationship for the Trident Submarine Basin population was significantly different from the other two populations. Turtles from the Trident Submarine Basin increase in mass slower than turtles from the other two sites. Differences in growth rates and length-weight relationships among sites may be attributed to turtle density and food availability.

Evaluating the effect of carrying capacity on dense nesting beaches: A novel approach is proposed

Antonios D. Mazaris, Yiannis G. Matsinos, and Dicran A. Matossian

University of the Aegean, Mytilene, Greece

The purpose of this study is to develop a tool for assessing carrying capacity effects on dense sea turtle nesting beaches. We proposed a conceptual – combinational model for examining carrying capacity effect on species that use land-based and spatial-limited habitats for their reproduction such as sea turtles. Our model is applied on Sekania Beach, Island of Zakynthos, Greece, the densest nesting beach of the loggerhead sea turtle (*Caretta caretta*) in the Mediterranean. Model parameterization is discussed while some preliminary results are also presented.

Using ecological covariates to strengthen sea turtle mixed stock analysis

Toshinori Okuyama and Benjamin Bolker

Zoology Department, University of Florida, Gainesville, Florida, USA

Statistical methods for mixed stock analysis have become steadily more powerful. For example, modern methods based either on maximum likelihood or Bayesian approaches can take account of unobserved haplotypes. However, current methods still fail to take advantage of ecological information, and as a result can produce unrealistic results, for example when they suggest that a tiny rookery contributes the majority of turtles found in a large mixed (foraging ground) population. Similar inconsistent results can also occur when analyzing the contributions of rookeries to multiple foraging grounds. Current methods contain no constraint, such as a dependence on population size, which prevents such unrealistic results when data are sparse. In this talk, we describe new methods (in the form of Bayesian hierarchical models) that improve estimation: we present both tests of the methods based on simulation and applications to existing data. Although the talk will focus on incorporating rookery size, we also demonstrate the flexibility of Bayesian methods for incorporating other forms of information about sea turtle biology.

Modeling marine turtles nesting season: A meta-analysis for 16 nesting beaches covering 600 km of coast line for 3 species in the Guianas region during the 2002 nesting season

Philippe Rivalan[1], Jean-Paul Briane[1], Bart de Dijn[2], Sandra Ferraroli[3], Ronald Wongsopawiro[4], Julien Gratiot[5], Maartje Hilterman[6], Florent Macé[7], Yvette Merton[2], Isabelle Nolibos[8], Benoît Viseux[1], and Marc Girondot[1]

[1] Ecologie, Systématique et Evolution, Université Paris-Sud, Orsay, INRA, ENGREF et CNRS, Bât. 362, 91405 Orsay cedex, France.
[2] Stinasu- Stichting Natuurbehoud Suriname, Cornelis Jongbawstraat 14 P.O.Box 12252 Paramaribo, Suriname
[3] Centre d'Écologie et Physiologie Énergétiques, CNRS, 23 rue Becquerel, 67087 Strasbourg cedex 02, France
[4] Réserve Naturelle de l'Amana, 270 Avenue Paul Henri 97319 Awala-Yalimapo, Guyane française
[5] Association Kwata -BP 672, 97335 Cayenne cedex
[6] Stichting Biotopic, Nieuwe Herengracht 61 BG, 1011 RP Amsterdam, The Netherlands
[7] Office National de la Chasse et de la Faune Sauvage, CV 17.1 Simarouba, 97310 Kourou, Guyane française
[8] Société d'Études, de Protection & d'Aménagement de la Nature en Guyane, 27 avenue Louis Pasteur, 97300 Cayenne, Guyane française

---

Marine turtles nest mainly on inter-tropical beaches during the so-called 'nesting season.' The 'nesting season' is different according to the geographic coordinates of the nesting beach and according to the species. The total number of nests deposited on a nesting beach is classically used as an indirect estimator of population size. The main purpose of this presentation is to propose a method that rendered both the global pattern of nesting season and its internal structure, and particularly to be able to handle partial nest counts on beach segments. The method estimates the likelihood of various models and can be used also to statistically compare the shape of nest distribution for several nesting beach even if the day with counts are not the same. Data for 3 marine turtles species on 16 nesting beaches from French Guiana and Suriname are used. More than 3100 nesting night counts were obtained on these 16 nesting beaches covering nearly all the nesting beaches in French Guiana and Suriname. The phenology of nesting season will be described and analyzed.

Testing long-term natural cycles in leatherback nesting populations

Philippe Rivalan[1], Peter H. Dutton[2], Emmanuelle Baudry[1], Suzanne Roden[2], and Marc Girondot[1]

[1] Laboratoire d'Ecologie, Systématique et Evolution, UMR 8079 CNRS, ENGREF et Université Paris-Sud XI, 91405 Orsay Cedex, France
[2] NOAA-Fisheries, Southwest Fisheries Sciences Center, 8604 La Jolla Shores Drive, La Jolla, CA 92037, USA

French Guiana and Suriname beaches are considered to be the largest remaining nesting ground for leatherbacks in the world. Before their modern discovery in the late 1960s, recorded observations of leatherback were rare in the region. Considering the 'spectacular' size and the highly specific anatomy of this species, and that leatherbacks lay nests in most months of the year, it is highly improbable that earlier observers would have overlooked leatherbacks if they

were present in the region. Two main hypotheses may explain this apparent absence of leatherbacks in historical times:
(i) Natural long-term cycles, for example driven by density-dependence, may reduce populations to very low sizes followed by subsequent recovery to large numbers.
(ii) Colonization of new beaches by migrants from nesting populations outside of French Guiana and Suriname may have occurred recently. Newly settled population that results from migrations may be issued from a low number of animals (i.e., founder effect) or of a large number of individuals.
Demographic events are expected to leave a temporary genetic signature. Therefore, we used microsatellite markers to test the two hypotheses above. Twelve polymorphic loci were screened on 147 blood samples gathered from leatherbacks nesting on Awa:la-Ya:lima:po beach (French Guiana). Using BOTTLENECK software, we did not detect a recent drastic population size, leading us to conclude that the periodic rarity of leatherback is probably due to the colonization of the region by individuals from large nesting populations outside the region.

Age and growth in juvenile Kemp's ridley (*Lepidochelys kempii*) sea turtles using skeletochronology

Melissa L. Snover[1], Aleta A. Hohn[2], and Larry B. Crowder[3]

[1] Duke University Marine Lab, Beaufort, North Carolina, USA/Pacific Fisheries Environmental Lab, Pacific Grove, California, USA
[2] NOAA Fisheries, Beaufort, North Carolina, USA
[3] Duke University Marine Lab, Beaufort, North Carolina, USA

We presented evidence-validating skeletochronology in Kemp's ridley sea turtles at the 20th and 21st Annual Symposia on Sea Turtle Biology and Conservation. Here we summarize the available evidence to date and propose that skeletal growth marks found in the humeri of Kemp's are deposited on an annual basis. From direct counts of growth marks, we estimated the ages of juvenile Kemp's that stranded along the mid-Atlantic coast (N=154). Sizes and ages ranged from 21.7 to 50.5 cm straight carapace length (SCL) and 1.0 to 8.0 years. Eight years appears to be the maximum age that can be estimated from direct counts, before the earliest growth marks are lost to resorption. We verified a constant proportionality between humerus dimensions and SCL, allowing for the estimation of somatic growth from dimensions of skeletal growth marks. From this relationship we estimated a single growth rate for each of the 154 animals plus an additional 13 growth rates from large juveniles and adults between 50.6 and 62.0 cm SCL. A von Bertalanffy growth curve was fit to the growth rates, resulting in an asymptotic length of 73.0 cm SCL and an intrinsic growth rate of 0.12. The agreement between age-at-size estimated from direct counts of skeletal growth marks and the von Bertalanffy growth curve provide further validation for using skeletal growth marks to estimate somatic growth rates. The von Bertalanffy growth curve yielded an estimate of 12 years to reach 60 cm SCL, the approximate size at which Kemp's begin to mature.

Simulating hatchling production in the green turtle nesting population at Tortuguero, Costa Rica

Manjula Tiwari[1], Karen A. Bjorndal[1], Alan B. Bolten[1], and Benjamin Bolker[2]

[1] Archie Carr Center for Sea Turtle Research and Department of Zoology, University of Florida, Gainesville, FL 32611
[2] Department of Zoology, University of Florida, Gainesville, FL 32611

Spatial and temporal nesting patterns of green turtles in Tortuguero, Costa Rica, over a thirty-year period have been remarkably consistent within and among years. Furthermore, these trends are consistent with the mid-domain hypothesis for spatial and temporal distribution of reproductive effort. Consequently, we would expect the density of nesting attempts in a given section of the beach to change proportionally with natural fluctuations in nesting numbers among years resulting in varying density-dependent effects on hatchling production among years. Per capita density-independent effects are assumed to be constant over time leading to varying numbers of nests lost in different years. In this study, processes affecting hatchling output were simulated to estimate variation in hatchling output with varying numbers of nests laid on the beach. Quantifying processes that underlie hatchling production and evaluating hatchling output is important for building models of green turtle population dynamics in the Caribbean.

Hurry up and wait: A behavioral strategy for little loggerheads new to a big ocean

Blair Witherington

Florida Fish and Wildlife Conservation Commission's Marine Research Institute

In this paper, the behavior of newly emerged loggerhead hatchlings is described from the point that they leave their natal beach to the hypothetical point when they leave neritic waters and disperse into oceanic waters. A summary of behavior and energetics is inferred from continuous behavioral sampling of tracked hatchlings, instantaneous sampling of neonate turtles found offshore, diet sampling of neonates captured offshore, and a test of associations between neonate turtles and floating material. In testing whether an affinity for floating material was active or passive, mass of floating material surrounding captured neonate loggerheads was compared to the mass of material surrounding turtle-sized inanimate objects already distributed within the habitat where turtles were captured. A behavioral summary for neonate loggerheads shows a contrast and transition between an initial active dispersal phase (the hatchling frenzy) and a low-energy-foraging, passive dispersal phase. Limited observations of neonate green turtles offshore suggest a behavioral strategy different from loggerheads.

SEA TURTLES AND SOCIO-ECONOMICS

An expedition to Turtle Islands in Sierra Leone

Edward Aruna and D.D. Siaffa

Conservation Society of Sierra

Since the inception of the Sea Turtle Conservation Program in Sierra Leone, the program has only been enhanced to cover the western region of the country with surveys on socio-economic importance, culture, folk laws and religious beliefs. The program has yet to extend to the southern or northern parts of the country. Among the many areas left to be visited are Shenge, Sherbro Island and a collection of 5 small islands known as Turtle Islands. These areas are considered turtle spots in Sierra Leone and report of massive nesting exercises have been recorded.

Shenge, 245km away from the capital city, Freetown, can be reached by boat or automobile. Around this area is a long stretch of beach where, as reported by inhabitants, hundreds of turtles do nest. Reports of accidental turtle catch with inscriptions have also been documented.

Sherbro Island is the largest island in Sierra Leone and it hosts sea turtles. Many protected areas, including this island, have been proposed by IUCN, but it has since become urgent to classify beaches at Sherbro and surrounding islands (5 small islands referred to as Turtle Islands) as a natural reserve or park for sea turtle protection. An unfortunate, dramatic political situation terminated a study started there in 1991. The present program intends to resume the study and confirm the declaration of the site as a protected area for turtle conservation.

Diagnostic on the illegal commerce of sea turtles in the Gulf of Venezuela

Héctor Barrios-Garrido[1] and Ma. Gabriela Montiel-Villalobos[2]

[1] Postgrado en Ecología Aplicada. Facultad de Ciencias. La Universidad del Zulia. Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV)

[2] Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV)

The Gulf of Venezuela constitutes an important feeding zone for the marine turtles in the Caribbean. The green turtle (*Chelonia mydas*), the hawksbill turtle (*Eretmochelys imbricata*) and the loggerhead turtle (*Caretta caretta*) are the main species exploited, supplying an illegal trade in productson the local, national and international levels. The main sub-products of marine turtles that market themselves in the area of study are meat, scales of hawksbill turtle, shells and oils. An exemplary living sea turtle (sub adult – adult) is quoted in 160.000 Bs (100 US$); the prices of the raw meat oscillate between 6,000 – 7,000Bs/kg (3.75 - 4.37 US$), while a plate of sea turtle meat (with rice and plátano) costs 3,500 Bs (2.18 US$). The scales of hawksbill turtle originating from a shell of an exemplary adult market themselves with a price of 100,000 Bs (100 US$) while the waxed and varnished shells of the green turtle can be sold for between 40,000 - 60,000 Bs (25 - 37.5 US$), depending on size. The most sought oil for its “medicinal properties” is that of the leatherback turtle (*Dermochelys coriacea*), with 1L costing between 1,000 – 2,500 Bs (0.625 – 1.56 US$). The sea turtle commercialization routes and their sub-products in the Gulf of Venezuela include the local market of Los Filúos in Paraguaipoa, grocery shops and restaurants located in the cities of Maracaibo, Mérida, San Cristóbal and Barquisimeto. These also supply

the international market through the Colombo-Venezuelan border, specifically in the locality of Riohacha, Colombia.

Market surveys for sea turtle products in northwestern Morocco

Wafae Benhardouze[1], Manjula Tiwari[2], Mustapha Aksissou[1], Benoît Viseux[3], and Matthew H. Godfrey[4]

[1] Dept. Biology, Faculty of Science, P.O. Box 2121, Tetouan 93002 Morocco
[2] Archie Carr Center for Sea Turtle Research, Dept. of Zoology, P.O. Box 118525, University of Florida, Gainesville, Florida 32611 USA

[3] 26, rue de Béthune, 62153 Souchez, France
[4] North Carolina Wildlife Resources Commission, 307 Live Oak Street, North Carolina 28516, USA

Market surveys to assess availability of sea turtles or their products constitute a valuable tool not only to uncover biological information (e.g. species present, size distributions, seasonality, population structure, etc.), but also types of utilization and importance in the diet/income of people in a specific region. Assessments of sea turtles in Moroccan markets have been few. In the summer of 2003, we visited 28 artisanal shops in northwestern Morocco and found 23 carapaces transformed into guitars, lamps, or wall decorations. Loggerheads were the only species seen (mean CCL = 54,58 cm; range = 32 to 82 cm). Current carapace prices (between $30 and $700) suggest that there is little local demand for them and that they are primarily for sale to tourists. Limited use by artisans and only the occasional consumption of meat locally suggest that sea turtles may have minimal commercial importance in Morocco, but a more thorough evaluation is to be undertaken.

The impact of sea turtle hatcheries in Sri Lanka

Naamal K. De Silva

Center for Applied Biodiversity Science (CABS) at Conservation International, Washington D.C., U.S.A (as of January 29, 2004); School of Forestry and Environmental Studies, Yale University, New Haven, Connecticut (August 2001-May 2003)

Five out of the seven species of sea turtles nest along the shores of Sri Lanka. Since the late 1970s, hatcheries have been the main means of sea turtle conservation along the southern coastline. These hatcheries are ecotourism ventures that claim to save thousands of turtle eggs from certain consumption, while also providing income and employment to local residents. Semi-structured interviews, participant observation, and archival research were used to evaluate these claims, as well as to assess the social and educational impact of the hatcheries on surrounding communities. The findings suggest that the hatcheries are beneficial to the local economy, providing employment for some locals and supplemental income for many others. The direct educational impact of these ventures is more mixed, being limited to students and tourists. Also, there is the possibility that locally-derived beliefs are being supplanted by information disseminated by the hatcheries. Conservation gains appear limited due in part to the location of hatcheries along increasingly developed coastlines. More importantly, the hatcheries utilize several potentially harmful conservation techniques. For instance, eggs are exposed to fluctuating temperatures and damage during transport to hatcheries, and hatchlings are held in overcrowded tanks for an extended period. The implementation of modified techniques by the hatcheries, along

with the establishment of in situ nest protection programs on less developed beaches, could increase the effectiveness of sea turtle conservation measures in Sri Lanka.

Historical, traditional use of sea turtles and their products in Benin (West Africa)

Josea Sagbo Dossou-Bodjrenou[1], Jacques Fretey[2], and Patrice Sagbo[1]

[1] Musee des Sciences Naturelles Nature Tropicale ONG 06 BP 1015 Akpakpa PK3 Cotonou (Bénin)
[2] FFSSN/IUCN, Museum national d'Histoire naturelle 57 rue Cuvier, 75231 Paris cedex 05, (France)

Sea turtles are strongly exploited in Benin by the local communities, as they are everywhere else in the West African region. Sea turtles are systematically slaughtered and their meat and eggs consumed. The fat, especially that of the leatherback, is used in traditional medicine and considered to be the most-required product in certain villages.
Fortunately, African legends, especially Ghanaian, laud a totemic and divine aspect of the sea turtle. That doubtlessly establishes an endigenous method of conservation. In some villages of the Benin coast, some communities do not touch sea turtles because of the existence of a prohibition within their family. These Beninese communities, which are, for the most part, of Ghanaian origin, not only preserve sea turtles, but they also offer a traditional cult.

Saving turtles a nest at a time: The economics of turtle conservation in Sarasota County, Florida

Jerris J. Foote, Anton D. Tucker, Paula M. Clark, James Grimes, and Sarah Condran

Mote Marine Laboratory, Sarasota, Florida, USA

Each year Mote Marine Laboratory's Sea Turtle Conservation and Research Program (STCRP) monitors 48 km of loggerhead nesting beach in Sarasota County, Florida. Sarasota County beaches are included in the statewide nesting beach and index beach surveys annually from April to October. To collect representative data, we patrolled beaches with 2002 nesting densities ranging from 6-26 nests per kilometer, with isolated zones of up to 96/km. We analyzed the economics of nesting surveys, nest protection, and nest relocation. We assigned currencies to the materials and the effort expended by staff, volunteers, and interns. The overall currency divided by the total number of nests in the survey area yielded a cost to protect one nest. An economic model allows a critical analysis of resource commitments and currencies (whether in time, money, or combinations thereof) to achieve a cost-effective conservation effort. We suggest that such data provide a necessary baseline currency for beach surveys. Similar studies may also serve to identify new costs arising from nest relocation efforts after perturbations to nesting habitats, such as beach nourishment or coastal armoring.

Helping communities to conserve marine turtles in West Africa

Jacques Fretey

UICN-France, FFSSN Muséum national d'Histoire naturelle, 57 rue Cuvier, Paris cedex 05, FR 75231

In today's world, laws and field projects have mostly been instated where necessary to ensure conservation of marine turtles. Big international funding agencies have compelled poorer nations to support ratification of big environmental conventions and coastal African countries have to now develop plans to protect their coastal areas and endangered species. Environmental NGOs have long been accused of prioritizing a species' conservation above human life. However, imposition of restrictions on local communities without compensation or alternatives to harvesting endangered species is becoming less acceptable. In West Africa, it is unthinkable to plan effective conservation of marine turtles without taking into account problems of health and hygiene in fishing villages. In this paper, work done with African communities using marine turtles as a flagship species is discussed. Not only can field projects provide direct employment and thereby support entire families, but they can also improve the quality of life while controlling the harvest of turtles. This conservation philosophy is based on the idea that a healthy and well-fed fisherman no longer has to be a poacher and it is easier for him to understand that a living turtle is worth more in the long-term than a dead turtle.

Exploring views of community-based sea turtle conservation in Gandoca, Costa Rica

Noella Gray[1] and Lisa M. Campbell[2]

[1] Duke University, Durham, NC, USA
[2] Duke University Marine Lab, Beaufort, NC, USA

In response to numerous problems with state imposed conservation schemes that divorce environmental resources from the people who live with them, there has been an international shift in recent years towards 'community-based' or 'new' conservation. 'New' conservation asserts that: 1) communities, not the state, should be the center of conservation activity; 2) resources can be used, so long as this use is sustainable; and 3) conservation must offer economic incentives. As an ever-increasing number of sea turtle conservation projects seek to implement (at least some of) the ideas of 'new' conservation, particularly in the form of ecotourism programs, it is essential to consider how these translate into practice. This paper contributes to a better understanding of the social aspects of community-based sea turtle conservation by examining the views of stakeholders associated with the Asociación ANAI sea turtle conservation project in Gandoca, Costa Rica. A grounded-theory analysis of interviews conducted with ANAI staff and volunteers/ecotourists, park guards, and cabin owners from May to August 2002, reveals a broadly shared view of community-based conservation that incorporates concerns for both nature and people. However, in those instances where there are perceived conflicts between human needs and sea turtle conservation, differences in views emerge that reveal the challenges of achieving and maintaining an 'ideal' community-based sea turtle conservation project. This paper will explore areas of consensus and conflict in stakeholder views, and suggest ways in which understanding these views can inform the implementation of existing and potential community-based sea turtle conservation programs.

Socio-cultural aspects of traditional leatherback hunting in Kei Islands, Indonesia. Implication for community-based management

Creusa Hitipeuw and Julius Lawalata

WWF Indonesia

The Kei Islands group is located in the Maluku Province of Indonesia (5°43'S and 32º50'E), on the Sahul plate between New Guinea and Australia. Six sea turtle species are among other marine life inhabiting this island group. Leatherbacks, locally known as Tabob, are the most important marine species for indigenous people serving the subsistance need of the local people. The species frequently occurs in the waters of southwest of Kei Kecil islands to feed on certain species of jellyfish seasonally found in large numbers in this area. The capture level of leatherbacks by the villagers of Kei is estimated as intensive as approximately 100 leatherbacks per season (Suares, 1999). Lack of protein resources from the forest and the increased human population are suspected to be the reasons behind the traditional practices. However, the critical endangered status of the Pacific leatherbacks requires closing down of such intensive traditional captures.

The traditional practices of natural resource utilization are of high socio-cultural value to many indigenous people. These practices reflect the vital linkage of people to the land and water, reinforce the spiritual beliefs that govern their existence and responsibility to their natural resources, and serve as a tool for passing on socio-cultural knowledge to the future generations. This presentation described the results of an assessment on socio-cultural background of the practice including perspectives and the traditional knowledge on the bio-ecological aspects of turtles, the existing local management wisdom associated with the hunting, and the local institutional framework relating to customary decision making.

The influential factors of the local communities to the sea turtle ecotourism on Wan-an Island, Penghu Archipelago, Taiwan, R.O.C.

Tsung-shun Huang and I. J. Cheng

Institute of Marine Biology, ROC

On Wan-an Island, the sea turtle ecotourism has reached limited success. The expansion of the program to the regular activities, however, met many difficulties. Thus, the understanding of involvement of local people in sea turtle ecotourism may provide the answers to the problems we face on the island. The questionnaire interviews of the local people from 2001 and 2002 showed this; the education and information availability were two major reasons. The execution of various ecological training programs and distribution of correct ecotourism information will have positive influence on sea turtle ecotourism. The study also found that families with a member whose education level was senior high school or higher tend to agree more with conservation policies and support various ecotourism concepts. Ironically, if the member of the family with education levels junior high school or lower has joined the beach patrol training program, he would pay a similar level of attention to the development and future of sea turtle ecotourism as the families with college-level education or higher. The families who live further away from the protected area tend to pay less attention to the development and future of the sea turtle ecotourism. However, if they have received the proper sea turtle ecotourism training program, the situation

would improve significantly. It is concluded that the success of ecotourism education programs plays an important role in the development of sea turtle ecotourism on Wan-an Island.

Sharing ecosystems: Active management of the "sea turtle – local community" interface

Kostas A. Katselidis[1] and John D. Pantis[2]

[1] National Marine Park of Zakynthos, Zakynthos, Greece
[2] Aristotle University of Thessaloniki, Thessaloniki, Greece

The National Marine Park of Zakynthos (NMPZ) is situated in a region that encompasses 50% of the island's mass tourism business and 42% of the loggerhead sea turtle nesting effort in Greece. Mass tourism has become firmly established on Zakynthos over the last 25 years, and uncontrolled land development, beach use and marine leisure sports threatened the survival of the loggerhead breeding rookery on Zakynthos. The NMPZ was formed in December 1999, following 17 years of campaigning by environmental organizations, and was greeted with suspicion by the Zakynthos local communities who feared it meant losing their tourism-oriented livelihoods.

The NMPZ is the first marine park in Greece dedicated to protecting sea turtles. The NMPZ is a coastal park, and encompasses both terrestrial and marine ecosystems essential for the reproduction of the loggerhead turtle populations on Zakynthos. The role of the Management Agency of the National Park is to aid the growth of the local economy through promoting long term sustainable initiatives, such as ecotourism, organic farming and management of fish-stock within the park boundaries. Within 3 years of operation, the active management policies of the park have generated co-operative ventures with law enforcement authorities and local businesses that directly use the terrestrial and marine habitats of the sea turtles. This presentation discusses how the National Marine Park has applied techniques, through example of two case studies, to actively protect the sea turtle terrestrial and marine habitats while simultaneously regulating and promoting local businesses in the same region.

Black turtle (*Chelonia mydas*) population ecology and fisheries mortality in Bahía Magdalena, Mexico

Volker Koch[1], Wallace J. Nichols[2], and Louise B. Brooks[3]

[1] Universidad Autónoma de Baja California Sur, La Paz, BCS, México/ Center for Coastal Studies, The School for Field Studies, Puerto San Carlos, BCS, México
[2] WiLDCOAST, Davenport, California, USA
[3] Moss Landing Marine Laboratory, Monterrey, California, USA

Bahía Magdalena, on the Pacific coast of Mexico, is an important developmental and feeding area for the endangered black turtle. Despite national and international protection, turtles are still being caught and eaten in the area. The objective of this study was to describe population structure, distribution, growth and mortality of black turtles in the bay, to determine how the population is affected by the ongoing exploitation and how sea turtles can be protected more effectively. Black turtles were caught year-round with entanglement nets during four years, measured, tagged and released. During the same period, mortality censuses were conducted in

seven communities and on 60km of Pacific beaches. The results show that over 90% of the black turtles caught alive were juveniles (straight carapace length SCL=54.4±9.4, n=217) and that the mangrove channels of Bahía Magdalena are important nursery grounds. As the turtles grow, they generally move towards the open bay and deeper waters. Growth of recaptures was slow (1.7±0.6cm SCL/year) and strictly seasonal, with growth rates being three times higher in summer than in winter. Mortality was high (up to 200 dead black turtles were found per year) and consumption was the most important cause of death (>90% had been eaten). Due to their slow growth, black turtles spend 15 to 20 years in Bahía Magdalena before reaching maturity, a time during which they are being caught and eaten. We conclude that population recovery is unlikely without a more effective protection of the feeding grounds through law enforcement, patrolling, habitat protection and education.

Talking about Tortuguero: Tourist perspectives on turtle-based ecotourism

Zoe A. Meletis and Lisa M. Campbell

Duke University- The Nicholas School of The Environment and Earth Sciences (Marine Laboratory), Beaufort, NC, USA

Tortuguero is often promoted as a successful example of ecotourism, one that can be used as a model to replace consumptive with non-consumptive use at other sea turtle nesting sites. Success can be measured in many ways, however, including economically, socially, and environmentally, and definitions of success will vary across stakeholders. Understanding differing perspectives is critical to managing for the sustainability of tourism. This paper will explore tourist views of the quality of the beach and general environment, and turtle-based tourism. Solid waste and its management will be highlighted as a tourism-related issue that poses environmental, economic, and social challenges for the tourism industry, and that threatens sustainability. The paper will be based on fieldwork undertaken from June-August 2003, and presents data derived from surveys of 518 tourists. This work contributes to the expanding literature on ecotourism and conservation in Tortuguero.

Conservation effort for the Ostional community, Costa Rica, in relation to the olive ridley egg use management project

Rodrigo Morera[1] and Gerardo Chaves[2]

[1] Asociación de desarrollo integral de Ostional, Ostional, Guanacaste, Costa Rica
[2] Escuela de Biología-Universidad de Costa Rica, San Pedro de mOntes de Oca, San José, Costa Rica

---

The Ostional community, represented by the Ostional community development association (OCDA, ADIO in Spanish) developed some strategies to protect and conserve the four sea turtle species that nest in their beach. These activities are in relation to the olive ridley egg use project that the environmental minister permits. The Ostional people have close to 15 persons to control the poaching. Close to 200 people clean the beach one or two times every month before the arribadas and hatchlings phenomenon. The women and children of the community form groups

that protect the hatchlings from the predators and the warm sand. The minimum cost for these conservation activities is close to 10,000,000 colones yearly ($24,000).

Sea turtles, hunters and human socioecology: From mystical feast to marine conservation icon

Wallace J. Nichols[1] and Rodrigo Rangel Acevedo[2]

[1] WiLDCOAST, Davenport, California, USA
[2] Grupo Tortuguero de las Californias, La Paz, Baja California Sur, Mexico

---

The conditions under which the use of sea turtles by humans evolved have largely changed. Northwestern Mexico was once one of the most difficult regions on the North American continent for human survival. Water and food were limited and seasonal, and human societies were largely nomadic. Sea turtles were common and hunting once led to a feast laden with mystical symbolism, solidarity and necessity. As human populations have grown and technology has aided food and water gathering, marine resources have declined due to overexploitation. The symbolism of the sea turtle feast is now often one of power, virility, lawlessness and wealth. Yet it also retains some elements of spirituality, group unity and tradition. Extinction of several populations of sea turtle is imminent. The furtive hunting of and black market trade in sea turtles are among the primary threats to their survival in northwestern Mexico. In response, international conservation efforts have promoted the idea of the sea turtle as a conservation icon, representing declines in ocean health and productivity as well as hope for recovery, rather than as simply a source of income or food. This has led to a growing grassroots marine conservation movement that has demonstrated nascent successes by promoting the many facets of the human relationship to sea turtles and other marine species. We will discuss the challenges and lessons of this campaign and present a personal view of the difficulties inherent in working at the interface of science and advocacy.

It takes a village: Local students as a catalyst for sea turtle conservation

Julie G. Osborn, Scott B. Pankratz, and Sophia M. Bickford

Ecology Project International, P.O. Box 9192, Missoula, Montana 59807, USA

Successful sea turtle conservation projects must address human influences on sea turtles and their habitat by integrating local residents into the conservation solution. Involving local students in sea turtle monitoring and research can serve as a catalyst to gain community participation in sea turtle protection, educate those who have the most immediate connection to sea turtles, and empower individuals with tangible ways they can contribute to conservation. Effective community response requires the collaboration of educational institutions, NGOs, landowners, government agencies, and individual community members. At high-density nesting beaches in Costa Rica and the Galápagos Islands, the integration of local students in conservation research has positively impacted the quantity and quality of data collection and beach protection. Each nesting season, five hundred high school and university students participate as research assistants on established sea turtle monitoring projects. Local students collect biometric data, augment the frequency and duration of patrols, contribute to habitat restoration of the nesting beaches, and provide energy and inspiration to resident researchers. Project success depends on appropriate

preparation and training of the students, teachers and biologists prior to and during the site visit, and support from relevant research institutions, landowners, and government agencies. We will describe the techniques we used to create an effective collaboration between these parties as part of a conservation model that can be applied at other sea turtle nesting beaches worldwide.

Local people's perception of marine turtle conservation in the Amansuri Conservation Area in Ghana

Erasmus Owusu[1], Edwina Okoh[1], James Parker-MaCkeown[1], and Richard Adjei[2]

[1] Ghana WildLife Society (G W S)
[2] Center for African Wetlands

The classic approach to conservation in Africa is commonly referred to as the "fences-and-fines" approach and this has failed to work on the African continent. The approach centered on conservation policies and legal regimes, which excluded the interest of the rural Africans and served to heighten conflicts between conservationists and communities rather than ameliorate them. A new paradigm, which seeks to involve local communities from the onset of the conservation process, seems to enjoy greater support at local, national and international levels. The paradigm shift is occurring in ecological thinking with the realization that past management of animal populations and vegetation has been based on far too static a concept of ecosystems. In this paper, we examined the perceptions of local communities in the Amansuri Conservation Area toward the conservation of marine turtles, visiting the beaches in the area vis-à-vis their participation in the conservation process. A socio-economic survey using semi-structured questionnaires was carried out focusing on people's attitudes and practices that are likely to affect marine turtles. The main factors tested included locality, level of education of individuals, the intensity of education undertaken by the Ghana WildLife Society in the selected communities and gender of individuals interviewed. The results show that three main factors were likely to determine people's attitudes towards conservation of marine turtles in the area. These included locality, gender and level of education of individuals.

Can the tourism industry play a role in sea turtle conservation? The example of Crete, Greece

Aliki M. Panagopoulou

ARCHELON, The Sea Turtle Protection Society of Greece, Solomou 57, GR-104 32 ATHENS, Greece

Crete hosts three of the most important nesting sites for loggerhead sea turtles in Europe. It is also one of the top tourist destinations in the Mediterranean, with 2.6 million visitors annually. Most of the tourist activity is concentrated on the coast, exerting pressure on the sea turtle nesting habitats of the island.

ARCHELON has been running conservation projects on Crete since 1989 and has completed a management plan aiming to mitigate the impact of tourism on sea turtle nesting activity. To achieve this, ARCHELON has established cooperation with major stakeholders of the tourist industry (e.g. tour operators, hoteliers, and tourism promotion associations), who seek to minimize the impact on the local environment in order to ensure that it will continue to appeal to clients in the future.

In the last 6 years, this cooperation has produced encouraging results. More than 1.5 million tourists have received information about the sea turtles on Crete prior to or upon their arrival to the island through brochures, the Internet and other promotion material. Such cooperation also empowers ARCHELON to further lobby local authorities, encouraging them to comply with sea turtle protection measures suggested in the management plan. As a result of the above, there is increased support among the local community for sea turtle conservation, since they no longer perceive their existence as a threat to the local economy.
This presentation analyzes ARCHELON's strategy of approaching the tourism industry, the fields of cooperation and the major outcomes.

ANAI sea turtle conservation program: A important tool for the Equator winning prize of sustainable development 2002, UNEP. An eco-volunteer program generating income within a world heritage site

Wagner Quirós[1] and Didiher Chacón[2]

[1] ANAI Costa Rica
[2] ANAI-WIDECAST

By 1985, an analysis supporting the creation of the Gandoca-Manzanillo National Wildlife Refuge showed that almost 100% of the sea turtle eggs were being poached, both for local consumption and sale outside the community. As part of an initiative to address the sea turtle conservation problem, the association ANAI began an eco-volunteer program that promotes the participation of national and international volunteers as project assistants. Food, lodging, transportation and other services are purchased from local families and currently about 25% of the population gets benefits from the new eco-friendly activities. The families that previously poached the eggs and sacrificed the females today are offering services to the visitors, annually (2003) receiving more than US$92 000 in direct payments. The estimated black market price for 100% of eggs laid in the 2003 season is US$13,960, indicating that this conservation model is about 6 times more economically effective than the direct usage of the resource. The poaching rate has declined to 2% in the 2003 nesting season from almost 100% in 1986. Conservation (looking into economical alternatives) and science (investigation) in developing countries depend on each other to succeed, and this is an example of both working together for the benefit of important areas' natural resources, and the people living there, long before the place was declared protected.

Protection program of sea turtles of Mondonguillo

Stanley Rodriguez

Estación Las Tortugas, Matina, Limón, Costa Rica

The project Estacion Las Tortugas, located between Limon and Tortugero on the Carribean coast of Costa Rica, was created to protect the leatherback and green sea turtles. The primary objectives of the project are the protection of the turtles from poaching, education of local and foreign students, and research. Activities at the station include nightly patrols for turtle protection, data

collection and monitoring of nesting turtles and hatchlings, and environmental education. Research activities also include monitoring the dynamics of the local beach, Mondonguillo. A unique and major part of this project is its economic base. The project is entirely supported by funds provided by students taking part in the station's environmental education program. Students from the United States, England, Canada and Costa Rica work at the station doing beach patrols, beach cleanup and data collection, and organic agriculture.

The project has added three kilometers of protected beach for the leatherbacks and green sea turtles, with more than 200 nests recorded and over 3,600 hatchlings released by students. In addition, the economic benefits for the local community and project employees have been tremendous. This project clearly demonstrates that it is possible for ecotourism to provide the economic resources necessary to enable sustainable conservation. Local ownership accompanied by active community participation has become the model of sustainability for other projects and communities. A similar program, promoting the participation of the local community in conservation, was begun this past year in Parismina

Use of marine turtles and trade in the area of Cartagena's District of Culture and Tourism, Colombian Caribbean

Clara J. Rodríguez Zárate

jimezarate@hotmail.com, Universidad Jorge Tadeo Lozano, Bogota, Cundinamarca, Colombia, Fax: (57) (+1) 6301891

Our research was focused on the identification, description and relevance of the traffic of turtles and their products in the area of Cartagena (Colombian Caribbean). This investigation was made through direct observation and open interviews in the region between May and June of 2002. We also measured the curved carapace length and width in observed turtles. As a short review, we find that there is an extraction of juvenile hawksbill turtles and subadult green turtles, and their capture in this area is in most of the cases incidental. Products derivated (meat and hawksbill handcrafts) are often supported by the extraction of turtles in other areas like Guajira, located in the north of Colombia, and San Bernardo Islands, located a few miles south of Cartagena. The people in the region use the meat, intestine and eggs, preferring the meat of the green turtle and the hawksbill. The hawksbill's shell and its products have an amazing demand in the market in the cockfight industry, handcrafts markets, restaurants and international market (San Blas Coast in Panama).

As part of our investigation, we have learned about control activities against the people who trade hawksbill turtles. One of these is the Corporacion Regional del Canal Del Dique (CARDIQUE), who has confiscated hawksbill turtles from illegal possession and trade since 1997. Our project also includes suggestions to maximize control of the illegal market in those areas, and also the importance of information, communication and education of the population.

Extracting fisher knowledge: Understanding fisher participation in sea turtle conservation research

Jennifer J. Silver[1] and Lisa M. Campbell[2]

[1] Department of Geography, University of Western Ontario, London, Ontario, Canada
[2] Nicholas School of the Environment and Earth Sciences, Duke University, Beaufort, North Carolina, United States of America

This paper describes the motivations, experiences, and attitudes that fishers had towards participation in a socio-economic survey investigating the capture and use of sea turtles in the Turks and Caicos Islands, British West Indies. The survey was undertaken as part of the Turtles in the Caribbean Overseas Territories (TCOT) research project (funded by the Department for Environment, Food and Rural Affairs and the Foreign and Commonwealth Office Environment Fund for the Overseas Territories). Data presented and analyzed here are based upon participant observation during survey administration and during daily interactions with fishers outside of the TCOT context. Fieldwork was undertaken over a two month time period (May/June 2003).
The research and its results are important due to the prominence of calls for local participation in conservation research and projects. Such calls are arguably over-simplified, and understanding how fishers experience participation will lead to improved data collection and accuracy, increased contextualization of the data during analysis, and enhanced legitimacy in any projects or policy resulting from the socio-economic survey research.

Economic consequences of the green turtle fishing ban in Costa Rica

Sebastian Troëng[1], Carmen Castro[2], and Eduardo Chamorro[3]

[1] Caribbean Conservation Corporation, Apdo. Postal 246-2050, San Pedro, Costa Rica
[2] Departamento Ambiental, Servicio Nacional de Guardacostas, San José, Costa Rica
[3] Área de Conservación Tortuguero, Finca Los Diamantes, Guápiles, Costa Rica

In 1999, the Constitutional Court of Costa Rica ruled that the green turtle fishery was unconstitutional. Subsequent national legislation has reinforced the ban on hunting and the prohibition of trade in green turtle products in Costa Rica. We evaluated the economic consequences of the ban by quantifying consumptive use, non-consumptive use, option, bequeath and existence values for green turtles in Caribbean Costa Rica in 1998 and 2002. We identified and pooled key stakeholders into loosely defined groups to evaluate the economic consequences experienced by each group. We estimate the total value of green turtles in Caribbean Costa Rica in 2002 at US$9,500,000 and an energy contribution of 1,500 GJ to terrestrial ecosystems. Our analysis shows that the ban on hunting has increased the total value of green turtles, mainly by promoting continued growth of green turtle ecotourism. This is particularly apparent in Tortuguero National Park where tourism visitation to participate in nightly turtle tours continues to increase. However, in terms of economic income from legal activities, turtle fishers and traders have been negatively affected by the ban. A major challenge is to ensure that this group also benefits economically from non-consumptive ecotourism use. We believe detailed studies aimed at identifying income distribution within each stakeholder group would be highly beneficial. The results of such studies would be helpful to decision makers trying to define strategies to increase the proportion of economic benefits that reach key stakeholder groups.

Money talks: A global economic valuation of marine turtles

Sebastian Troëng[1] and Carlos Drews[2]

[1] Consultant to WWF, San José, Costa Rica
[2] WWF Central America, San José, Costa Rica

In a globalized world, few human societies exist outside the monetary economy. Motivations driving marine turtle use are likely to be influenced more by economic incentives than any other impetus. Human population growth, decline in natural resources and societies striving for greater wealth mean that economic considerations will become increasingly important to marine turtle use and conservation efforts. The objective of our study is to quantify the global economic value of marine turtles in monetary terms so that informed management decisions can be made with regards to marine turtle use and conservation. We estimate the global consumptive value from the gross income of sale of marine turtle products documented in seven case studies. Global non-consumptive use value is estimated from total tourism expenditure for 12 case studies where marine turtles are used as an ecotourism attraction. The option value is determined by comparing the economic outcomes of five case studies with different marine turtle management regimes. The global bequest value is determined by the total expenditure of marine turtle conservation organizations and international sea turtle conventions. Existence value is estimated from the cost of raising marine turtles in captivity. Results are discussed and we provide suggestions for strategies that could ensure economic benefits to human societies and restoration of depleted marine turtle populations, over the long term.

Zakynthos sea turtle odyssey – A political ball game

Lily Venizelos[1] and Keith Corbett[2]

[1] President, MEDASSET, 1 (c) Licavitou St., 106 72, Athens, Greece
[2] Scientific Advisor, MEDASSET, c/o 24 Park Towers, 2 Brick St., London W1J 7DD, UK

Nowhere are the socio-economic aspects of sea turtle conservation better illustrated than in the 25-year struggle to establish conservation and protection in the premier loggerhead rookery of the Mediterranean: Laganas Bay, on the Island of Zakynthos, Greece.

A timeline graphic will illustrate the significant events of the on-going, seemingly insoluble situation.

The stakeholders include the local population and administration, landowners and tourists, NGOs, the management of the national marine park, The Athens Agricultural University, the police and coastguards, the church, the government, the Greek Constitutional Court, international conventions, the European Commission, Ombudsman and Court of Justice, each operating within their own socio-economic and political priorities.

There exists a long saga of conflicting interests and policies, political ineptitude, personal insecurities, indifference and occasional violence. The impotence of international legal instruments such as the Bern Convention and the European Community (EC) Habitats Directive are amply illustrated.

Despite 20 years of EC and government-funded research on the beaches, inadequacies in scientific data obscure the conservation needs, hindering the implementation of legislative

measures and preventing value judgments of what needs to be done in order to allow a detailed, structured, long-term management plan for the conservation and protection of the area.
Loggerhead nesting in Zakynthos, Greece was recorded by Weber in 1894. The first time long-term conservation efforts were promulgated to the international public was 1983, before being brought to the attention of the Bern Convention in 1984 and to the EC in 1994.

Monitoring for management: Sea turtles in the Milne Bay Province, Papua New Guinea

Noel Wangunu

Conservation International - Marine Protected Areas, Alotau, Milne Bay Province, Papua New Guinea

Since turtle stocks are considered endangered on a global basis, there is a need to development monitoring programs and community-level education in the Milne Bay Province (MBP), possibly one of the last places in the Pacific still having adequate turtle populations. If the people of the MBP wish to maintain turtles for their descendants to harvest, they need to have the responsibility of collaborating in planned conservation and management activities, and be made aware of the impact of their actions. In this presentation, I will describe the recent efforts to develop a monitoring program for the management and sustainable use of sea turtle resources involving villagers in the Milne Bay Province, the results from the first survey conducted in January this year, future directions and recommendations.

SEA TURTLES IN COSTA RICA: MINI-SYMPOSIUM

Marine turtles of Costa Rica: Part 1

Randall Arauz

Programa Restauración Tortugas Marinas, PRETOMA, San Jose, Costa Rica

Prior to 1970, little was known about the sea turtles on the Pacific coast of Costa Rica, only that leatherbacks, olive ridleys and Pacific green turtles commonly nested and that coastal residents avidly utilized their eggs. In 1970, David Hughes and Joseph Richards discovered two olive ridley arribada nesting sites at Ostional and Nancite. The discovery was a major event, as until then no olive ridley arribada beaches were known. In 1971, David Hughes started Costa Rica's first ever sea turtle field work. In 1973, Douglas Robinson (Jan 9, 1936 – Jun 8, 1991) of the University of Costa Rica, initiated sea turtle research in Ostional and mentored many Costa Ricans in sea turtle biology. In 1980, Steve Cornelius initiated long term project on reproductive biology of sea turtles in Costa Rica, with emphasis on Nancite and Ostional. The 1st American Pacific Sea Turtle Symposium was held at the University of Costa Rica in 1985, organized by

Douglas Robinson and hosted by the University of Costa Rica. The pioneering work of Cornelius and Robinson provided the scientific information for the Ostional project, where sea turtle eggs are legally extracted and sold throughout Costa Rica. Mario Boza, María Teresa Koberg, and Peter Pritchard were instrumental in the initial protection of Playa Grande since 1988, and the eventual declaration of Las Baulas National Park, in 1991.

After years of working on coastal communities, local attitudes have changed. Currently, dozens of "community hatchery projects" have sprouted along the Pacific coast. Members of coastal communities have begun to organize to become sea turtle guides, proving once more that sea turtles can be worth much more to coastal communities if kept alive.

Unfortunately, in spite of this very positive change, sea turtles are still under grave threat in Costa Rica. Coastal development to supply the tourism industry threatens to permanently alter critical nesting habitats, especially when domestic legislation regulating these developments is openly violated and no sanctions are imposed, such as the recent destruction of nesting beaches in the Hermosa National Wildlife Refuge to build condominiums. Hundreds of dead sea turtles are reported constantly along the Pacific coast, most of which have direct evidence of interaction with fisheries. An estimated 15,000 sea turtles are caught by the industrial shrimp trawl fleet per year. Since 1996, the United States government imposes a ban on the importation of shrimp products from nations that fail to protect their sea turtles from dying in the shrimp trawl nets. The expected measure to be adopted to avoid the imposition of the embargo is the use of Turtle Excluder Devices during shrimp trawl operations. Collaborative efforts between conservationists and commercial fishermen resulted in a unique TED design for Costa Rica, kindly named the Tico TED. Unfortunately, Costa Rica has suffered two embargos, one in 1999 and one that was just lifted before the symposium, for failure to use TEDs. Demand for shark fin soup in Asia, fosters an unsustainable fishery where sharks are overfished until extirpation. During this overfishing process, species such as turtles are also fished to extinction. Costa Rica's longline fleet of 550 vessels deploys over 60,000,000 hooks/year, catching over 300,000 turtles per year. Much work is currently being carried out jointly with the fishery industry. Observer work is held on board longline vessels to evaluate the problem. Research is being held in fields such as the use of bait and gear modifications to mitigate the impact of longlining on sea turtles, and satellite telemetry to study post hooking mortality.

In spite of the positive conservation efforts by local fleets, the impact of the foreign flagged fleets is overwhelming. They pirate fish in the Exclusive Economic Zone of Costa Rica, and even when evidence is presented against them, the authorities do not act. This was the case of the Shen 1 Tsay 3 of Taiwan, caught on video pirate fishing in the EEZ of Costa Rica in May of 2002. In spite of complaints to Fishery and Coast Guard officials, no actions were held against his vessel. In fact, this vessel landed its products in Costa Rica only two weeks after the complaint was filed, in a private dock in Puntarenas. Every year, several hundred foreign flag vessels (Taiwan, Indonesia, Belize, Bolivia, Georgia, United States) land fishery products at illegal, uncontrolled, and unregulated PRIVATE docks in Puntarenas. Why does the government allow this to happen? The Costa Rican people are now calling for change. Over 3,000 Costa Ricans supported a call to stop the construction of an 80 condo development in Las Baulas National Park, in 2002. Over 30,000 Costa Rican citizens have signed on to a call to the President of Costa Rica to save endangered marine species from overfishing, and to halt the landing of international flag vessels at Costa Rican ports. Public support and pressure is needed to ensure national legislation and regulations are abided by, and that the public interest is respected.

Currently, Costa Rica is working with other countries of the region (Ecuador, Colombia and Panama) on a plan to develop the Eastern Tropical Pacific Seascape. Unfortunately the seascape is still a vague concept, and sea turtles need immediate action under a precautionary regime.

Species composition, catch rates, and destiny of sea turtles captured during two 6-month observation programs on board high seas mahi mahi (*Coryphaena hippurus*) longline vessels operating in the Exclusive Economic Zone of Costa Rica

Randall Arauz[1], Jorge Ballestero[2], Allan Bolaños[2], and Raúl Suárez[2]

[1] Sea Turtle Restoration Project, STRP
[2] Programa Restauración de Tortugas Marinas PRETOMA

Species composition and catch rates of sea turtles were recorded during two separate six-month observer programs on board Costa Rican high seas mahi mahi (*Coryphaena hippurus*) longline vessels, from August 1999 to January of 2000 and from January to July of 2003. Each program consisted of 6-month observations totaling 39,284 and 40,124 hooks, which caught 262 and 200 sea turtles, respectively. Sea turtles as a group represented 7.6% and 6.6% of the total catch per individuals of each observer program. Olive ridley sea turtles (*Lepidochelys olivacea*) were the second most common species captured, representing 7.28% and 6.04% of the total catch per individuals, and in both programs were second only to mahi mahi, the target species, which represented 72.4% and 78.6% of the total catch by individuals. Pacific green turtles (*Chelonia mydas agassizii*) represented only 0.35% and 0.42% of the total catch by individuals, or 4.8% and 9.2% of the total turtle catch. Observed sea turtle mortality was 0%. Most olive ridley sea turtles caught were hooked in the mouth as a result of directly biting the baited hooks. Possible mitigation measures are discussed.

Contributions of the Tortuguero green turtle nesting population

Karen A. Bjorndal

Archie Carr Center for Sea Turtle Research and Department of Zoology, University of Florida, Gainesville, Florida 32611 USA

The Tortuguero green turtle nesting population is the largest rookery in the Atlantic, by at least an order of magnitude. Following a long, drastic decline in the number of green turtles in the Caribbean, the number of green turtles nesting at Tortuguero is increasing. Tortuguero green turtles have important roles in marine ecosystems as major consumers of sea grasses. Throughout history and continuing to the present, Tortuguero green turtles have made important contributions to humans in several forms, providing food, employment, education, inspiration, and subjects for research. These contributions are reviewed, and the decline of green turtles in the Caribbean and restoration targets are discussed.

Marine turtles of Costa Rica: Part 2

Didiher Chacón

Programa de Conservación de las Tortugas Marinas del Caribe Sur, Talamanca, Costa Rica, Asociación ANAI / WIDECAST

-Invited Presentation- Abstract not available.

Trends in nest density, eggs viability and hatching success in Ostional Wildlife Refuge, Costa Rica

Gerardo Chaves[1], Rodrigo Morera[2], and Juan R. Avilés[2]

[1] Escuela de Biología-Universidad de Costa Rica, San Pedro de Montes de Oca, San José, Costa Rica
[2] Asociación de desarrollo integral de Ostional, Ostional, Guanacaste, Costa Rica

We show the trends in the nest density, nest estimation, viability, hatching success and production of hatchlings in Ostional National Wildlife Refuge from Costa Rica, one arribada nesting beach. The relationship between actual and potential nest estimation is close to 40%. The viability is close to 70%. The hatching success is close to 20%. Even though the arribadas are monthly, the hatchlings only hatch between July and February. However, during the la Niña phenomenon there are hatchlings year round.

An analysis of sand characteristics in relation to nest site selection and hatch success of leatherback turtles (*Dermochelys coriacea*) at Playa Grande, Costa Rica

Patricia Clune and Frank V. Paladino

Department of Biology, Indiana-Purdue University, Fort Wayne, Indiana, USA

The proper exchange of O_2, CO_2, heat, and water along with the natural morphology of the beach are important factors for the development of leatherback (*Dermochelys coriacea*) embryos. Therefore, the placement of nests by females that best optimizes these physical characteristics is crucial to the reproductive success of the individual and should play a role in nest site selection. Differences in the sand characteristics that control gas, heat and water exchange have not been rigorously investigated on many leatherback nesting beaches, including those at Playa Grande, Costa Rica. This season (2003-2004), we performed a thorough analysis of sand at nest depth, between 60 and 100cm, for the 37 one-hundred-meter sections along Playa Grande including the hatchery. This analysis included the physical, as well as oceanographic and morphological, characteristics such as currents, beach slope, and bathymetric data of Tamarindo Bay. The results from these analyses will provide a better understanding of the soil physics and morphology of Playa Grande and their effect on nest site selection and hatch success. These data will allow for effective preservation of the leatherback nesting habitat at Parque Nacional Las Baulas.

The lora turtle in Tecolutla, Veracruz

Fernando Manzano, Claudia Cinta, and Irma Galvàn

Vida Milenaria AC, Tecolutla, Veracruz, Mexico

-Invited Presentation- Abstract not available.

Managing arribadas: What is the objective?

Peter C. H. Pritchard

Chelonian Research Institute, Oviedo, Florida, USA

In general, marine turtle conservationists seek the simple goal of maximizing productivity, and thus future population size, of managed populations by developing and applying mitigation procedures for all identifiable stresses, both anthropogenic and natural. The process is intuitive rather than scientific in that the stresses are not isolated and mitigated one at a time, and so, if population recovery is ultimately achieved, it may not be clear which factors were crucial for this recovery and which were non-limiting.

Arribada managers typically apply the same overall philosophy of maximization of populations of the target species even though localized over-abundance of turtles on nesting beaches and concomitant reduced recruitment and productivity may already be evident. It is proposed that potential arribada managers first define their goals as objectively as possible, as this will then dictate appropriate strategies. Possible goals include 1) Recovery of a depleted population; 2) Stabilization of a non-depleted population against future changes, both natural and anthropogenic; 3) Re-creation of the long-term cyclical changes typical of a pre-management, pre-exploitation scenario; or 4) Maximum sustainable yield for human benefit.

While no rigorous experiments have been undertaken to determine the best methods of achieving desired outcomes or population responses, the management strategies that have been adopted for various arribadas in recent decades, combined with information on exploitation histories outside defined management strategies, have now been conducted for long enough for causal relationships between specific conservation/exploitation undertakings and subsequent population trends to be discerned.

Tidal movement of the water table and its effect on oxygen levels in leatherback turtle (*Dermochelys coriacea*) nests at Parque Nacional Las Baulas, Costa Rica

Paul Sotherland[1], Bryan Wallace[2], James Spotila[2], Cameron Ralph[3], and Tim Muir[1]

[1] Kalamazoo College, Kalamazoo, Michigan, USA
[2] Drexel University, Philadelphia, Pennsylvania, USA
[3] Monash University, Victoria, Australia

For the past three decades, vertical movement of the water table beneath sea turtle nests has been assumed to have little impact on the composition of respiratory gases surrounding eggs in those

nests. Measured levels of oxygen in hatchery nests of leatherback turtles (*Dermochelys coriacea*), at Parque Nacional Las Baulas, Costa Rica, are much higher than expected. We hypothesized that the two to three meter differences between high and low tides at Playa Grande cause significant vertical movement of the below-nest water table thereby inducing convective ventilation of the nests and elevating intranest oxygen levels. We measured movement of the water table, located two to three meters below the nests, near the beach hatchery at Playa Grande and found that the twice-daily cycle of water-table height is coincident with the cycle of tides and has an amplitude of about 15-20 cm, a distance that is close to the diameter of leatherback turtle nest chambers. We also measured oxygen partial pressure in nests containing bionic eggs, made with batteries that consume oxygen at a constant rate. These measurements showed us that oxygen levels in nests rise when the tide is falling, indicating that air is being pulled into nests from above when the water table drops. Thus, tides at Playa Grande, Costa Rica, ventilate nests of leatherback turtles. We infer from our observations that sea turtle nests will be ventilated wherever the amplitude of tides is sufficient to cause significant vertical excursions of the water table beneath nests. Our results call for more thorough investigation of physical properties of sea turtle nesting beaches and their impact on embryonic development.

Marine turtles of Costa Rica: Part 3

Sebastian Troëng

Caribbean Conservation Corporation, San Pedro, Costa Rica

Small country with lots of sea turtles

Costa Rica is a country of approximately 51,000 square kilometers, located on the Central American Isthmus – the narrow land bridge that join together the continents of South and North America. Costa Rica is bordered in the east by the Caribbean sea and in the west by the Pacific Ocean. In spite of its relatively small size, Costa Rica is home to many of the largest sea turtle rookeries in the world. Green turtles *Chelonia mydas* come to nest in large numbers on the wild shores of Tortuguero National Park. The Caribbean coast also hosts small numbers of nesting hawksbill turtles *Eretmochelys imbricata* and very occasionally a loggerhead *Caretta caretta* may also crawl up to nest.

Many of the beaches on the Pacific coast of Costa Rica receive visits by olive ridley turtles *Lepidochelys olivacea*. The most impressive events are the "arribadas" when tens or even hundreds of thousands of olive ridleys come ashore to lay eggs over a couple of days time. The largest arribadas take place on the beaches of Nancite and Ostional. The olive ridley population that nest at Ostional is one of the largest sea turtle rookeries in the world. Small numbers of hawksbill and black turtles also come to nest on the Pacific coast.

Leatherback turtles *Dermochelys coriacea* come ashore on both coasts. On the Pacific most of them nest at Playa Grande and on adjacent beaches between October and March. On the Caribbean coast, leatherbacks come up on virtually every beach between late February and July with the most dense nesting occurring at Gandoca, Pacuare and Tortuguero beaches.

Geological history of Costa Rica and Mesoamerica

Why is there such a difference in terms of sea turtle species on the different coasts of Costa Rica? To learn about the present we need to go back in time to the origins of the country's formation. Today, Central America is a thin strip of land that separates the Pacific Ocean from the Caribbean

Sea but this has not always been the case. 15 million years ago North and South America had not yet been tied together by the Central American Isthmus. A current of tropical warm water was flowing between the continents and future Costa Rica lay submerged under water. Then, due to the movements of the tectonic plates, some 12 million years ago the Central American volcanic arc collided with South America and the waters between the continents became more shallow.

First, the deep-water connection between the oceans was cut off. Plate tectonics contributed to the creation of islands between South America and the southern spit of North America that finally grew together to form a barrier between the oceans and a bridge between the continents. The Isthmus was fully formed about 3 million years ago. The creation of Central America had profound impacts on the fauna both on land and in the seas. Giant ground sloths, anteaters, armadillos, toxodonts (which were rhinoceros-like huge herbivores), and enormous predatory birds moved north from South America. Cats, deer and mice spread south from North America. For sea turtles, one of the most remarkable consequences of the closure between the oceans was the isolation of the ancestral populations of olive and Kemp's ridley turtles that ultimately gave us two ridley species.

Different conditions along the two coasts

Today, the climate in Central America is determined by the interactions of the trade winds with a large, low pressure air mass known as the Intertropical Convergence Zone. Roughly from May to December, the air mass sits over Costa Rica, interrupting the trade winds and causing considerable rainfall over the country. Fortunately, between December and May, the air mass lies south of Costa Rica and allow the trade winds to blow and keep the rain away. The climate also contributes to the differences between the ocean areas. Strong tradewinds seasonally sweep across the lower areas of Mesoamerica from the Caribbean to the Pacific ocean. As the wind blows over the Isthmus and down over the Pacific slopes, and in concert with the currents, the wind pushes surface water away from the coast. The surface water is replaced by colder water from down below that in turn is replaced by even deeper, nutrient rich water. The result is that the Pacific coast of Central America has important upwelling areas.

Currents, climate and plate tectonics have formed entirely different marine circumstances on the two coasts. On the Pacific side, which is the eastern edge of the Pacific Ocean, weather is variable and seasonal. On the Caribbean coast on the other hand, the climate is more stable during the entire year. In the Eastern Pacific there is upwelling but the Caribbean is low in nutrients. In the Eastern Pacific the water is cooler than the high salinity warm water of the Caribbean. The water is also deeper in the Eastern Pacific than the relatively shallow Caribbean coast of Central America. The oceanographic features of the Eastern Pacific result in pelagic primary production of plankton whereas the Caribbean Sea is dominated by benthic (or bottom) primary production such as sea grass. Consequently, animals higher up the foodchain in the Pacific include shrimp, pyrosomes and salps. On the Caribbean side, the shallow clear water instead stimulate the growth of coral reefs.

So now for the point of this geological and oceanographic retrospect – what species of sea turtle feed on shrimp, pyrosomes and salps? Olive ridleys of course. And what sea turtles prefer to eat sea grass and live at coral reefs if not the green and hawksbill turtles.
Leatherback turtles feed further away from the coast so nearshore habitats are probably of less importance and consequently we have leatherback turtles arriving to lay eggs on both coasts of Costa Rica.

Anthropogenic impacts on sea turtles

Humans have also had profound effects on sea turtles in Costa Rica. Indigenous people utilized sea turtles for thousands of years with unknown effects on the turtle populations. However, the

arrival of Europeans to the Caribbean certainly had a huge impact on sea turtles. Christopher Columbus landed on the Caribbean coast of Costa Rica, close to what today is the port city of Limón, on September 18, 1502 during his fourth voyage to the New World. Spaniards exploring the Pacific regions of this new land were given so much gold by the natives that by 1539 the territory between Panama and Nicaragua had become officially known as the "rich coast“ or Costa Rica. But the land was also rich in sea turtles.

One of the first references to sea turtles in Costa Rica is in the book Itinerario by Dutchman Jan Huygen van Linschoten, from 1596. van Linschoten compiled information from Spanish and Portuguese sailors and also included a map in his book. van Linschoten wrote about the area where Tortuguero lays today:
“After Nicaragua the coast is so raw and sharp, with dense woods and mountains which cannot be walked, where horses cannot go: and people pass them only with great trouble and labour, and it takes about 4 months to follow the coast, and on its beaches there are very large turtles, which like crocodiles lay their eggs in the sand, from which immediately come young because of the great heat from the sun. The flesh of these turtles, when it is fresh, is healthy and lovely to eat.”

Sea turtles were much appreciated by early European seafarers. One of the few ways of have fresh meat on the long journeys between Europe and the New World was to stock up on sea turtles that would survive for weeks on end, turned upside down underneath the deck of the boat. The abundance of sea turtles has been given as a reason why people moved up from Panama to establish places such as Puerto Viejo and Cahuita on the Caribbean coast of Costa Rica. Clearly, sea turtles were more common then and Swedish traveller Carl Bovallius noted during a visit to Cahuita in 1881:
“We passed around 20 hawksbill turtles turned on their backs…the turtles are the most valuable catch for people in Cahuita.”

For comparison purposes it may be interesting to know that Asociacion ANAI estimates that only 63 hawksbill nests were laid in Cahuita during the whole of last year.

In 1923, the US Consul in Limón, estimated the annual take of sea turtles to 750 green turtles and the same number of hawksbill turtles. Then, as now, most turtles caught along the Caribbean coast of Costa Rica were harpooned. Concessions were given for the right to collect sea turtles from the nesting beaches and monopolies for sea turtle trade were in place. In the national archives you can read about Maduro & Sons complaining that fishermen were selling hawksbill shell to Panama in disregard of Maduro & Sons’ monopoly right on the tortoiseshell trade. In documents from the 1920’s the roles are reversed and fishermen are complaining in writing about having to sell hawksbill shell to the Limon Trading Company that then held the concession on trade. It appears that the fishermen were heard. In 1927, President Ricardo Jímenez declared the sea turtle fishery free for anyone who had resided in Costa Rica for at least five years. Concessions were still given for collection of turtles and eggs on the nesting beaches. Hawksbill hunting has resulted in a considerable decrease in nesting as shown by Caribbean Conservation Corporation’s monitoring efforts in Tortuguero.

The beginning of research and conservation efforts

In the 1950’s, Dr Archie Carr took advantage of his time at Universidad de Costa Rica in San Jose to visit Tortuguero for the first time. His first travel to and investigations in Tortuguero are eloquently described in the book the Windward Road. Dr. Carr brought his family and students to participate in the work and also employed Tortuguero villagers to patrol the beach and collect sea turtle information. Dr Carr formed the Caribbean Conservation Corporation or CCC in 1959 and his work in Tortuguero is continued by CCC to this day. In the 1950’s, the take of sea turtles and eggs was controlled by the Municipalities of Limon in the Caribbean and Puntarenas in the

Pacific. Dr. Carr wrote of the veladores, meaning stayers-awake, that would patrol the beach at night to turn nesting turtles and sell them at local markets or for export.

Research at Tortuguero increased the interest and concern for sea turtles and in 1963 the first decree protecting sea turtles was passed. It stated that green turtles and their eggs could no longer be taken from the nesting beach or in waters 1 km or less from shore. In 1969, the export of calipee, the body fat from green turtles and the main ingredient in turtle soup was banned. Many important sea turtle nesting beaches are now National Parks or Wildlife Refuges. In the case of Tortuguero, the National Park was created by decree in 1970 but it was not until 1975 that the park was created by law and park rangers started regular patrols. Protected areas represented a new concept in Costa Rica and green turtle eggs were still extracted under dubious circumstances in the early 1970's to support a foreign sea turtle farm.

The green turtle fishery at sea was modified by decrees in 1983 and 1988. During the 1990's concerns grew that the green turtle catch was exceeding the annual quota of 1,800 green turtles and that the fishery masked a large illegal take. In 1998, conservation groups and concerned individuals filed a lawsuit in Costa Rica's constitutional court and as a result the green turtle fishery was outlawed in early 1999. The most recent legislative step was the approval of a comprehensive sea turtle law in 2002 that firmly places the responsibility of sea turtle issues with the Ministry of Environment and Energy. The only legal consumptive use is the regulated egg collection of olive ridley eggs at Ostional. The new law also makes it mandatory for the Ministry of Education to include sea turtle conservation in its environmental education curriculum.

Sea turtle tourism

Another important aspect of sea turtles and use in Costa Rica is the development of tourism to observe nesting turtles. Visitation to sea turtle nesting beaches such as Tortuguero has increased dramatically since the mid-1980's and Tortuguero now hosts over 26,000 turtle tourists each year. Tourism generates livelihoods through guiding and other services and has created economic incentives in favor of sea turtle conservation. Local tour guides can now be heard stating that a live turtle is worth more than a dead turtle as the income the turtle generates as a tourism attraction is much more than the potential income from its meat, eggs and shell.

Results of sea turtle conservation

Five decades of sea turtle research and conservation have had positive effects in Caribbean Costa Rica. The green turtle trend at Tortuguero, demonstrates the increase in nesting since 1971. CCC estimates that the Tortuguero green turtle rookery now averages over 100,000 nests per year, making it one of the largest green turtle rookeries in the world.

Nature conservation in Costa Rica

Alvaro Ugalde

Area de Conservación Osa, Ministerio del Ambiente y Energía, San José, Costa Rica

---

-Invited Presentation- Abstract not available.

Internesting behavior of leatherback turtles (*Dermochelys coriacea*) at Parque Nacional Marino Las Baulas, Costa Rica

Cassondra L. Williams[1], James R. Spotila[2], Bryan P. Wallace[2], and Frank V. Paladino[1]

[1] Department of Biology, Indiana-Purdue University, Fort Wayne
[2] Department of Bioscience and Biotechnology, Drexel University

Female leatherback sea turtles (*Dermochelys coriacea*) at Parque Nacional Marino Las Baulas, Costa Rica nest between six and ten times every seven to fourteen days, thus spending two to three months in the region. However, little is known about the movements and behavior of turtles during the nesting season. Last season, we attached 19 archival data loggers to record diving behavior of turtles during their internesting periods. During the 2003-2004 nesting season, we used satellite transmitters and data loggers to record locations as well as diving behavior of female leatherbacks during successive internesting periods in order to identify highly frequented areas and to describe marine habitat use by female leatherbacks.
This study will play an important role in the conservation of this endangered leatherback nesting population. Currently, only a limited 12-mile zone from the beach is included within the park. Characterizing the movement and locations of reproducing female leatherbacks could be used to support an expansion of the marine portion of the park to protect the marine habitat critical to nesting leatherbacks.

TECHNOLOGY AND SEA TURTLES

Three dimensional kinematic analysis of powerstroking by hatchling and pelagic stage loggerhead sea turtles (*Caretta caretta*)

L.E. Becking[1], R.W. Blob[2], and J. Wyneken[3]

[1] University of Amsterdam, The Netherlands
[2] Clemson University, Clemson SC. USA
[3] Florida Atlantic University, Boca Raton FL. USA

Understanding of the particular mechanisms of thrust production during the powerstroke of sea turtles was previously limited to 2-dimensional studies combined with force measures. In this study, a 3-dimensional forelimb kinematic analysis of powerstroking by hatchling and juvenile loggerhead sea turtles (*Caretta caretta*) was made together with direct measurements of the thrust generated. We addressed the questions: (i) When in the powerstroke is thrust produced and by what mechanisms? (ii) How does the stroke vary between juveniles under normal and stressed (fasted) conditions? and (iii) Do the different life-stages execute the powerstroke differently?
The stroke cycle was divided into five phases:
1. posteroventral downsweep, 2. posteroventral scoop, 3. posterodorsal sweep (recovery), 4. anterior sweep 5. dorsal medial arch.A peak forward force was recorded in both hatchlings and juveniles during phase 2 of the down stroke. From the qualitative observations and quantitative kinematic data, it was deduced that this was a drag-based thrust generation. The juveniles generated a second smaller force peak during phase 5 in the upstroke, caused by a lift-based thrust.

Fasted juveniles had powerstroke kinematic parameters that remained within the boundaries of the high natural variation of fed juveniles, showing that acute periods without food do not adversely affect swimming kinematics. The stroke of hatchlings as a whole was simpler, of shorter duration and more homogenous among individuals than that of juveniles. The differences between hatchlings and juveniles probably reflect contextual function as well as the physical differences in the neonate vs. juvenile morphology.

Recommendations to reduce loggerhead bycatch in longline fisheries in the Azores: Results from a 4-year study

Alan B. Bolten[1], Helen R. Martins[2], Marco Santos[2], Rogerio Ferreira[2], Eduardo Bettencourt[2], Vasco Silva Pires[2], Ana Giga[2], Andreia Cruz[2], Natacha Carvalho[2], Eduardo Isidro[2], Joao Goncalves[2], and Karen A. Bjorndal[1]

[1] Archie Carr Center for Sea Turtle Research and Department of Zoology, University of Florida, Gainesville, FL USA
[2] Department of Oceanography and Fisheries, University of the Azores, Portugal

---

The problem of sea turtle bycatch in longline fisheries has been recognized worldwide. The bycatch of loggerhead sea turtles in the swordfish and blue shark longline fisheries in the Azores has been well documented. The waters around the Azores are an important developmental habitat for the oceanic-juvenile stage of the Atlantic loggerhead population. Because the source rookeries for this oceanic population are primarily in the southeastern USA, the nesting population of loggerheads in the southeast USA is the primary population impacted by the longline fisheries in the Azores. Our experiment has been conducted over 4 fishing seasons from 2000 through 2003 and has evaluated 7 different hook types in a rigorous experimental design using a commercial longline fishing vessel. The primary objectives were to evaluate the effect of hook type on rates of sea turtle bycatch and location of hooking (e.g., mouth vs. esophagus). Circle hooks significantly decreased the rate of throat hooking in loggerhead turtles. This result has important implications for reduced sea turtle mortality. Hour of day of longline retrieval had a significant effect on the rate of loggerhead turtles caught. Therefore, retrieval of the longline earlier in the day would reduce the interaction with loggerhead turtles. Effect of hook type on target species was also evaluated. Gear modifications have excellent potential to reduce sea turtle mortality in longline fisheries and can be applied to longline fisheries around the world.

Can surface current influence the migration behavior of green turtle?

I-Jiunn Cheng and Ya-Ro Cai

[1] Institute of Marine Biology, National Taiwan Ocean University, Keelung, Taiwan, R.O.C.

Sea turtles are known to migrate hundreds to thousands of kilometers to their foraging and nesting sites. Evidence has suggested that there exists a relationship between the surface current and migration behavior of sea turtles. The hatchlings and adults may ride the current to their

nursery and foraging grounds. Sea turtles may also be carried by the strong currents for a short period of time. Some even use the current as the clue to their foraging grounds or to approach near-shore shallow waters. The combination of satellite telemetry and oceanographic observations, such as sea surface temperature profile, ship-board observation of the surface current, etc., in recent years allows us to determine the importance of surface currents to the migration of sea turtles.

The analyses of the speed and direction of 12 satellite-tagged post-nesting migration green turtles that nested on Wan-an Island and the surface current speed obtained from the shipboard observations showed that the strong current in the Taiwan Straits did influence the direction and speed of the post-nesting migration in the Taiwan Straits. However, the analyses of the post-nesting migration of six satellite-tagged turtles that nested on Taipin Tao, Nan-sha Archipelago and geostrophic current obtained from the model suggested that the turtles might use the weak surface current as a guide to reach the near-shore shallow waters from the open ocean. The study concluded that the relationship between the surface current and sea turtle migration may depend on the difference in the speed of these two components.

An integrated system for archiving, analyzing and mapping satellite telemetry data from sea turtles

Michael S. Coyne[1], Brendan J. Godley[2], Annette C. Broderick[2], Janice Blumenthal[3], Katherine L. Mansfield[4], Alan F. Rees[5], and Matthew H. Godfrey[6]

[1] SEATURTLE.ORG, Silver Spring, MD, USA
[2] Marine Turtle Research Group, University of Exeter, Exeter, UK
[3] Department of Environment, Cayman Islands and Marine Turtle Research Group, University of Exeter, Exeter, UK
[4] Virginia Institute of Marine Science, Gloucester Point, Virginia, USA
[5] ARCHELON, the Sea Turtle Protection Society of Greece
[6] NC Wildlife Resources Commission, Beaufort, NC, USA

The use of satellite telemetry in the study of sea turtles is becoming more prevalent each year. Unfortunately, the handling of data from these projects is not trivial. In most cases researchers must go through a number of steps to prepare their data for mapping or analysis. There are a number of useful tools available to help with tasks related to data retrieval, filtering, analysis and mapping, but no single tool integrates more than one or two of these tasks and, most importantly, none were designed specifically for handling sea turtle data. The satellite telemetry data manager (STDM), available on SEATURTLE.ORG, is a complete package designed specifically for handling sea turtle satellite telemetry data. The STDM system downloads data from the ARGOS system, archives it into a relational database, backs up the database daily, and provides integrated tools for filtering, analyzing, exporting, summarizing and mapping data. In addition, the STDM system provides a user-friendly interface for sharing sea turtle tracking projects with the public through the SEATURTLE.ORG web site. The public web site allows visitors to follow individual projects through daily e-mail updates and provide support to these projects through an adoption program.

OBIS-SEAMAP: Mapping the global distribution of sea turtles, marine mammals, and sea birds

L. Crowder[1], A. Read[1], P. Halpin[2], B. Best[2], S. Freeman[1], D. Hyrenbach[1], and C. Spoerri[2]

[1] Duke University Marine Lab, Beaufort, NC, USA
[2] Nicholas School of the Environment and Earth Sciences, Duke University, Durham, NC, USA

Recent technological advances, including the advent of remote sensing of ocean habitats, the design of instruments to monitor the movements and behavior of marine animals, and the development of visualization and analysis tools, are for the first time providing a coherent picture of the everyday lives of marine mammals, sea birds and sea turtles. These novel technologies allow researchers to monitor the movements of wide-ranging species like loggerhead and leatherback turtles and to characterize their oceanic habitats.
The Spatial Ecological Analysis of Megavertebrate Animal Populations (SEAMAP) initiative, a node of the Ocean Biogeographic Information System (OBIS), is populating a digital database of global marine mammal, seabird, and sea turtle distribution and abundance data(http://obis.env.duke.edu). This publicly available system, designed to facilitate the analysis of megavertebrate distributions in conjunction with environmental data, is intended for a broad audience of educators, students, resource managers, and researchers. Additionally, supporting web-based mapping tools, educational materials and explicit metadata have been designed to enhance the potential research and educational applications of this database.
OBIS-SEAMAP seeks to enhance the understanding and management of sea turtles by: 1) promoting research on their distribution and abundance; 2) facilitating the mitigation of anthropogenic impacts on protected species; and 3) supporting modeling efforts to assess distributional changes in response to environmental change. OBIS-SEAMAP provides managers with the ability to place the habits and habitats of sea turtles in an oceanographic context, which is essential to design effective conservation measures.

Loggerhead sea turtle diving behavior in relation to longline dynamics for the Madeiran Black scabbardfish fishery

Thomas Dellinger and Telma Ferreira

University of Madeira. Center of Macaronesian Studies. Campus da Penteada, 9000-390 Funchal, Portugal

Waters around Portuguese archipelagos are considered an important developmental habitat for North Atlantic juvenile pelagic stage sea turtles. This stage is subjected to incidental capture, recognized worldwide as one of the main human-related sources of mortality. Madeira Black scabbardfish fishery accidentally captures around 500 loggerhead turtles per year, most of which are hauled in dead. To reduce this mortality and protect the turtles it is important to understand the dynamics of the longline and turtle diving behavior.
Using time-depth-recorders (TDRs), we describe the time-depth profiles of the commercial longline catching cycle and present first data on juvenile loggerhead detailed time-depth diving profiles in the northeastern Atlantic. The time longlines remain within loggerhead diving range is compared with their depth distributions and encounter probabilities are calculated. Some impact reduction solutions are discussed.

Satellite telemetry combined with genetic analysis as tools for study of sea turtle ecology: New discoveries and future possibilities

Peter H. Dutton

NOAA-Fisheries Southwest Fisheries Science Center, La Jolla, California, USA

Technological advances in satellite telemetry and molecular genetics have enabled insights to be gained on the biology of sea turtles in the marine environment, such as migration, habitat use, population structure and demographics, that have been at best difficult to achieve using traditional approaches. I will examine what we have learned from integrating satellite telemetry with molecular genetics in studies of sea turtles in the Pacific, which goes beyond studies using just one method. I will present recent findings from studies of leatherbacks, green turtles and olive ridleys in the Pacific and discuss the significance to conservation and future research. Significant findings include discovery that leatherbacks foraging in North Pacific and west coast of the USA are of Indonesian nesting stock origin; migratory behavior of olive ridleys in the North Pacific differ depending on stock origin; discovery and confirmation that green turtles show fidelity to foraging grounds in southern California and originate from Islas Revillagigedos in Mexico; and filling in gap in knowledge of loggerhead life history in the southern Pacific.

Technology and the study of migratory marine vertebrates: 15 years of experience with marine turtles, birds, and mammals

James Harvey

Moss Landing Marine Laboratories, Moss Landing, California, USA

The study of movements, diving behavior, and population structure of marine vertebrates has improved greatly with advances in technology associated with telemetry, archival tags, and identification tags. The successful use of these devices is often predicated on three necessities: delivery, attachment, and data recovery. For marine turtles and birds, delivery is accomplished by capturing the animal, whereas for mammals it can be capture or remote delivery (projectile tags). Attachment has taken the form of adhering the tag to the exterior of the animal using various adhesives (e.g. epoxies, pressure adhesives, and tape), tags placed on harnesses or tethers, or inserting an anchor into the animal to hold the tag in place. Tags have been placed on marine mammals using adhesives (pinnipeds), harnesses or collars (pinnipeds, polar bears, and sirenians) and suction cups, anchors, and subdermal placement (cetaceans, sea otters). The recent advances in electronics have allowed better data recovery via UHF or VHF, and greater data storage on archival tags. Self actuated or VHF-controlled release mechanisms have been developed to release packages from the animal. The future involves better use of GPS receivers, data recovery and tag re-programming via mobile phone technology and other wireless connections, and of course smaller instruments.

Surfing for sea turtles – Search engines, listservs and websites

Dean Hey

CSC/DynCorp, Patuxent River NAWC-AD, Patuxent River, MD

This talk accompanied by slides will introduce several tools for conducting sea turtle research using the Internet. In this information age, it is necessary to use all available tools for the broadest research results. The talk will provide as much information as possible on these three research tools:
1. Search engines. What is a search engine? What are some of the better search engines? About a dozen prominent search engines will be mentioned. This section will end with a brief introduction to the GOOGLE search engine and some of its many features. Examples of Google searches on sea turtle topics will be demonstrated.
2. Listservs. What is a listserv? In this section, the CTURTLE list will be discussed as the quintessential sea turtle website. The section could also discuss weblogs or blogs.
3. Sea turtle websites. Some of the more useful and comprehensive websites will be explored including sites such as seaturtle.org, cccturtle, turtle trax, euroturtle and other interesting sites. A list of many of the nearly 1000 extant sea turtle websites including both homepage titles and URLs will be available for interested people.
The talk concludes with a comment encouraging further Internet research on sea turtles including the building of new sea turtle websites.

A new beak sensor reveals: Turtles cannot keep their big mouths shut

Sandra Hochscheid[1], Fulvio Maffucci[1], Flegra Bentivegna[1], and Rory P. Wilson[2]

[1] Stazione Zoologica “Anton Dohrn”, Naples, Italy
[2] Institut fuer Meereskunde, Kiel, Germany

This study was performed to evaluate the readings of a new beak sensor with respect to observed behavior of 6 captive loggerhead turtles. The beak sensor consisted of a Hall sensor, associated with a data-logger, which was glued posterior to the upper rhamphotheca (beak) of the turtles and a rare earth magnet, which was glued to the lower rhamphotheca opposite of and close to the Hall sensor. Thus the magnetic field at the Hall sensor was maximal and decreased with increasing distance between the rhamphotheci when a turtle opened its beak. The relationship between Hall sensor voltage and inter-rhamphothecal distance was determined using pieces of plastic pipes of known diameter to separate the rhamphotheci. We filmed the behavior of such equipped turtles being fed with anchovies, squid and living crabs. Based on the beak sensor data, recorded at 5 Hz intervals, it was possible to count the number of food items ingested, to determine the time it took from food uptake to swallowing and to distinguish between the types of food ingested. However, even when the turtles were not feeding the sensor detected regular jaw movements at a low amplitude of ca. 2.2 mm, which clearly differed from feeding movements and were related to buccal oscillations. In conclusion, the beak sensor presents a reliable method to investigate feeding behavior in sea turtles and could therefore potentially allow us to determine the time allocated to foraging in free-ranging sea turtles.

Key factors in the invention and diffusion of marine conservation technology: A case study of TEDs

Lekelia D. Jenkins

Duke University Marine Laboratory, Beaufort, North Carolina, USA

To solve problems such as bycatch, policy-makers resort to conservation technologies, such as turtle excluder devices (TEDs). Although substantial funding has been directed toward the invention and diffusion—the spread and adoption of an item by people—(I&D) of conservation technologies, little research has investigated the I&I process itself. As a case study, I examined the use of TEDs for the U.S. shrimp trawl fisheries. I identified key features for successful I&D by conducting on-site interviews with people involved in the process including National Marine Fisheries Service gear specialists, Sea Grant agents, and industry representatives. In addition, I analyzed records from management agencies using the grounded-theory approach, a method that allowed me to identify concepts that emerge from the text and to link these concepts to existing theories of invention and diffusion of innovations. The resulting data were used to (1) diagram the relationships among participants in the network and (2) construct a graphical depiction of how technology evolved, including encoded information about the I&D process. I conclude that: 1) social and political pressures compel speedy action at the determent of adequate goal setting and research planning; 2) people with both mechanical and shrimping expertise have invented the most widely adopted TEDs but directed-recruitment and integration of these individuals into the invention network is poor; and 3) industry-sensitive adoption efforts are the most successful and include the use of videos, translation for non-English speakers, and community-based Sea Grant agents but translation is inadequate and community-based agents are too few.

Experiments in the western Atlantic Northeast Distant waters to evaluate sea turtle mitigation measures in the pelagic longline fishery

John W. Watson[1], Sheryan P. Epperly[2], Arvind K. Shah[3], and Daniel G. Foster[1]

[1] NOAA Fisheries, Pascagoula, MS, USA
[2] NOAA Fisheries, Miami, FL, USA
[3] Merck Research Laboratories, Rahway, NJ, USA

NOAA Fisheries, in cooperation with the U.S. pelagic longline fishery, implemented a three-year research program in the western Atlantic Ocean to develop and evaluate sea turtle mitigation measures. Five potential mitigation techniques were evaluated during 687 research sets in 2001 and 2002. Data were collected to evaluate the effectiveness of the mitigation measures and to investigate variables that effect sea turtle interaction rates with pelagic longline gear. A significant reduction in loggerhead catch may be achieved by reducing daylight soak time. 18/0 circle hooks and mackerel bait were found to significantly reduce both loggerhead and leatherback sea turtle interactions when compared with industry standard J hooks and squid bait. Also, circle hooks significantly reduced the rate of hook ingestion by the loggerheads, reducing the post-hooking mortality associated with the interactions. The combination of 18/0 circle hooks and mackerel bait was found to be the most efficient mitigation measure for both loggerhead and leatherback turtles. Mackerel bait was found to be more efficient for swordfish than squid bait and circle hooks were more efficient for tuna than J hooks. Preliminary results from the 2003 experiment also will be discussed.

PART 2. POSTER PRESENTATIONS

GLOBAL AND REGIONAL SEA TURTLE CONSERVATION AND RESEARCH

The First Workshop on Biology and Conservation of Sea Turtles in the P. N. N Tayrona, Colombia

Sofía Álvarez[1], Héctor Barrios-Garrido[2], Carolina Rosada[3], and Aminta Jáuregui[4]

[1] Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV)
[2] La Universidad del Zulia, Facultad de Ciencias Veterinarias.
[3] Postgrado en Ecología Aplicada. Facultad de Ciencias. La Universidad del Zulia
[4] Universidad de Bogotá Jorge Tadeo Lozano

During the 19th, 20th and 21st of May 2003, the "The First Workshop on Biology and Conservation of Sea Turtles in the P. N. N Tayrona" was carried out in the installations of the Museum of the Sea of the University of Bogota Jorge Tadeo Lozano, Nucleus Rodadero (Santa Marta - Colombia). This was organized in cooperation amongst the Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV), The University of Bogota Jorge Tadeo Lozano (UJTL) and The University of Zulia (LUZ), and was comprised of 12 theoretical hours and a practical session of work in which 10 students of marine biology of the UJTL and 1 student of veterinary of LUZ participated. The presentations covered themes such as background information on sea turtles, feeding zones, sexing techniques, main technical pathologies in genetics and necropsy, and environmental education. Activities of this type are important to the efforts in sea turtle conservation carried out in Venezuela and Colombia.

Implications of population genetics of a Cuban sample of *Chelonia mydas* nesting colonies on the philogeography of the species

Julia Azanza Ricardo[1], Ariel Ruiz Urquiola[1], González Pumariega[2], Rogelio Díaz Fernández[1], María Elena Ibarra Martín[1], and Georgina Espinosa López[2]

[1] Marine Research Center. Havana University
[2] Faculty of Biology. Havana University

The genetic structure of two samples from nesting colonies of *Chelonia mydas* of the western part of the Cuban archipelago is analyzed, by means of the comparative study of partial sequences of the control region of mtDNA. The haplotype patterns found are compared with those reported for the species finding four polytypical lineages, two located in the Atlantic and the others in the Pacific, and three monotypical, exclusive of the Pacific. The lineages of the Atlantic are related naturally, while those of the Pacific are related artificially, to each other and with the first ones. In turn, the monotypical lineages are artificially related to the polytypicals of the same region, and one of the firsts, located in Japan, serves as connection among the polytypical. The Atlantic lineages are more diversified internally than those of the Pacific, however, the differentiation levels are similar. The lineage of the North Atlantic it is more diversified than the other of the South Atlantic. The present work intends a phylogeographic hypothesis based on a unique colonization event of the Atlantic to explain the current distribution of the species. This occurred in the region of present day Panama, before the formation of the Isthmus. Therefore, starting from

a common ancestor, the precursors of the Atlantic lineages were originated by means of a vicariant model associated to the biggest readiness of marine grasses in the Caribbean Sea and the coasts of Brazil.

Adhesion from Guatemala to Inter-American Convention for the Protection and Conservation of the Marine Turtles

Anabella E. Barrios

Consejo Nacional de Areas Protegidas (CONAP), Guatemala.

It is necessary to establish appropriate legislation in Guatemala referring to the conservation and preservation of marine turtles in Guatemala. A considerable number of organizations and individuals of government and nongovernmental organizations have performed the activities that have promoted the conservation of marine turtles since 1971. Although the subject is mentioned in several related laws, the protection of marine turtles and their habitat is not specifically covered in any piece of legislation.

Guatemala has fought to adopt the Inter-American Convention for the Protection and Conservation of Marine Turtles since 1996. Following a long history of sea turtle management and promotion, Guatemala was established as one of the 10 countries to be a member of the Inter-American Convention on the 11th of August 2003. This was made possible with the support of the National Advisory on Protected Areas, WIDECAST, and the Regional Network for the Conservation of Marine Turtles in Central America (RCA). The group currently works with involved organizations in order to formulate the annual working plan for development.

First hawksbill turtle (*Eretmochelys imbricata*) marked and released in the Gulf of Venezuela

Héctor Barrios-Garrido[1], Ma. Gabriela Montiel-Villalobos[2], Libicni Rivero[3], Sofía Álvarez[3], Yeni Barrios[4], José Castañeda[4], Gresly Castro[4], Alejandro Godoy[4], Luz Lisset[4], Leidy Morales[4], Mary Sol Nuñez[4], Paola Valero[4], and José Zambrano[4]

[1] Postgrado en Ecología Aplicada. Facultad de Ciencias. La Universidad del Zulia Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV)
[2] Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV)
[3] Facultad de Ciencias Veterinarias. La Universidad del Zulia.
[4] Facultad Experimental de Ciencias. Departamento de Biología. La Universidad del Zulia

The release of the first hawksbill turtle (*Eretmochelys imbricata*) is reported in the Gulf of Venezuela. During fieldwork carried out in the zone of Guajira Venezuelan on the 1st and 2 nd of November 2003, a juvenile hawksbill turtle (*Eretmochelys imbricata*) whose shell measurements were: 27.1 cm LMC and 24 cm AMC was found at the home of several fishermen. The animal had been captured the previous day and held in a container of seawater for 22 hours when it was discovered by investigators. Before its release, the turtle was marked with two (2) plates of Monell, one in the right flipper (P2218) and another in the left flipper (P2219), with the purpose of beginning to monitor the population of hawksbill turtles that feed in the Gulf of Venezuela.

Sea turtles recovered at the Wild Fauna Recovery Center in Gran Canaria (Canary Islands, Spain)

Pascual Calabuig[1], Ana Liria Loza[1], and Luis F. López-Jurado[2]

[1] Wild Fauna Recovery Center, Tafira Alta, Gran Canaria, Canary islands (Spain)
[2] Instituto Canario de Ciencias Marinas, Carretera Melenara s/n, Telde, 35200 Las Palmas, Canary islands (Spain)

Since the beginning of the 1990's, the Wild Fauna Recovery Center in Gran Canaria (Canary Islands, Spain) has received a large number of injured animals for recovery. Apart from birds and mammals, a considerable number of sea turtles representing different species are gathered each year. During the last five years (1999-2003), more than 100 turtles were sheltered annually; more than 80% successfully recovered and were released. The vast majority of turtles received at the center (roughly 98%) are loggerheads (*Caretta caretta*), almost all of them juvenile or subadult individuals. To a lesser extent, other species are also represented: adult leatherbacks (*Dermochelys coriacea*), juvenile green turtles (*Chelonia mydas*), and a few juvenile hawksbills (*Eretmochelys imbricata*). The main causes of turtle harm are fishing activities (e.g. entangled animals, ingested hooks) or direct wounding by humans. Other causes of damage are those related to marine pollution, such as ingestion of fuel, plastic debris, and so on. Finally, there are also natural causes, such as shark attacks, various diseases, anemia, flotation disorders, etc. The high number of sea turtles gathered at the Recovery Center clearly show the importance of this area (Canary Islands) for sea turtles in general, and especially for pelagic loggerheads migrating in the North Atlantic Ocean, which is a prime development habitat.

The First Meeting on Research and Conservation of Sea Turtles in the Southwestern Atlantic Ocean (ASO)

Alejandro Fallabrino[1], Andres Estrades[1], Milagros López-Mendilaharsu[1], Martin Laporta[1], Laura Prosdocimi[2], Gilberto Sales[3], and Carlos Drews[4]

[1] CID/Karumbé, Tortugas Marinas del Uruguay, J. Paullier 1198/1001, Montevideo, Uruguay, email: karumbe@adinet.com.uy
[2] Proyecto Peyú, Calle 52 y 118- Jardín Zoológico y Botánico de la Ciudad de la Plata. 1900 La Plata, Bs. As.- Argentina
[3] Projeto TAMAR-IBAMA, Cx Postal 2219, Rio Vermelho, Salvador, Bahia, Brazil, email: gilsales@tamar.org.br
[4] WWF Coordinación Regional de Tortugas Marinas, Apartado 629-2350, San José, Costa Rica email: cdrews@wwfca.org

The Southwestern Atlantic Ocean (ASO) is comprised of Argentina, Uruguay and Southern Brazil. This region includes developmental/foraging habitats and migratory corridors for five of the seven species of sea turtles: *Caretta caretta*, *Chelonia mydas*, *Dermochelys coriacea*, *Eretmochelys imbricata* and *Lepidochelys olivacea*. These are threatened due to human-related causes such as habitat modification and incidental and direct fisheries capture of juveniles and adults. The First Meeting on Research and Conservation of Sea Turtles in the Southwestern Atlantic Ocean (ASO) was held between 3 and 4 October 2003 in Montevideo, Uruguay. The meeting was attended by approximately 50 participants representing Argentina, Brazil and Uruguay, including representatives from the government, scientific sector, fishing communities and NGO's. The main objective of the meeting was to share scientific information about the biology, conservation and rehabilitation techniques of sea turtles, as well as to standardize working methods and scientific protocols between projects in order to improve management practices and strengthen collaboration among researchers within the region. In addition, Dr.

Carlos Drews facilitated the creation of a "Regional Action Plan for the Conservation of Sea Turtles in the ASO" and the formalization of a steering committee for its implementation to complement the actions already performed individually in the region. To promote the development of the Action Plan a representative for each country was designated along with the creation of a web page of the ASO. Also we decided to continue performing further meetings, and Buenos Aires, Argentina was elected for the next meeting in 2004.

Sea turtles off Madeira Island, Portugal: From commercially exploited objects to protected species - A general overview

Telma Ferreira[1], Thomas Dellinger[1], and Ana Madeira[2]

[1] University of Madeira. Center of Macronesian Studies. Campus da Penteada, 9000-390 Funchal, Portugal
[2] Direcção Regional do Ambiente. Direcção de Serviços de Conservação da Natureza. R. Dr. Pestana Júnior n.º 6, 3º D.º. 9064-506 Funchal, Portugal

On Madeira Island, sea turtle carapaces were sold to tourists and the meat considered appetizing and used in soup and stews. Just in 1985, regional specific regulation for their protection was published.

In 1997, the University of Madeira initiated a 'Life (EU) Project' dedicated to the conservation of loggerhead sea turtles. This was intended to be a first step toward understanding the biology of pelagic-stage sea turtles in the North Atlantic and, specifically, around Madeira. At the same time this was a way of raising public awareness among local populations, especially coastal fishing communities, of the dangers sea turtles face and the importance of Madeira as a developmental habitat within the North Atlantic Ocean. The project generated a first-data basis for management guidelines for pelagic stage sea turtles and pointed to possible areas to include in the European Natura 2000 network of protected areas. Follow-up projects focused more on research issues related to pelagic stage biology.Seven years after the conservation efforts were started, we report on results from an inquiry performed regionally to assess actual understanding and responsiveness towards the 'sea turtles problematic' – knowledge of their life history, threats and existence of directed research.The implementation of some of the 'Life Project' objectives and final recommendations are discussed with the intention of identifying constraints and future directions.

Program Kudu in western Africa: First assessment

Jacques Fretey[1], Manjula Tiwari[2], and Alexis Billes[3]

[1] UICN-France, FFSSN Muséum national d'Histoire naturelle, 57 rue Cuvier, Paris cedex 05, France 75231
[2] Archie Carr Center for Sea Turtle Research and Department of Zoology, University of Florida, Gainesville FL 32611, USA
[3] Bureau régional Kudu, Cellule de Coordination ECOFAC / BP 15115, Libreville, Gabon

In May 1999, CMS organized an international conference for the conservation of marine turtles of West Africa in Abidjan, Ivory Coast, with France, IUCN-France, and WWF. An agreement, known as the Memorandum of Abidjan, was proposed to the States in order to politically seal this decision of regional cooperation. In May 2002, at UNEP in Nairobi, the First Conference of the Memorandum of Abidjan took place. A regional conservation plan for marine turtles was elaborated. This conservation plan applies to all the countries ranging from the Straits of Gibraltar to the Cape of Good-Hope, including the islands of Macaronesia, Saint Helena, Ascension, and the Spanish territory of Ceuta. To date, 19 states have signed the memorandum, and several

others, including European countries, are preparing to do so. This vast program, initiated by the CMS, is superimposed on the southeastern Atlantic region of the IUCN-MTSG. We call it Program Kudu. Kudu is the vernacular name for marine turtles in several African languages. A regional office and a database were created in Gabon, with assistance from the French Co-operation and the European program ECOFAC. Universities or NGOs carry out numerous national projects. Conservation projects still remain to be organized in Mauritania and Angola. It is important that the Kudu Program and national projects are given continuity by long-term funding. If not, the regional action plan will only be a beautiful wish on paper.

What makes a turtle-friendly light "friendly"?

Kristine E. Halager, Mathew J. Denton, and Michael Salmon

Department of Biology, Florida Atlantic University, 777 Glades Road, Boca Raton, 33431, USA

Artificial lighting repels females from nesting beaches and disrupts hatchling orientation. The best solution is to prevent light from reaching the beach, but under some conditions that isn't possible. Is there a solution? One possibility is the use of filters that exclude light wavelengths attractive to hatchlings, but transmit wavelengths useful to humans. These lights are categorized as "turtle-friendly." Results indicate they are far less attractive to hatchlings than the same light, unfiltered.

In this study, we focus on how filtering modifies the attraction of hatchlings to lights. While it is known that excluding the "shorter" wavelengths is required, relationships between specific wavelengths and hatchling attraction have not been studied systematically.

We used a T-maze to present loggerhead hatchlings with choices between high-pressure sodium vapor (HPS) lights, filtered HPS lights, and an experimental fluorescent light (Twistee). Spectra for all light sources were defined before and after passage through a filter, and all were presented at a similar intensity. All lights were "yellow-orange" (peak energies at 600 nm, range: 550 – 650 nm) to the human eye, but the turtles were remarkably sensitive (i.e., attracted) to wavelengths below 550 nm, even if these were minor constituents of total luminaire output. These results suggest that artificial light sources become increasingly "friendly" as their wavelengths become longer and more restricted in range. Lighting companies are interested in developing luminaries with these properties. Doing so is feasible, and may soon result in lights that are superior to the current standard (filtered HPS lights).

Updates on the status of leatherback nesting population and management issues, Papua, Indonesia

Creusa Hitipeuw and Julianus Thebu

WWF Indonesia

Protection of nesting habitats of leatherback turtles in a 20 km stretch of Jamursba Medi located at the Birdshead Peninsula has been carried out by WWF-Indonesia (Species Program-Region Sahul) for almost a decade. The area was identified as having a large aggregation of nesting leatherbacks in the region that was heavily subjected by various threats including anthropogenic threats. The management activities, including the community-based beach patrols and control of feral predation has resulted in a significant reduction of human induced threats especially egg harvest and habitat disturbances. Despite the question of data accuracy, a general overview on the

annual number of nesting turtles collected by the patrol team reveals a decreasing trend. It is a fact that the area currently hosts the largest breeding population in the Pacific.
Despite local commitments to conserving leatherback turtles, a lack of formal protection status for the nesting habitat in Jamursba Medi makes it difficult to accomplish cooperation across sectors. Such cooperation is needed, for example, to handle the critical issue of log-pond establishment by a concessionaire on the notable nesting beach habitat. Therefore, legal protection measures for the beach should be pursued. Economic needs of communities living around the nesting beach require an innovative conservation approach that integrates livelihood options. Partnerships with community-development NGOs and donors to address the economic and poverty issues are therefore crucial.

Genetic stock composition of Atlantic loggerheads (*Caretta caretta*) in the Northeast Distant (NED) longline fishery using mitochondrial DNA analysis

Erin L. LaCasella[1], Peter H. Dutton[1], and Sheryan P. Epperly[2]

[1] NOAA-NMFS Southwest Fisheries Science Center, La Jolla, CA, USA
[2] NOAA-NMFS Southeast Fisheries Science Center, Miami, FL, USA

Little is known about the pelagic stage distribution of the Atlantic loggerhead turtle (*Caretta caretta*). Loggerheads are one of the most common species of sea turtle taken incidentally in various high seas fisheries every year, including the U.S. Northeast Distant (NED) longline fishery. Estimating stock composition of this turtle bycatch is an important contribution to better species and fisheries management. We used Markov Chain Monte Carlo (MCMC) methods to estimate stock composition from mtDNA haplotype mixes found in juvenile loggerheads caught incidentally in the NED fishery in the North Atlantic. We present results from analysis of 344 turtles sampled from this fishery between 2000-2003, and discuss the management implication for loggerheads in the North Atlantic.

Description of industrial fisheries that interact with sea turtles and overview of reported incidental captures in the southwestern Atlantic Ocean

Martín Laporta [1], Gilberto Sales[2], Alejandro Arias[3], José Luis Di Paola [4], Bruno Giffoni [5], Andrés Domingo[6], and Philip Miller [7]

[1] CID/Karumbé, Tortugas Marinas del Uruguay, J. Paullier 1198/1001, Montevideo, Uruguay, email: martinl2adinet.com.uy
[2] Projeto TAMAR-IBAMA, Cx Postal 2219, Rio Vermelho, Salvador, Bahia, Brazil, email: gilsales@tamar.org.br
[3] Fundación Vida Silvestre Argentina Córdoba 2920 4º BB7602CAD Mar del Plata, Argentina, email: arias@copetel.com.ar
[4] Proyecto Peyú, Tortugas Marinas de la República Argentina, La Plata, 1900, Provincia de Buenos Aires, Argentina, email: josedipaola@yahoo.com.ar
[5] Projeto TAMAR-IBAMA, Rua Antônio Athanazio nº 273, Itaguá, Ubatuba - São Paulo, Brazil. CEP: 11680-000. e-mail: bruno@tamar.org.br
[6] Dirección Nacional de Recursos Acuáticos (DINARA), Recursos Pelagicos, Constituyente 1497 CP11200, Montevideo, Uruguay, email: adomingo@dinara.gub.uy
[7] CID/Karumbé, Tortugas Marinas del Uruguay, J. Paullier 1198/1001, Montevideo, Uruguay, email: kanario@adinet.com.uy

Industrial fisheries are an important threat to the populations of sea turtles all over the world. For more than 30 years, research and conservation efforts have been directed towards nesting beaches, and little is known about the life cycle of sea turtles and the threats they face in the sea. Published data show that all over the world fisheries have an impact on sea turtles. Three nations – Brazil, Uruguay and Argentina - have coasts on the southwestern Atlantic Ocean (SAO), which also comprises international waters. Industrial fisheries are widely developed in this region. Starting at the state of Pará, Brazil, through Rocha and Montevideo, Uruguay, and ending in the province of Buenos Aires, Argentina, there are 15 ports of call for industrial fishing vessels. Only a few published papers have quantified the incidental capture of sea turtles by the industrial fisheries operating in this zone. The fact that the migration pattern of sea turtles involves a very extended area implies that an adequate conservation plan has to be designed at a regional scale. This work shows the distribution of the most studied industrial fisheries (trawl and longline) that interact with sea turtles in the SAO, their fishing grounds, and also gives an overview of the reported incidental captures in this zone using GIS. A preliminary assessment of the impact of industrial fisheries on sea turtle populations is presented, which may serve as a starting point for a regional action plan directed toward the conservation of these species.

The Brazilian national plan to reduce incidental capture of sea turtles in fisheries: An update

Maria Ângela Marcovaldi, Gilberto Sales, João C. A. Thomé, Augusto C. C. Dias da Silva, Berenice M. G. Gallo, Eduardo H.S.M. Lima, Eron P. Lima, and Claudio Bellini

Fundacao Pro-TAMAR, Caixa Postal 2219, Salvador/Bahia, Brazil 40223970

Sea turtle feeding areas where incidental capture is high have been the focus of TAMAR field activities since 1990 (Thomé et al. 2003). Conservation strategies, including instituting measures to mitigate capture, are continuously implemented in these areas. The National Action Plan to Reduce Incidental Capture of Sea Turtles in Fisheries was created in 2001 (Marcovaldi et al. 2002). The objective of the current project is to evaluate and update the plan in light of the following major results: 1) The term “fishery” was defined as “the unit upon which evaluation and management of interactions between sea turtles and fishing activities is based” in early 2002 (Sales et al. 2003). This has enabled: (i) estimation of turtle capture rates (CPUE) from monitoring activities in each fishery, including statistical estimates of error and precision; (ii) species identification of turtles captured per fishery; (iii) establishment of, or participation in, forums where stakeholders directly involved in priority fisheries can interact; 2) Systematic evaluation of incidental sea turtle capture in fisheries off the Brazilian Coast has been initiated (pelagic longline targeting swordfish and tuna and driftnet targeting sharks); 3) Awareness of sea turtle incidental capture has been increased in fishery planning and management and 4) On-board observers have been trained.

Due to the great extension of the Brazilian coast and financial limitations, priorities for next year are to: (i) Improve data collection; (ii) Participate in the Western South Atlantic Network, which includes Brazil, Argentina, and Uruguay; (iii) Implement mitigation measures and (iv) Increase the awareness campaign.

Achieving conservation of marine turtles through gear-based management

Sara M. Maxwell[1], Lance E. Morgan[1], Ratana Chuenpagdee[2], Chih-Fan Tsao[1], and Lekelia Jenkins[3]

[1] Marine Conservation Biology Institute, Redmond, WA, USA
[2] St. Francis Xavier University, Antigonish, NS, Canada
[3] Duke University Marine Laboratory, Beaufort, NC, USA

In the United States, conventional management of marine turtles and commercial fisheries uses a single-species approach. However, the 1996 Magnuson Stevens Fisheries Conservation and Management Act mandates the use of ecosystem-based management in commercial fisheries, which includes considering the impact of fishing on marine turtles. Incorporating the many impacts of fishing is a challenging task, but including marine turtles is necessary because habitats on which turtles depend can be destroyed by fishing and nearly one-third of all turtle mortalities result from fishing. A recent report titled '*Shifting Gears*' provides an analysis that can be applied to marine turtle conservation. The report ranked ten different fishing gears operated in U.S. waters, based on habitat impacts and bycatch. Turtles, together with seabirds, were one bycatch group explicitly considered in the study. A group of experts rated midwater gillnets and pelagic longlines as gear with the highest impact on marine turtles. Further, bottom gear such as bottom trawls and bottom gillnets also ranked high on the scale of ecological severity. Overall, the report suggests that damage to habitats, including those critical for marine turtles, and high turtle bycatch warrant stringent policies, such as 1) shifting to gear types with lower impacts on marine turtles; 2) utilizing conservation technology such as turtle excluder devices; (3) and initiating gear-based closed areas in response to turtle habitat usage. Conservation of marine turtles can be achieved through gear-based management, while fulfilling the goals of ecosystem-based management.

Incidental catch of loggerhead turtles (*Caretta caretta*) during scientific longline cruises in the central North Atlantic. Summers, 2001-2002

Abigail McCarthy[1], Scott Heppell[1], Selina Heppell[1], Molly Lutcavage[2], and Peter Dutton[3]

[1] Oregon State University Department of Fisheries and Wildlife, Corvallis, OR
[2] University of New Hampshire Department of Zoology, Durham, NH
[3] NOAA Fisheries Southwest Fisheries Science Center, La Jolla, CA

For many species of marine turtle, the characteristics that define pelagic habitat have yet to be fully identified. A better understanding of these habitat characteristics is critical to reduce high seas fisheries interactions with turtles, especially since the status of many turtle populations has placed them on the threatened or endangered species list.

To gain a more thorough understanding of pelagic loggerhead habitat, we analyzed sea surface temperature, sea surface height anomaly and chlorophyll values for sites where loggerhead turtles were caught during scientific longline cruises in the central North Atlantic. The cruises were conducted during the months of May, June, July and August of 2001 and 2002, in an area of the central North Atlantic that is rarely fished. Loggerheads caught were measured and weighed, and several animals were sampled for genetic analysis of stock origin. We expect to see a correlation between turtle catch and the presence of oceanographic features such as fronts due to high concentrations of potential prey items at those features. We also examined turtle catch relative to catch of other finfish species.

Historic decline of green and hawksbill turtle populations in the Caribbean

Loren McClenachan

Scripps Institution of Oceanography

The question of pristine abundances of sea turtles remains an unresolved problem that requires historical analysis. Populations of green and hawksbill turtles around the world exist today as shadows of their past abundances. The only way to understand the magnitude of the population decline is to reconstruct historic population sizes. Using 350 archaeological and historic sources in 24 regions within the Caribbean, I estimated historic abundances and geographic distribution of green and hawksbill turtles over the past 8,000 years. I located a minimum of 57 hawksbill turtle nesting sites and 62 green turtle nesting sites, 9 of which were comparable to the historic Grand Cayman nesting aggregation. Calculations based on geographic and historic abundance data leads to revised upward estimates of historic abundance of over 120 million green turtles and 5 million hawksbill turtles in the Caribbean. Using modern data on diet and consumption, I estimated the ecological impacts of the removal of green and hawksbill turtles. These abundances translate to an annual consumption of 10 billion kg DM of turtle grass (Thalassia testudinum) and 3.7 billion kg WM of sponges. Even if original abundances were only 10% of these estimated historic values, this research indicates that current populations of green and hawksbill turtles in the Caribbean are severely depleted.

The First Theoretical – Practical Course on Biology, Medicine and Conservation of Sea Turtles in the Gulf of Venezuela

Gabriela Montiel-Villalobos[1], Héctor Barrios-Garrido [2], Sofía Álvarez [3], Libicni Rivero[3], and Juan Aguilar[4]

[1] Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV)
[2] Postgrado en Ecología Aplicada. Facultad de Ciencias. La Universidad del Zulia. Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV)
[3] Facultad de Ciencias Veterinarias. La Universidad del Zulia
[4] Asociación Estudiantil Veterinaria por la Fauna Silvestre (ASOEVEFAS)

The “I Theoretical - Practical Course on Biology and Marine Conservation of Sea Turtles in the Gulf of Venezuela” was carried out in the audience of the Veterinary Faculty of Sciences of the University of Zulia between October 27th and November 2nd, 2003 under the auspices of the Grupo de Trabajo en Tortugas Marinas en el Golfo de Venezuela (GTTM-GV), the Asociación Estudiantil Veterinaria por la Fauna Silvestre (ASOEVEFAS) and the Division de Extension of the Veterinary Faculty of Sciences, with the assistance of 12 participants, students and professionals in the fields of biology and veterinary medicine. The objective of the course was to form and train an interdisciplinary group of personnel to work in the activities of investigation, protection and conservation of sea turtles in the Gulf of Venezuela. The course was comprised of 24 theoretical hours and 26 practical hours, including audiovisual presentations and in-laboratory sessions on the most important aspects of the biology of the sea turtle such as: life cycle, basic aspects of taxonomy, anatomy and physiology, main pathologies and first aid, method of necropsy, general aspects of the investigation on nesting beaches and feeding zones, main menaces to sea turtle survival, Venezuelan legislation affecting these species, and priorities of conservation for sea turtles in the Gulf of Venezuela. Likewise, the participants had a practical session in the field, visiting and applying the theoretical knowledge acquired.

Investigation and restoration of the nesting population of the hawksbill turtle (*Eretmochelys imbricata*) at Comarca Ngöbe-Buglé Chiriquí Beach, Escudo de Veraguas, and Bastimentos Island National Marine Park, Panamá

Cristina Ordoñez[1], Sebastian Tröeng[2], Argelis Ruiz[3], Earl Possardt[4], David Godfrey[5], Peter Meylan[6], and Anne Meylan[7]

[1] Correo General, Bocas del Toro, Bocas del Toro Province, Republic of Panama
[2] Caribbean Conservation Corporation, Apartado Postal 246-2050, San Pedro, Costa Rica
[3] Smithsonian Tropical Research Institute, P.O. Box 2072, Balboa, Panama, Republica de Panama
ruiza@tivoli.si.edu
[4] U.S. Fish & Wildlife Service, University of Georgia, Department of Biology, Carrollton, Georgia 30118, USA
[5] Caribbean Conservation Corporation, 4424 NW 13th St., Suite A-1, Gainesville, Florida
[6] Natural Sciences, Eckerd College, 4200 54th Ave. S., St. Petersburg, Florida 33711, USA
[7] Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, 100 8th Ave. SE, St. Petersburg, Florida 33701 USA

Several important nesting beaches for marine turtles exist in the Province of Bocas del Toro, Panamá. Archie Carr described one of these, Playa Chiriquí, in 1956 as the most important nesting beach for the hawksbill turtle in the Caribbean. During the mid-1900s, the nesting population was heavily exploited for tortoiseshell to supply international trade, and it experienced a huge decline. Encouraged by increased nesting levels at a few sites in the Caribbean where rigorous, long-term protection has been provided, we initiated this project to study and hopefully restore the remnant Chiriquí population. The project began in June 2003 in collaboration with the indigenous communities, Autoridad Nacional del Ambiente de Panamá (ANAM), and the traditional authorities of the Comarca Ngöbe-Buglé. Daily surveys were carried out from June through October, resulting in the documentation of 350 hawksbill nests on Playa Chiriquí, 19 on Escudo de Veraguas, and 100 on the Zapatilla Cays in the Bastimentos Island National Marine Park. Data were also collected on the regionally significant leatherback turtle (*Dermochelys coriacea*) population at Playa Chiriquí. Also, the first seminar for teachers on marine environmental education took place in August 2003 at Rio Caña. Restoration of this historically important population is highly dependent on the continued ban on international trade in hawksbill shell through CITES and on improved enforcement of laws banning domestic trade.

Reducing bycatch of loggerhead turtles in coastal fisheries of the Baja California Peninsula, Mexico

S. Hoyt Peckham[1], Wallace J. Nichols[2], Peter H. Dutton[3], Victor de la Toba[4], Edgar Caballero-Aspe[5], and Oscar Salazar-Oropeza[5]

[1] University of California at Santa Cruz, Santa Cruz, CA USA
[2] WiLDCOAST, Davenport, CA, USA
[3] NOAA - National Marine Fisheries Service, La Jolla, CA USA
[4] Grupo Tortuguero de las Californias, Puerto Lopez Mateos, BCS, Mexico
[5] Proyecto Caguama, La Paz, BCS, Mexico

There is great concern over the continued decline of Pacific loggerhead turtles. In the North Pacific, the waters around Baja California are important feeding and developmental areas for the North Pacific stock of loggerhead turtles, which nest almost exclusively in Japan. Bycatch in

various high seas and coastal fisheries of many countries are known to impact loggerhead turtles throughout their range, but the extent of mortality on the feeding grounds off Baja remains unknown. We present results of systematic surveys conducted from 2002-2003, which show that bycatch mortality of loggerhead turtles along the BCP is alarmingly high and is a significant impediment to recovery of this species in the Pacific. We discuss habitat use and foraging ecology based on our diet studies and satellite telemetry, and we show that we have integrated our findings with community-based conservation initiatives to raise awareness and develop methods to reduce bycatch in partnership with fisherman and their communities.

Foraging hot spots and migration corridors for loggerhead (*Caretta caretta*) and olive ridley (*Lepidochelys olivacea*) sea turtles in the oceanic North Pacific

Jeffrey J. Polovina[1], George H. Balazs[1], Evan A. Howell[1], Denise M. Parker[2], Michael P. Seki[1], and Peter H. Dutton[2]

[1] PIFSC, NOAA Fisheries, 2570 Dole St Honolulu, HI, USA
[2] SWFSC, NOAA Fisheries, 8604 La Jolla Shores Dr, La Jolla, CA, USA

Satellite telemetry from 26 loggerhead (*Caretta caretta*) and 10 olive ridley (*Lepidochelys olivacea*) sea turtles captured and released from pelagic longline fishing gear provided information on the turtles' position and movement in the central North Pacific. These data together with environmental data from satellite remote sensing are used to describe the oceanic habitat used by these turtles. The results indicate that loggerheads travel westward, move seasonally north and south primarily through the region 28°-40°N, and occupy sea surface temperatures (SST) of 15°-25°C. Their dive depth distribution indicated that they spend 40% of their time at the surface. Loggerheads are found in association with fronts, eddies, and geostrophic currents. Specifically, the Transition Zone Chlorophyll Front (TZCF) and the southern edge of the Kuroshio Extension Current (KEC) appear to be important forage and migration habitats for loggerheads.
In contrast, olive ridleys were found primarily south of loggerhead habitat in the region 8°-31°N latitude, occupying warmer water with SSTs of 23°-28°C. They have a deeper dive pattern than loggerheads, spending only 20% of their time at the surface and 60% shallower than 40m. However, the three olive ridleys identified from genetics to be of western Pacific origin spent some time associated with major ocean currents, specifically the southern edge of the KEC, the North Equatorial Current (NEC), and the Equatorial Counter Current (ECC). These habitats were not used by any olive ridleys of eastern Pacific origin suggesting that olive ridleys from different populations may occupy different oceanic habitats.

Marine turtle conservation program in the northwestern Mediterranean Sea

Sara Pont, Ferran Alegre, and Mari Luz Parga

Marine Animal Rescue Center, CRAM

The northwestern Mediterranean Sea is an important developmental habitat and migration route for juvenile and subadult loggerhead turtles. In this area, longline fishing efforts became very intensive during the summer season and annually a large number (15,000 – 20,000) of juvenile and subadult loggerhead turtles are accidentally caught.

Since 1995, CRAM has been running a marine turtle conservation program. The aim of the program is to reduce the mortality rates of *Caretta caretta* by fisheries, especially longline, working on all different aspects that are closely related to sea turtle populations in the northwestern Mediterranean Sea.

The program carries out different actions such as 1) an awareness campaign for fishermen to show them procedures to reduce sea turtle mortality rates; 2) annual rescue and rehabilitation campaign of injured loggerheads incidentally caught by longline fisheries; 3) research focused to achieve more knowledge on marine turtle population structure; 4) clinical management of the rescue centers and 5) an intensive awareness campaign aimed toward the general public, but specially pointed to coastal schools frequented by fishermen's children.

In this presentation, we present the results of this program, initiated in 1995, that led to fishermen and the local communities related with them being more sensitive to sea turtle conservation and, in last term, reduced loggerhead mortality induced by fisheries activity.

Creation of the Regional Program of Investigation and Conservation of Marine Turtles in Argentina (PRICTMA)

Laura Prosdocimi[1], Diego Albareda [2], Sergio Rodriguez Heredia [3], Adriana Giangiobe[4], and Victoria Masola[5]

[1] Proyecto Peyu -lprosdo@yahoo.com.ar
[2] Acuario de Buenos Aires / Funadción Aquamarina
[3] Fundación Mundo Marino
[4] Fundación Mar del Plata Aquarium
[5] Reserva de Uso Múltiple Bahía Blanca, Bahía Falsa, Bahía Verde

---

In 1990, different investigation groups began their activities along the coast of the Buenos Aires province, Argentina, monitoring stranding and netting of different marine turtle species. In addition, rehabilitation centers specializing in marine fauna began to study the medical aspects of the rehabilitation of these animals, providing the first pieces of information about the sanitary state of the turtles found on our coasts.

Despite individual efforts of each group, the advance in biological knowledge of marine turtles was slow, making it difficult to find and establish suitable conservation strategies.

In 2000, these groups began to interact and, in 2003, they completed the Regional Program of Investigation and Conservation of Marine Turtles in Argentina (PRICTMA). Two work meetings were held, where they discussed and worked out a diagnosis report to determine the present knowledge about the different species of marine turtles in Argentina, forming the basis for the creation of PRICTMA. The main aim of this program is to optimize and to strengthen the information obtained individually, forming a common pool of knowledge that allows us to make more significant advances in the investigation and conservation of marine turtles in Argentina. As well as being able to determinate the existence of feeding areas and establish the concordance with handmade fishing areas activities and commercial trawling on the Buenos Aires coast, it will contribute to the regional efforts for the conservation of marine turtles in the southwestern Atlantic Ocean.

Clinical evaluation of a hawksbill turtle (*Eretmochelys imbricata*) captured in the Gulf of Venezuela

Libicni Rivero[1], Sofía Álvarez[1], Gabriela Montiel-Villalobos[2], and Héctor Barrios-Garrido[3]

[1] Facultad de Ciencias Veterinarias. La Universidad del Zulia.
[2] Postgrado en Ecología Aplicada. Facultad de Ciencias. La Universidad del Zulia Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV)
[3] Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV)

A hawksbill turtle (*Eretmochelys imbricata*) was found in the locality of Casuzai located in the Guajira Venezuelan. The sea turtle was a juvenile with shell measurements of: LMC 27.1 cm and AMC 24 cm. Signs of stress due to human manipulation were observed, causing researchers to create an artificial pool in a shadowed area near the edge of the beach in order to minimize the stress caused to the animal. Following a period of observation, researchers proceeded to do a physical evaluation. The turtle showed lifting and laminar detachment of scales in the shell, sunken eyes, and ecto-parasites (balanus); in general representing poor physical condition, which impeded the taking of blood samples and prevented a final diagnosis. Due to the main pathologies in the sea turtle being associated with its captivity, and to the lack of a sea turtle rehabilitation center in the area, it was decided to free the animal after injecting him with a wide-spectrum antibiotic in order to avoid possible infections or additional ailments. The importance of reports of this type to the advancement of veterinary medicine in sea turtles lies in that an individual can represent the state of health of the population and its environment.

Stock composition of foraging leatherback populations in the North Atlantic based on analysis of multiple genetic markers

Suzanne E. Roden[1], Peter H. Dutton[1], and Sheryan P. Epperly[2]

[1] NOAA-NMFS Southwest Fisheries Science Center, La Jolla, CA, USA
[2] NOAA-NMFS Southeast Fisheries Science Center, Miami, FL, USA

Relatively little is known about the distribution and movements of foraging leatherbacks in the North Atlantic. However, significant numbers of leatherbacks are recorded foraging or stranding and as bycatch in various coastal and high seas fisheries. Previous genetic studies have used mtDNA to examine stock composition of foraging sea turtle populations, however, this marker has not been informative for resolving stock structure for leatherbacks in the Atlantic. We recently developed an array of microsatellites that we were able to use to detect population substructuring. With this nesting stock baseline data, we used Markov Chain Monte Carlo (MCMC) methods to estimate stock composition from mixes of mtDNA haplotypes combined with 12 micro satellite loci found in leatherbacks caught incidentally in the U.S. Northeast Distant (NED) longline fishery. We present results from analysis of 178 turtles sampled from this fishery between 2002-2003, which show stocks were represented in this region, and discuss the management implication for leatherbacks in the North Atlantic.

Implications on genetic structure of a Cuban sample of *Caretta caretta* nesting colonies on the philogeography of the species

Ariel Ruiz Urquiola[1], Julia Azanza Ricardo[1], Juan Solano Abadía[2], Rogelio Díaz Fernández[1], María Elena Ibarra Martín[1], and Georgina Espinosa López[2]

[1] Marine Research Center. Havana University
[2] Faculty of Biology. Havana University

The genetic structure of a sample from nesting colonies of *Caretta caretta* of the Cuban Archipelago is analyzed, by means of a comparative study of mtDNA control region's partial sequences. The haplotype patterns found are compared with those reported for the species finding three polytypical lineages, two located in the Atlantic and the other one in the Pacific. Atlantic lineages are related to each other through artificial phylogenetic relationships established from the lineage of the Pacific. The lineage of the American Atlantic (II-ASMO), located above 25°C latitude north and below 5°C south, is naturally related with the Pacific lineage. The Atlantic lineages, internally, are less differentiated and more diversified than the Pacific one. The lineage of the lowest latitudes in the North Atlantic (I-ANM) is more diversified than the other of the Atlantic, but equally differentiated. The present work intends a phylogeographic hypothesis based on two colonization events of the Atlantic to explain the current distribution of the species. The first one probably happened in the region occupied at present times by Panama, before the formation of the isthmus, during which the I-ANM ancestor was originated by means of a vicariant model. The second, more recent and after the last glaciation, probably happened through the Cape of Good Hope passing giving place to the lineage II-ANS by means of a dispersal model. In the colonies of Florida and Cuba, more recent colonization of the lineage of the South Atlantic are evidenced, accountable by means of a dispersal model.

The Eastern Tropical Pacific Seascape - Turtle conservation in the context of shared ecosystem management

George L. Shillinger[1] and Roberto R. Roca[2]

[1] Conservation International, Stanford University, Hopkins Marine Station, Stanford University, Oceanview Blvd., Pacific Grove, California, USA
[2] Conservation International, 1919 M. St. N.W., Ste. #600, Washington, D.C. 20037

This presentation will discuss the strategic vision and objectives of the Eastern Tropical Pacific Conservation Seascape (ETPS). The ETPS is a collaborative marine ecosystem management initiative involving the governments of Costa Rica, Panama, Colombia, and Ecuador. The four participating governments, Conservation International, UNESCO, and numerous other stakeholders, including over 50 leading conservation and research groups are uniting to develop a holistic, shared ecosystem management plan for this important marine region. The overarching vision of the ETPS is to establish an oceanic and coastal conservation and sustainable development corridor through the creation of a network of marine protected areas (MPAs) within the more than 211 million hectare area encompassed by the combined exclusive economic zones (EEZs) of Ecuador, Colombia, Panamá, and Costa Rica. Among other species, sea turtles will benefit from the successful development and implementation of this initiative through conservation interventions across their ranges, along migratory routes and within critical nesting and feeding areas. Recent Seascape funding secured through the Global Conservation Fund as part of the World Heritage Partnership (United Nations Foundation and Global Conservation Fund initiative) is already being applied towards the acquisition of critical leatherback nesting habitat at Playa Grande in Costa Rica's Parque Nacional Las Baulas.

Missile test fire endangers mass nesting of sea turtles at the Gahiramatha Beach of Orissa, India

Ashis Senapati

Orissa Turtle Trust, Khadianga, Kendrapara, Orissa, India Pin- 754211

India's missile development program has, as such, nothing to do with sea turtles. But, the test firing of missiles and the bright light from the defense establishment in Wheeler's Island in front of Gahiramatha Beach, the rookery of olive ridley turtles, has put a question mark on the future of the mass nesting of the olive ridleys. Gahiramatha missed the nesting turtles in three consecutive years in the recent past. Dr Abdul Kalam, then Advisor to Defense Ministry, now the President of India speaking in course of the Northern Indian Ocean Sea Turtle Workshop at Bhubenswer, Orissa in 1997 assured that the Central Defense authorities would take all necessary action to ensure that the turtles were safe. As of now, the Defense authorities have failed to keep up his assurance. Again, the state government of Orissa handed over Wheeler Island to the Defense Ministry in 1990 without obtaining a clearance from the Ministry of Environment and Forests. Last year, a coordination meeting was held with the defense personnel on the initiative of the forest officials regarding the light pollution and test firing during the turtle congregation period and allied matters. Nothing substantial has come of the meeting as of this writing.

Updating the migratory movements of the green turtle (*Chelonia mydas*) population from Aves Island Wildlife Refuge, Venezuela

Vincent Vera

Biological Diversity Direction, Ministry of Environment and Natural Resources, Caracas, Venezuela

This analysis is one of the results obtained from green turtle (*Chelonia mydas*) nesting population monitoring in Aves Island Wildlife Refuge. This monitoring has been performed for almost 30 years, with only short periods lacking information.

The purpose of this study is to complete and improve the knowledge of migratory movements; a comparison will be performed between the recent data and those obtained in previous investigations.

With respect to the scarcity of information about international recaptures, the study will attempt to discover the probable causes. Among the perspectives, it will propose advanced technologies to obtain a better overview of the migratory movements.

A field guide for sea turtle nesting surveys, southeast U.S. region

Lawrence D. Wood

Marinelife Center of Juno Beach

"A Field Guide for Sea Turtle Nesting Surveys" is a full-color instructional manual for use by sea turtle nesting beach managers and their trainees in the southeast U. S. region. Detailed instructions are presented for initiating nesting surveys, crawl identification, data management, nest protection, and survivorship assessment. Designed for use as a field reference, this manual is

written in accordance with guidelines developed by the Florida Fish and Wildlife Conservation Commission. Full-color photographs differentiate crawls by species and nesting vs. non-nesting emergences, with step-by-step instructions for evaluating loggerhead, green, and leatherback turtle crawls. Sections of particular interest include nest marking techniques, nest protection strategies, disorientation assessment, and data management. Copies of this publication are available through the Marinelife Center of Juno Beach, Florida.

POTPOURRI

Duration of pipping-hatching phase and emergence phase relative to hatchling weight and sex in green turtle, *Chelonia mydas* at Ras Al-Hadd, Oman

Abdulaziz Y. AlKindi, Ibrahim Y. Mahmoud, Taher B. Omar, Sultan S. Al-Siyabi, Saif N. Al-Bahry, and Charles S. Bakheit

Sultan Qaboos University, Muscat, Oman

Green turtle eggs were collected from Ras Al Hadd Reserve. The eggs were taken at random from 5 different nests and were incubated 16 hours after oviposition under constant temperatures in incubators set at 30-31 C (female producers) and at 26-27 C (male producers). The eggs were incubated according to the method of Morsovsky (1987). Pipping occurs when the eggshell has a slit and hatching is considered when the head and one flipper are outside the shell. Emergence occurs when the hatchling is completely free from shell. Durations of emergence and pipping-hatching phases in hours are: (54.80 ± 3.33) and (26.16 ± 1.21) for females, and (45.39 ± 2.17), (20.07 ± 1.04) for males, respectively. Hatchling weights in grams are: for females (28.22 ± 0.83), and for males (25.74 ± 0.58). In both sexes, there is no correlation between hatchling weight and duration of pipping-hatching phase or emergence phase. Periods of pipping-hatching and emergence are significantly longer in females than in males. In females, there is no correlation between the two phases; however, in males the two phases are significantly correlated. Field observations show that green turtle hatchlings remained in nest for at least 36 hours after emergence until the umbilical swelling is subsided before attempting their emergence escape.

Priorities for a conservation plan for the sea turtles in the Gulf of Venezuela

Héctor Barrios-Garrido[1] and Gabriela Montiel-Villalobos[2]

[1] Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV)
[2] Postgrado en Ecología Aplicada. Facultad de Ciencias. La Universidad del Zulia. Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV)

The five species of sea turtles that feed in the Gulf of Venezuela at present face similar threats; among the ones that are emphasized are the overexploitation and illegal commerce of their sub-products, fishing and accidental capture. Likewise, the absence of efficient regulation mechanisms adapted to the specific conditions of the zone constitutes another factor to consider

in regard to the conservation plan to be executed in the Gulf of Venezuela. In recent years, the conservation of these species has been guided by specific projects for each zone, considering social, economic, and cultural variables of each community. Building on these projects, the priorities of a sea turtle conservation plan in the Gulf of Venezuela include a program of management and protection of sea turtles and their habitats that has been adapted to the needs and beliefs of the native Wayuú, stressing the integration of common activities and environmental education for the communities, including translation from Spanish to Wayunaiky (indigenous language) and vice versa. The priority is the creation and economic implementation of alternatives adapted to the specific conditions of the region. Additionally, it is a priority to identify the "hot zones" of sea turtles in the region and, also, the migratory routes traveled by the turtles that feed in the Gulf of Venezuela.

Rapid assesment of highly erosional sea turtle nesting habitat: A tool for global conservation

Gale A. Bishop[1], Michael Knell[1], and Mark Dodd[2]

[1] Museum of Geology and Paleontology; SD School of Mines and Technology; Rapid City, S.D. USA
[2] Sea Turtle Coordinator, Georgia Department of Natural Resources, Brunswick, GA, USA

The quality of nesting habitat on St. Catherines Island, Georgia, has significantly declined since 1995 due to erosional effects thought to be driven by rising sea level, attenuation of long-shore migration of sand caused by dredging of the Savannah harbor, and lack of local fluvial sand systems. A quantitative assessment tool was established to score the habitat in terms of back beach geomorphology including presence of inlets, bluffs, and scarps; berms, terraces and dunes; wash-over and wash-in fans; and the presence of relict marsh mud or skeletal trees. Rapid habitat assessment is performed annually during the nesting season using point data based upon a beach grid or GPS data. The assessments indicate St. Catherines currently hosts approximately 15% adequate nesting habitat. The rapid assessment tool was modified by Georgia DNR and has been used since 1999 for temporal study of potentially deteriorating habitat and for longitudinal assessment of Georgia sea turtle habitat.
St. Catherines Island is a sentinel island for assessing health of sea turtle nesting habitat on the Atlantic Coast of the USA, predicting future history of successively more distant barrier islands in Georgia, and in Florida and the Carolinas: a model potentially transferable other areas of the world ocean and to other coastal rookeries. Management plans for conserving sea turtles must accommodate geological factors and processes that can rapidly modify nesting habitat on a world-wide basis as global warming continues to cause rising sea levels and as humans continue to modify sand movement in the coastal environment.

Management of a terrestrial ecosystem to protect the quality of a densely-nested loggerhead sea turtle beach in the Mediterranean

Giorgos Catsadorakis, Charikleia Minotou, Gail Schofield, and Theodota Nantsou

World Wide Fund for Nature – Greece, Athens, Greece

Sekania is currently the most densely nested beach for loggerhead sea turtles in the Mediterranean. Sekania holds over 50% of nests (approx. 700 nests on 650 meters of beach) made in Laganas Bay on the island of Zakynthos, Greece. Sekania is a pristine nesting beach that has not been subject to tourism development or agricultural use. Therefore, in 1994 WWF-Greece

purchased 32.7 hectares of land surrounding Sekania to manage the area and protect it against human-induced factors that may negatively impact the nesting beach. Despite this, the area has been subject to 4 events of arson across a period of 12 years, the most recent being in 2001. As a result, erosion from the surrounding area causes clay deposition and subsequent vegetation encroachment on the beach, threatening to degrade the sand quality essential for successful nesting and egg incubation.

This presentation discusses the integrated management plan compiled by World Wide Fund for Nature-Greece (WWF) for the nesting beach of Sekania and the surrounding land. The annual cost of implementing this management plan is approximately 55,000 Euros. Field actions include monitoring and controlling soil erosion, sediment movement, measuring beach profile, analysis of beach sand composition, and implementation of fire prevention measures. WWF-Greece management decisions are carefully researched in collaboration with a number of services, organizations and consultants experienced in erosion monitoring and prevention schemes. Furthermore, all WWF-Greece schemes at Sekania receive approval by the Forest Directorate of Zakynthos and the Management Body of the National Marine Park of Zakynthos prior to implementation.

Ceuta Beach: Soil, sand, and physical description as a referent for *Lepidochelys olivacea* nesting

Ingmar Sosa Cornejo[1], Marcos Bucio Pacheco[1], Fernando Enciso Saracho[2], Ramón Enrique Morán Angulo[2], Rogelio Sosa Pérez[3], Marco Antonio Barraza Ortega[2], Héctor Contreras Aguilar[2], and Vania Ruiz González[1]

[1] Escuela de Biología de la Universidad Autònoma de Sinaloa, Culiacan, Sinaloa, Mèxico
[2] Facultad de Ciencias del Mar de la Universidad Autónoma de Sinaloa, Mazatlán, Sinaloa, México
[3] Centro de Ciencias de Sinaloa, Culiacán, Sinaloa, México

It is known that there are biotic and abiotic factors that participate and are important in an organism's behavior (in sea turtles for *Lepidochelys olivacea* sp) of pushing the muzzle into the sand when the turtle is going up to the shore, just before deciding where they will lay. This could be because of some physical, chemical or environmental characteristics of the soil. In this way it is important to make a nesting beach characterization in order to know how these properties change (soil characteristics), because the shore's erosion may result in the lost of the desirable habitat for turtles, and, so, human interference with natural processes through coastal development and related activities has generated accelerated erosion rates in some localities and the interruption of natural migration on the coastline. The tracks and compaction left by vehicles on the beach block the ability of the hatchlings to reach the ocean; when incubation sites are directly transited, the sand gets compacted and causes a decrease in hatching success or death in an early developmental stage.

Because of that, the Sea Turtle Program of the UAS has been characterizing the nesting beaches´ soil. In our results (apparent density, porous space, wet retention capability, slope and sand compaction), it was observed that those soil characteristics in Ceuta Beach had a variance in terms of space and time, and it is viewed that the water retention and the slope seem to be important factors for nesting.

A review on sea turtle feeding ecology: New perspectives

Alvaro G. de Los Rios y Loshuertos and Oscar Ocaña Vicente

Septem Nostra, Ceuta, Spain

A review of the marine turtles feeding ecology is made in relation with the marine ecosystems as a whole, although with special emphasis on loggerhead (*Caretta caretta*) and leatherback turtles (*Dermochelys coriacea*). In addition, some feeding habits of green (*Chelonia mydas*) and hawksbill turtles (*Eretmochelys imbricata*) are discussed.We try to offer new and consistent perspectives about the feeding ecology studies, treating each species with its own particular circumstances as a potential feeder of certain resources surrounding it, and capable to search actively for them. As a matter of fact, a number of variables (biotic and abiotic) are taken into account in order to understand the trophic biology of these exceptional creatures.

A walk through diferent North African biomes: Autoecology of *Caretta caretta* and *Dermochelys coriacea* related with the benthic systems

Alvaro G. de Los Rios y Loshuertos and Oscar Ocaña Vicente

Septem Nostra, Ceuta, Spain

We analyze three different marine biomes of the North African region from Western Sahara coast to the Strait of Gibraltar with special emphasis on the benthic system and their communities as feeding grounds for loggerhead (*Caretta caretta*) and leatherback turtles (*Dermochelys coriacea*). The ecological relation of marine turtles is something well proved, and even the most pelagic species as *Dermochelys coriacea* keep a strong dependence from the benthos. The autoecology of both species is analyzed in a long-term concept making reference to the relationship of the turtle itself with other species, including man. Our aim is to extend the range of research, not focusing only on the turtles, but also in the rich ecosystems supporting them.

Assessment of loggerhead nest protection strategies in Georgia, USA, 2002-2003

Mark G. Dodd[1], Carolyn N. Belcher[2], Adam H. Mackinnon[1], and Erica A. LeMoine[1]

[1] Georgia Dept. of Nat. Resources, Brunswick, GA, USA
[2] University of Georgia, Marine Ext. Service, Brunswick, GA, USA

The Recovery Plan for the U.S. Population of Loggerhead Turtles (USFWS/NMFS 1991) lists six major actions necessary to achieve recovery including ensuring a hatching success of > 60% on all important nesting beaches. The Georgia Department of Natural Resources (GADNR) provides recommendations to beach managers to maximize loggerhead hatchling production in Georgia. Current recommendations include the placement of wire/plastic screening over all nests to protect from mammalian depredation (raccoons, feral hogs) and the relocation of nests deposited at low beach elevations to avoid tidal inundation. In order to test the effectiveness of our recommendations, we randomly applied 4 nest management treatments to loggerhead nests on Sapelo Island, Georgia, during the 2002 and 2003 nesting seasons. Management treatments included: 1) no management; 2) plastic screen, no relocation; 3) no screen, nest relocated to higher elevation; and 4) plastic screen, nest relocated to higher elevation. Nests were monitored

and depredation and inundation events were recorded. We obtained accurate elevations (+ .5 cm) for all nests using standard surveying techniques. Nest elevations were examined in the context of historic tidal amplitudes.
We found no differences in the hatching (ANCOVA, F=0.79, df=3, P=0.4994) or hatchling emergence success (ANCOVA, F=0.83, df=3, P=0.4820) between the 4 management treatments. Nest elevation was found to have a significant positive relationship with hatching and emergence success. Modifications to our current management recommendations are suggested based on our findings. Our results have implications for other loggerhead nest protection projects in the southeastern United States.

First partial ethogram of *Caretta caretta* in captivity in Argentina

Cintia G. Echenique and Marina Sebastián

Proyecto Peyu-Tortugas Marinas de Argentina, La Plata, Buenos Aires, Argentina

The loggerhead turtle is one of the three species of sea turtles cited for the Argentinean Sea. It is a solitary species and there is no information related to the biology and behavior of these taxa in our country. The main objective of this work is to carry out a partial ethogram of loggerhead turtles in an effort to increase the knowledge about this species and contribute to ex-situ conservation.
In this preliminary report, we give an introduction of patterns described up to the present based on one male specimen allowed at Municipal Aquarium of Mendoza, Argentina. Since 2002, a total of 16 patterns of behaviors have been described and organized into groups of 7 categories. In October 2003, we started an environmental enrichment routine with the aim of generating new behavior patterns suppressed by captivity.

Fungi and aflatoxins on eggshells and failed eggs of *Chelonia mydas*

Abdulkadir E. Elshafie

Sultan Qaboos University , Muscat, Oman

Eggshells and soil samples were collected from nests of *Chelonia mydas* from Ras Al-Hadd, Oman. Fungal colony forming units/g of the eggshells and soil were determined. Aflatoxins were extracted from samples of eggshells collected from nesting sites. The abilities of twenty strains of *Aspergillus flavus* isolated from eggshells to produce aflatoxins were assessed. A total of 650 eggs collected from Ras Al Hadd were incubated. Fungi were isolated from failed and successful eggs. The inner and outer layers of the eggshells were examined for fungal hyphae. Fungi isolated from eggshells and soil were *A. flavus, A. nidulans, A. fumigatus, A. terreus, Fusarium spp*. *Penicillium spp*. and *Rhizopus spp*. Aflatoxins were found in the eggshells at concentrations of 4.1-8.4 ppb. The 20 *A. flavus* strains studied were found to produce aflatoxins ranging between high and low. The percentage of failed eggs was 26 %. Fungi on failed eggs represented 29 % of failed eggs. These fungi include *A. flavus, A. niger fusarium, Gramphium puteridinus, Phoma, Tricladium,* and *Rhizopus spp*. Successful eggs had 0.19% fungal contamination. Fungal hyphae were found in the outer and inner layer of the shells of the failed eggs. The presence of the hyphae on the outer and inner layers of the eggshells deprives the developing embryo of gas

exchange and calcium. Aflatoxins and other mycotoxins might affect the normal development of the embryo and might contribute to turtle egg mortality.

Lunchtime for Vito: Esophagostomy as a feeding alternative in a 100 kg loggerhead

Kristin L. Erickson[1], Sandy Fournies[2], and Nancy Mettee, DVM[2]

[1] Virginia Institute of Marine Science & Marinelife Center of Juno Beach
[2] Marinelife Center of Juno Beach

Nutrition is a critical component in the rate of recovery and rehabilitation of sick or injured wildlife. Sea turtle patients requiring prolonged rehabilitation and parenteral nutrition are a management concern for any rehabilitation facility. Repeatedly inserting a feeding tube can cause irritation and potential esophageal damage. Orogastric feeding of sea turtles also requires the animal be out of water and in an almost vertical position for extended periods of time. When conducted multiple times per week, these procedures are potentially stressful and dangerous to both turtles and technicians. A 100 kg debilitated loggerhead sea turtle was presented to the MLC for rehabilitation for a neurologic condition. The animal was unable to open the mouth normally as would be required for traditional tube feeding. An alternative procedure, esophagostomy tube placement, was performed. While anesthetized, a plastic-coated wire mesh tube was placed into a surgically created opening in the left side of the turtle's neck, into the esophagus and down to the turtle's stomach. The tube was sutured in place and the animal returned to the water. This allowed the turtle to be fed daily instead of twice weekly and minimized stress for the turtle until it was able to maintain its own nutritional needs. The tube was left in place for 6 months without complications. Ultimately, this critical care procedure proved to be very successful, facilitating a rapid weight increase, weight maintenance, and release of the turtle. Esophagostomy is a viable procedure to insure proper nutrition in critically ill sea turtles.

A study of the effects of logging activities on the nesting beaches of the continental region of Equatorial Guinea

Rigoberto Esono and Crisantos Obama

Instituto Nacional de Desarrollo Forestal y Gestión de las Areas Protegidas - INDEFOR (CUREF), Apdo 207, Bata, Equatorial Guinea

The continental region of Equatorial Guinea (Central Africa) has a 150 km coastline, consisting primarily of sandy beaches. Sea turtles nest along most of the coast (mainly leatherbacks, olive ridleys and greens), but are more abundant at three sites: Rio Campo, Punta Llende and Playa Nendyi. Extensive logging activities have been underway in the interior of the country since the late 1980s. Two of the timber companies operate near the southern coast and use the Rio Muni as a means of transport for the timber. Log rafts are floated down the river, pulled by a tugboat, and then loaded onto timber boats. Another company uses a special wooden loading pier near the Rio Aye. A Cameroonian company loads onto transport boats directly from a floating platform at sea. During all these operations, logs occasionally escape and are swept to sea, representing an economic loss for the companies. Subsequently, most wash up onshore due to currents and tides, littering the beaches often at very high densities. Logs create a serious obstacle for nesting sea turtles and for emergent hatchlings, particularly in the areas of Punta Llende and Playa Nendyi. We present the results of a survey of the entire coastline of the continental region, including

Corisco Island. We determined the abundance, density, species, position and volume of all logs encountered on the beaches. Based on log position and volume, we evaluated the potential negative impact to the overall availability of suitable nesting habitat in the country.

Effect of diets with different levels of ulva meal and raw spirulina on feed utilization of hawksbill turtle (*Eretmochelys imbricata*) juveniles

Iliana Fraga[1], Madelín de Arazoza[2], José Galindo[1], Olga Valdés[3], and Mercedes Cano[3]

[1] Centro de Investigaciones. 5ta. Avenida y 246, Barlovento, Playa, Ciudad de la Habana, Cuba
[2] Centro de Investigaciones Marinas de la Universidad de la Habana. Calle 16 entre 3ra. Y 1ra., Miramar, Playa, Ciudad de La Habana, Cuba
[3] Instituto de oceanología de la Academia de Ciencias de Cuba. Loma y 37, Nuevo Vedado, Ciudad de La Habana, Cuba

Two feeding trials were conducted in laboratory conditions to assess the potential nutritive value of two algae, ulva meal and raw spirulina, in practical diets of the hawksbill turtle (*Eretmochelys imbricata*). For experiment I, juveniles with 105 ± 8.2 g of initial mean weight were fed a diet containing 0, 10 and 20 % of Ulva meal. For experiment II, juveniles with 208.2 ± 15.1 g of initial mean weight were fed a diet containing 0, 2 and 5 % of raw Spirulina. All diets were prepared to be isonitrogenous (45 % of protein) and isoenergetic (370 kcal/100 g). Each experiment had five replicates for each treatment. After 8 weeks of feeding, the hawksbill turtles fed a diet of Ulva meal and raw Spirulina showed improved physiological condition, including feed protein assimilation, growth performance and feed efficiency. Survival was greater than 80 % in all treatments.

Bioecological aspects of the nesting and feeding areas of the marine turtles in the central coastal region of Edo Miranda, Venezuela

Marco García

Universidad Central de Venezuela. Facultad de Ciencias. Escuela de Biología. Caracas. Venezuela

Five of the seven sea turtle species known can be found in Venezuela, *Eretmochelys imbricata*, *Chelonia mydas*, *Caretta caretta*, *Dermochelys coriacea*, and *Lepidochelys olivacea* (Pritchard and Trebbau, 1984). The main goal of this work was to find out the bioecological behavior of the sea turtles on Venezuela's central coastline. For this purpose, nesting beaches were patrolled and feeding habitats were determined and described.. A total of 59 nests and 9 scars were located. The most representative species was the leatherback, *D. coriacea*, followed by the hawksbill, *E. imbricata*, however there was no eidence of the green turtle, *C. mydas* nesting. The most active nesting beaches were El Banquito, Máspano and Playa Grande. The biodiversity and the abundance in these areas of marine algaes, sponges, invertebrates, and corals and the visibility, create a favorable envirnment for food and shelter. A total of 40 adult turtles were found in the study area; 38 E. imbricata and 2 C. mydas. The main problem in the study area was the nest vandalism in the nursery areas and incidental capture from fishing activity in the feeding areas.

Relocation rates of loggerhead nests in North Carolina

Matthew H. Godfrey and Wendy M. Cluse

NC Wildlife Resources Commission, North Carolina, USA

The relocation or translocation of sea turtle nests is a common tool employed by nesting beach conservation programs worldwide. Nest relocation is often used when clutches are threatened by tidal inundation, human encroachments (in the form of human foot traffic or nighttime lighting), or other threats (predation, beach development, etc.). In North Carolina, nesting beaches are monitored by a network of volunteer groups that are coordinated by the NC Wildlife Resources Commission. The decision to relocate nests is largely left to each volunteer group. Here, we present data on the rates of relocations on different beaches, from 1994 through 2002. The possible reasons and implications of the trends are discussed.

General results in the different components of the Integrated Conservation Program (PICD) for the recovery of sea turtle populations in Nueva Esparta State, developed by the GTTM-NE in Margarita Island, Venezuela, from 1999 until 2002

Angel J. Gómez B.[1] and Pedro D. Vernet P.[2]

[1] Grupo de Trabajo en Tortugas Marinas del Estado Nueva Esparta, Isla de Margarita, Venezuela.
[2] PROVITA, Wildlife Trust

Since 1999, the GTTM-NE has been developing a plan of action to come to understand the current status of marine turtles and their habitats. Strategies have been developed for the follow-up and the monitoring of events such as nesting, strandings/mortalities, hatchings and others, to identify the most sensitive areas and to focus the managing plans of education and sensitization on the efficient recovery of these populations. The results obtained in the areas of attention of the program are: 1) nesting beach monitoring; there have been observed 507 cases of which 483 (95.26 %) have been nesting cases, 24 cases (4.73 %) of dead turtles, 378 nests have been protected and nesting activity has been recorded on 36 beaches of Margarita Island. Net of Opportune Support (R.A.O): 87.17 % of the whole of events, or 442 of 507 recorded events, were attended by the R.A.O. in the period 1999 - 2002, which demonstrates the high efficiency of this strategy. Environmental education: 263 sessions, of which 83 (31.55 %) have been dictated in our hatchery area in Parguito Beach, 35 (13.30 %) in colleges, 18 (6.84 %) in fishing communities, 12 (4.56 %) were inter-institutional sessions and 115 (43.72 %) were held directly on the beaches. 4,860 people have attended these education sessions during this period. Twenty-two (22) specializing workshops and courses of training in diverse areas, at which 450 persons have been present, have also been held. Community integration: Approximately 252 men and women of the communities have taken part as volunteers in beach monitoring and working with R.A.O. during these 3 years.

Preliminary analysis of marine turtle protection and conservation for the seasons 2000-2004 at the turtle camps operated by Asupmatoma, A.C., in Baja California Sur, Mexico

Elizabeth Gonzalez

ASUPMATOMA, A.C. Los Cabos B.C.S. Mexico

In 1991, the "Asociación Sudcaliforniana de Protección del Medio Ambiente y la Tortuga Marina de los Cabos, A.C." (ASUPMATOMA) (Association to Protect the Environment and the Marine Turtle of Los Cabos) joined efforts with the Regional Center of Fishery Investigations (CRIP) to protect the marine turtles reported on the shores of the peninsula of Baja California Sur.

By 1998 two camps had been created, "El Suspiro" and "Rancho Punta San Cristobal," covering a total of 20 kilometers of beachfront protecting olive ridley turtle (*Lepidochelys olivacea*) nests and nesting females; with the hatchlings, a program of environmental education was implemented.

During the 2000-2001 season, a new camp was established at Agua Blanca beach, located at the Delegation of Todos Santos, Municipality of La Paz. This camp specializes only in protecting leatherback turtles (*Dermochelys coriacea*).

In this project, ASUPMATOMA analyses the most recent four seasons of the three camps it coordinates, obtaining positive results: during the 2000-2001 season, we had a hatching percentage of 72.66%; in 2002-2003, the percentage was of 77.67%, as opposed to the 2001-2002 season, when a natural phenomenon (Hurricane Juliet) occurred causing the loss of 50% of the protected nests of olive ridley turtles. With respect to the leatherback species, low temperatures did not allow for the development of in situ hatchlings, implementing a system of artificial incubation.

Hawksbill sea turtle foraging ground in Campeche, Mexico, preliminary results. NFWF Project #2002-0084-009

Vicente Guzmán Hernández[1] and F. Alberto Abreu Grobois[2]

[1] Dirección General de Vida Silvestre, Delegación Federal de SEMARNAT en Campeche, Av. López Mateos x Av. Héroes del 21 de Abril s/n, Col. Playa Norte. CD. del Carmen, Campeche, MÉXICO. C.P. 24150.

[2] Laboratorio de Genética ICMyL, Unidad Académica Mazatlán. Apdo. Post. 811, Mazatlán, Sinaloa, MÉXICO. 82000

Since 2001, four shore sites of the "Campeche Sound" in Mexico, located in front of the most important nesting beaches: Isla Aguada, Sabancuy, Chenkan and Punta Xen, were monitored in order to look for the main aggregation sites for juvenile hawksbill sea turtles (*Eretmochelys imbricata*). Three different methods of see/capture were tested and evaluated to be efficient:

1. Scuba dive on established transects
2. Capture using a siege of 4 inch fishing net
3. Hand-capture while snorkeling

Individuals obtained by fishermen as "incidental catch" during fishing activities in the area were collected in return for a symbolic reward. Every single individual was tagged and biometric data taken on LSCC, LMCC and weight. When possible, capture and recapture sites were registered by GPS. More than 200 individuals were captured during this period, some were recaptured between one and five times. Preliminary data were estimated in relative abundance through C-M-R by method and site. Increases of length and weight by size class intervals were obtained by M-

R. Some movements were registered at aggregations in which individuals were observed as residents and transients. The haplotypes by site were obtained through blood samples.

The evident destruction of olive ridley sea turtle eggs (*Lepidochelys olivacea*) by the beetle *Omorgus suberosus* (Fabricius, 1775) at Escobilla Beach, Oaxaca: A proposal of a biological control

Martha Harfush[1], Elpidio M. López Reyes[2], Haydee Cantillo Sánchez[1], Jazmín Ávila Barrientos[3], Gabriel Ruvalcaba[3], Ernesto Albavera[1], Rodolfo Figueroa Brito[4], Ma. Elena Valdez Estrada[4], Rafael Pérez Pacheco[5], and Laura Martínez[5]

[1] Centro Mexicano de la Tortuga. Dirección General de Vida Silvestre, Semarnat
[2] Centro Mexicano de la Tortuga. Dirección General de Vida Silvestre, Semarnat & Universidad Autónoma Benito Juárez de Oaxaca
[3] Universidad del Mar, Campus Puerto Ángel
[4] Centro de Investigación de Productos Bióticos. Instituto Politécnico Nacional. Yautepec, Morelos
[5] CIDIIR . Oaxaca. Instituto Politécnico Nacional

The olive ridley sea turtle (*Lepidochelys olivacea*) population is increasing, causing a sense of satisfaction for the people who are working to protect them. However, there remains a large problem that is necessary to evaluate, control and exterminate: the beetle *Omorgus suberosus* (Fabricius, 1775).

This arthropod eats the eggs, embryos and hatchlings, regardless of stage of the eggs or the beetles' phase. We did two studies; in both the nests were placed in plastic pots and incubated with sand, avoiding beetle contamination including larvae. A known quantity of beetles was introduced into each pot and there were three trials for each treatment. After the hatch period, the nests were reviewed to calculate the percentage of eggs destroyed by beetles. The destruction percentage was proportional to the number of beetles. In this poster, we show the results and how the study was done. With this problem, it is necessary to use a non-chemical alternative for control of the beetles. This avoids risks to human health, turtles, and to the environment, as they would be seriously affected by the use of chemicals. It has been demonstrated in the field of agriculture that the use of seeds of superior plants to combat insects represents an economic savings and does not undermine the environment.

Protection and conservation actions for marine turtles in Guatemala 1999-2002

Mario Roberto Jolon-Morales[1], Regina Sánchez-Castañeda[2], Patricia del Carmen España-Herrera[2], Héctor Antonio Andrade[2], Francis Carballo[2], and José Roberto Ruíz-Fumagalli[3]

[1] Unidad Nacional de Manejo de la Pesca y Acuicultura (UNIPESCA), Maga, Guatemala. mario_jolon@yahoo.com
[2] Consejo Nacional de Áreas Protegidas (CONAP), Guatemala
[3] Escuela de Biologia Universidad de San Carlos de Guatemala

This is a brief description of the last three nesting seasons of sea turtles in Guatemala. During this period 22 turtle hatcheries were active. However the number of active hatcheries was different each season and only 11 were active all three seasons. Eggs from five species were collected (*Lepidochelys olivacea*, *Dermochelys coriacea*, *Chelonia mydas*, *C. mydas agassizii*, *Eretmochelys imbricata*) with between 92 and 97% of collected eggs belonging to *L. olivacea.*

Being significant the decreasing number of eggs of *D. coriacea* in the last season. A total number of 188,699 eggs were planted and 159, 843 hatchlings were released, accounting for a 84.71% of success during the three seasons. The eggs collected reached a market value of $403,345.00 for collectors. The supervision and control program reported 11 incidents, confiscating 908 eggs. During March 2001- January 2003 UNIPESCA carried out 12 inspections offshore on the shrimp fleet, with 93 boats inspected for a total of 8% of the fleet inspected. In addition, 1109 inspections for DET were done on land. Parallel to those activities at a national level a lot of publications were distributed as well as international presentations.

Elaboration of the National Strategy of Management and Conservation of Marine Turtles (ENTM) for Guatemala.

Mario Roberto Jolon-Morales[1], Regina Sánchez-Castañeda[2], Claudio González-Lorenzana[2], Juan Carlos Villagrán-Colón[2], Juana Lorena-Boix[3], and Herman Dieseldorff-Monzón[2]

[1] PROBIOMA, Guatemala. mario_jolon@yahoo.com
[2] Consejo Nacional de Areas Protegidas (CONAP), Guatemala
[3] Facilitadora Ad honorem

A national strategy to manage and preserve sea turtles (ENTM) was created as a need for centralized action to coordinate the use, management, and conservation of sea turtles amoung the different institutions involved in this activity. As a result, a National Diagnostic, a Strategic Plan, an Action Plan and a Guide for Use and Management were created. Stakeholders participation was satisfactory (20 women and 54 men) representing eighteen institutions; government, non-government, universities, and local communities. The ENTM mission in Guatemala is clearly stated in seven principles, five main political guidelines with different strategies and specific actions for a total of 38. The actions should be carried out in a time period of 10 years under the supervision of designated personnel and collaborators with the established periodicity. The main role of this strategy is to organize and offer straight forward guidelines for the following years, as well as a tool for measures of success or failure. The approval of this document will provide funding for the conservation efforts on these threathened species.

Intestinal helminths of loggerhead sea turtle (*Caretta caretta*) from the eastern Adriatic Sea

Mladen Kucinic[1], Bojan Lazar[2,3], Dusan Zavodnik[4], and Nikola Tvrtkovic[2]

[1] Department of Zoology, Faculty of Sciences, University of Zagreb, Zagreb, Croatia
[2] Department of Zoology, Croatian Natural History Museum, Zagreb, Croatia
[3] Blue World Institute of Marine Research and Conservation, Veli Losinj, Croatia
[4] Center for Marine Research, Institute Rudjer Boskovic, Rovinj, Croatia

We inspected gastrointestinal tracts of 25 loggerhead sea turtles (mean CCL: 47.6 cm, SD: 15.9, range: 26.4 – 85.4) stranded dead in Croatia and Slovenia for the presence of helminths. Nine loggerheads (36%) were found infected. We recorded four trematode species and one nematode (*Sulcascaris sulcata*). *S. sulcata* was the most frequent and the most abundant species, present in all nine infected turtles, represented with 1 - 102 specimens per turtle. *Rhytidodes gelatinosus* was the most abundant trematode species, followed by *Calicodes anthos*. Although about one third of loggerheads examined were infected with intestinal helmints, they were not a contributory factor to stranding.

Comparative study of the epibionts on the pelagic and mature female loggerhead turtles on the Canary and Cape Verde Islands

Ana Liria Loza and Luis F. López-Jurado

Instituto Canario de Ciencias Marinas, Telde, 35200 Las Palmas, Canary Islands, Spain

Marine turtles commonly carry diverse forms of epizoa on their shells. The occurrence of a particular species may ultimately help to clarify certain questions about sea turtle natural life history. This paper gives a detailed and comparative list of epizoic species found on two populations of macaronesian loggerheads: pelagic and juveniles living around the Canary Islands and mature females nesting in Boavista Island, Cabo Verde. For the epizoic flora, the most important genera founded is *Polysiphonia* (Rhodophiceae); *P. carettia* for the pelagics and *Polysiphonia sp*. for the nesting animals. Another genera founded only in the pelagic turtles was the Phaeophyceae, *Hincksia mitchelliae*; one small and filamentous algae who was considered to be one of the primary colonizers. The most represented group of fauna is the Crustaceae: two species of Cirripedia (*Lepas anatifera* and *Conchoderma virgatum*) are very abundant in both populations. One species of Balaniadae (*Chelonibia testudinaria*), is not very important in the pelagic turtles but very representative in the nesting females. We found huge quantities of organisms of the order Amphipode (Caprelliadae, Gammaridae) in both populations, and a very important number of Isopodes, mainly in the nesting turtles. There are other Orders of epizoics in sea turtles like Hidroidea, represented mainly by *Obelia geniculata*, most important in nesting females of Cabo Verde than in pelagic and juvenile turtles. The order Tanaidacea is only found in the nesting females. A new record of nudibranchia, *Fiona pinnata* was found in the pelagic and juveniles loggerheads from the Canary Islands.

Gales Point Wildlife Sanctuary patrols hawksbill nesting beach in Belize

Lincoln McSweaney

Gales Point Wildlife Sanctuary

The Gales Point Wildlife Sanctuary Management Committee (GPWS) is a community-based organization that was founded in 2001 to inform, inspire and empower the community to speak and act on behalf of the endangered hawksbill and loggerhead turtles that nest on the beach at Gales Point. The beach at Manatee Bar was identified in the late 1980s as an important nesting beach for hawksbill sea turtles. Primary access is by boat from Gales Point Village to the bar mouth. About 6 miles of beach are patrolled by volunteers during peak nesting season, and one full-time employee patrols the beach during the entire nesting season. Preliminary analysis of data collected during beach patrols conducted from June 7 through Nov 10, 2003 have identified 72 nests in the survey area, the majority of nests being laid by the hawksbill turtle. Of the 72 known nests, 66 nests have emerged with a total 7579 eggs laid and 5355 live hatchlings being released, representing an average success rate of 70%. Some nests have been completely destroyed as a result of predation by raccoons, while other nests have had a 100% hatching success. Fire ants, land crabs and skunks are also observed scouring the area in search of food and contribute to a reduced success rate of the nests.

Sea turtle study in Iranian coasts of Oman Sea

Asghar Mobaraki

Department of Environment P.O. Box 5181-15875 Tehran-Iran

The Islamic Republic of Iran, with about 780 km coastline, has the longest contact with Oman sea. Unfortunately, there have not been any regular studies on sea turtles in this important body of water. Study of the area with the aims of finding any nesting sites and feeding habitats, as well as identification of species diversity has been proposed and started since April 2003. During the several regular visits to the area and the coastline, some important nesting beaches and feeding areas, species, related existing threats on sea turtles, and breeding season were determined. In addition, by preparing and implementing a simple survey, any needed information and knowledge from local people and fishermen was collected. Based on this study, nesting of green sea turtles was observed and recorded for the first time in Iran, in which one 160 kg nesting turtle with CCL of 103 cm was captured in September. Nesting season in the area starts in August. The eggs in the nest numbered 101, and had a mean weight of 57.06g (54-78.8) and a mean diameter of 48.5 mm (46.6-52.4).

Fishing activities (incidental catch in the fishing nets), egg harvesting, pollution, and habitat destruction are the main important threats to sea turtles in the area.Incidental catch in fishing nets is the main cause of mortality of juvenile green turtles (CCL=40 cm) in the feeding areas.

Relative abundance of nesting marine turtles on the coasts of Guatemala from July to December 2002

Nancy L. Montes-Osorio[1], Mario R. Jolon-Morales[2], Roberto Ruíz-Fumagali[1], and Regina Sanchéz-Castañeda[2]

[1] Universidad de San Carlos de Guatemala, Ciudad Guatemala
[2] PROBIOMA, Ciudad de Guatemala

From July to December 2002, 11 beaches were surveyed in Guatemala, 9 on the Pacific coast and 2 on the Caribbean coast. A total of 14,284 km were walked during 1,123 surveys. We reported direct sightings and signs of *Lepidochelys olivacea* (99.94%) and *Dermochelys coriacea* on the Pacific coast, and *Eretmochelys imbricata* (66%) and *Chelonia mydas* (3.5%) on the Caribbean. 30.5% of the tracks reported were unidentifiable on the Caribbean coast. Significant differences ($p < 0.05$) were found in the temporal and spatial distributions of the relative abundance of marine sea turtles that nest in Guatemala. The most important months for nesting of *L. olivacea* were August and September. The only report for *D. coriacea* occurred in December. The months that *E. imbricata* presented the most nesting activity were July and August. The only observation of *C. mydas* occurred at the beginning of August. September was the month with the most detection of unidentified signs. Physical examination of turtles revealed external parasites (63%), blows or blunt-force trauma (26%, N = 156) and mutilations (10%, N = 156), which could considerably affect the populations of marine sea turtles. The main causes of death in the carcasses found were extraction of eggs (opening the abdomen) (39%, N=31), blows or blunt-force trauma (26%, N=31), mutilations (19%, N=31) and injuries from fishing nets (13%). These data are an indicator of the high impacts that commercial and local fishing (shrimp, shark and others) have on the sea turtles of the area.

Olive ridley crawl counts on the Pacific coast of Guatemala: Towards an estimate of population trends and economic value

Colum Muccio[1], Scott Handy[2], and Francesca Barker[2]

[1] ARCAS, 4 Ave 2-47 Sector B5 Zona 8 San Cristobal Guatemala
[2] ARCAS

ARCAS is a Guatemalan NGO managing the proposed Hawaii Protected Area under an integrated coastal zone management effort on the Pacific coast of Guatemala. As part of its sea turtle conservation activities in the area, it has for the last 5 years been conducting crawl counts of the olive ridleys nesting on the 16km of coastline that it covers in an attempt to determine how many turtles per year are nesting in the area. Using this crawl count data, as well as similar historic data, ARCAS hopes to: 1) begin to determine population trends among olive ridleys on the Pacific coast of Guatemala; 2) determine the economic value of the trade in sea turtle eggs in Guatemala, and; 3) determine what percentage of eggs being laid on area beaches are being donated to local hatcheries and what percentage are being consumed.

Impacts of flipper tagging on sea turtle fitness and survival: How much do we really know?

April D. Norem and Raymond R. Carthy

Florida Cooperative Fish & Wildlife Research Unit, University of Florida, Gainesville, Florida, USA

Among the gaps that remain in our knowledge of sea turtle life histories is a grasp of the full impacts that humans, in particular researchers, may be having on the overall fitness and long-term survival of sea turtle populations. As sea turtle researchers, we tend to focus on the more obvious tolls that humans are having (e.g., incidental take by the commercial fishing industry, direct take, and continuing beach development problems), but is it possible that our own practices (i.e., research techniques) are actually negatively affecting sea turtle survival?

This poster discusses the possible impacts that flipper tags may be having on the overall fitness and survival of sea turtles. Attention is drawn to such questions as: 1) What are the health and growth implications of tag rip-outs, especially since within the last decade there has been a marked increase in research on juvenile sea turtle populations within developmental habitats (personal observation), and 2) Could the shiny metallic “glint” given off by Inconel tags actually being attracting predators, thereby increasing injury rates and reducing fitness and overall survival? Such questions may seem highly theoretical, but our job as researchers is to understand all factors influencing the survival of sea turtle species worldwide. This includes understanding the impacts that we might have on the very species that we have dedicated our hearts and careers to conserve.

Evaluation of olive ridley sea turtle (*Lepidochelys olivacea*) size with fecundity and hatch success percentage from their eggs transferred to a protection corral on Escobilla Beach, Oaxaca

Yesenia Oropeza Mendez[1], Elpidio M. López Reyes[2], Ernesto Albavera Padilla[2], and Martha Harfush[2]

[1] Universidad Autónoma Metropolitana-Xochimilco. Departamento del Hombre y su Ambiente
[2] Centro Mexicano de la Tortuga. Dirección General de Vida Silvestre, Semarnat

In the olive ridley sea turtle, the most common size range of nesting females is from 60 to 70 cm long. Few studies have taken note of females outside of this range. The present study seeks to compare the incubation results among individuals with sizes smaller than 60 cm and bigger than 70. In this study, we compare the number of eggs, hatch success and incubation results in the three different phases of embryonic development that are managed for this species, unhatched apparent success and other embryonic development.

This comparison was carried out by incubating 50 olive ridley nests of large-size females and 50 of small-size femalesafter transferring them to a protected place. Nests hatch between the 44th and 59th day of incubation. There were a total of 4,771 eggs from small-size females (95.4 eggs for nest average), which produced a total of 3,706 fry, which calculates to a 74% hatching success. The large-size females hatching success was smaller: 66% out of a total of 5,234 eggs for an average of 104.7. In the large-size, a total of 924 eggs were obtained with an embryonic mortality of 18%, with 15% occurring in the last phase of development (phase III). In females smaller than 60 cm, the percentage is 9%. The largest percentage of eggs without apparent embryonic development was presented in females of large-size with a total of 762 (15%), compared to 5% of the eggs from smaller females.

Ten years of the study and control of the beetle *Omorgus suberosus* (Fabricio, 1775) that destroys the eggs of the olive ridley turtle (*Lepidochelys olivacea*) during incubation at La Escobilla Beach, Oaxaca

Elpidio Marcelino López Reyes

Universidad Autónoma Benito Juárez de Oaxaca

This summary presents the work carried out during 10 years, from August 1993 to December 2003, at "La Escobilla" beach, Oaxaca, Mexico. One of the objectives was to capture beetles using traps baited with sugar, chicken feces, dead fish and squid. To understand the depth and width of their distribution, we sieved a cubic meter of sand every 500m. In order to understand how the beetles make their way to the beach, we used pots as traps at the surface, placing them every 300m over 15km along the riverside of the Cozoaltepec River between the beach and mountains. Using this strategy, our theory was confirmed that the beetles arrived in the dry, dead trees. The eggs of the beetles were incubated in plastic flasks to understand their life cycle and determine how the beetles destroy sea turtle eggs. Approximately 10,000,000 coleoptera have been captured.

During these ten years, we have learned that the most affected areas are from stations 8 to 39 parallel to the coast. These coleoptera lay six small eggs each cycle, with an incubation period between 30 to 90 days. The reproductive season is ten months, from June to February, coinciding with the reproductive season of the sea turtle and with the rainy season.

Research and conservation of sea turtles in the Paria Península, Venezuela: Results of the 2003 nesting season

María de los Angeles Rondón[1], Ricardo A. Hernández S[2], and Hedelvy J. Guada[1]

[1]CICTMAR (Centro de Investigación y Conservación de Tortugas Marinas) / WIDECAST. Apdo. 50.789. Caracas 1050-A. Venezuela
[2]CICTMAR (Centro de Investigación y Conservación de Tortugas Marinas) / WIDECAST. Apdo. 50.789. Caracas 1050-A. Venezuela, 2Estación de Investigaciones Marinas, Fundación La Salle de Ciencias Naturales (EDIMAR-FLASA), Campus Margarita. Punta de Piedras. Isla de Margarita. Estado Nueva Esparta. Venezuela

Cipara and Querepare beaches are the most important nesting localities in Venezuela, with the exception of Aves Island. The leatherback turtle is the most important species at both sites, with lower levels of nesting by hawksbill, loggerhead and green turtles, as well. Cipara Beach (62º42'W, 10º45'N) was monitored between mid-April and mid-September. Forty-four new gravid leatherbacks were tagged and five females from the 2001 nesting season were recaptured. One female from Querepare Beach was later found nesting in Cipara. Seventy-five nests were transferred to a hatchery, showing a hatch success of 72.22% and a recruitment success of 68.45% (n= 4,932 hatchling leatherbacks released). In addition, four loggerheads, one hawksbill and one green turtle were tagged; 70 and 178 hatchlings of hawksbill and loggerhead turtles, respectively, were released. Querepare Beach (62º52'W, 10º42'N) was monitored between May and mid-September. A total of 31 gravid leatherbacks were tagged; there were two recaptures from Cipara. One gravid hawksbill was tagged. The nests were translocated to a protected hatchery. The hatching and recruitment success of the leatherback nests was of 57.06 and 51.14, respectively; 2,359 leatherback hatchlings were released, as well as 255 hawksbill hatchlings. Volunteers from Venezuela, Mexico, Peru and Spain participated in the project and two new local assistants were recruited. With respect to the awareness activities, a poster on the incidental capture of sea turtles in local fisheries was widely distributed. Lectures, video and slide sessions were offered to local fishermen, teachers, children at schools and military personnel.

Control of mammalian predation using habanero pepper powder in conjunction with screening sea turtle nests

Kirt W. Rusenko, Callie M. Walker, Julia E. Moriarty, Jennifer L. Mann, Robert W. Albury, Kristin Child, and H. Lynne Carter

Boca Raton Sea Turtle Conservation and Research Program, Boca Raton, FL, USA

Sea turtle nests in Boca Raton were routinely caged from 1976 through 1996 to protect the nests from mammalian predators. When a study performed in 1996 (Mroziac et al., 2000) demonstrated that mammalian predators used the cages to locate sea turtle nests, the routine use of cages was discontinued which resulted in fewer successful attacks during the 1997-98 nesting seasons. Without cages to guide them, the raccoons soon began to find nests during the last two weeks of incubation starting in the 1999 nesting season so cages were reintroduced to the park areas in 2000 with good success. Expecting the mammalian predators to re-associate cages with food, other alternatives to protect the nests were sought beginning in the 2001 season. Hot pepper sauce was chosen because it deters mammals but has no effect on birds and reptiles. The hot pepper sauce reduced the number of successful attacks (Rusenko et al., 2001) but the chunky liquid was hard to apply to areas of predator digging. A source of extremely hot habañero pepper powder was located in 2002 and has been shaken into every dig at each nest site.

During the 2003 season, screening nests in areas of high predator activity in combination with the use of habañero pepper powder resulted in a record low number of predations despite the fact that raccoon predatory attempts increased during the 2003 nesting season. Attempted and successful raccoon attacks accounted for 92% of the attacks in Boca Raton during the 2003 nesting season.

Sea turtle / jaguar interaction in French Guiana

Freddy Sehoe[1], Magali Morisson[2], Raymond Jean-Jacques[3], and Laurent Kelle[1]

[1] WWF Guianas
[2] WWF Guyane
[3] Kulalasi

Interaction between the jaguar (*Panthera onca*) and sea turtles remained poorly known until 2002 in French Guiana, with the phenomenon being limited to isolated nesting beaches. In 2002 and 2003, new monitoring camps were implemented on West French Guiana beaches. A daily count was made on presence (through tracks) of jaguar on the beach, and attacks. It appears that the cats prey on all three species of marine turtles nesting in the area, and up to 3 attacks a night were noticed.
These data allow an assessment of this natural predation on nesting turtles in French Guiana.

Past, present and future of a historical collection of a green turtle (*Chelonia mydas*) carapace as an important tool for environmental education at the "Adler-Apotheke" museum in Eberswalde, Germany

Walter Vaughan-Rojas, Andreas Linde, Manja Bode, and Manuela Voigt

University for Applied Sciences, Eberswalde, Brandenburg, Germany

The carapace of a sea turtle in the collection of the museum "Adler-Apotheke" is part of Mr. Samuel Hauser´s collection of exhibits from Oceania. The collection was assembled over one hundred years ago and passed as a gift to the city of Finow in 1939, where it was distributed for education in different schools. Unfortunately, many of the 420 pieces of the extensive collection were lost during the war. In 1961, Ms Clara Hauser recollected the exhibits and gave the collection to the neighboring city of Eberswalde.
Nowadays three herpetological exhibits like the carapace of the sea turtle are shown as an important part of the museum’s exhibition. It was only in November 2003 that the species was identified as a carapace of the green turtle (*Chelonia mydas*) by a student of the University for Applied Sciences in Eberswalde, Germany.
The carapace is serving the community of Eberswalde, located in the Barnim district of Brandenburg, Germany as an important tool for environmental education. The "Adler-Apotheke" museum will attempt to present a larger part of Hauser´s collection to the public during the centennial celebration in the year 2005. For the scientific community working in Oceania the SCL of 985 mm and the SCW of 814 mm could be important data that should be compare with the average of known SCL and SCW of green turtle (*Chelonia mydas*) carapaces of the recently passed last century.

Marine turtle status in the Colombian penninsula of La Guajira

Rodrigo Villate

Universidad Javeriana, Bogotá, Colombia

The Guajiran peninsula, located at the northeastern side of Colombia, has become the principal consumption center of marine turtles. During the months of May through August 2002, 481 marine turtles were captured and distributed to the principal cities of this region. Of these 273 were *Chelonia mydas*, 181 *Eretmochelys imbricata*, 15 *Caretta caretta*, 11 *Dermochelys coriacea* and one *Lepidochelys olivacea*.

During this same period 137 stomach content samples were collected, with a dry weight of 552.46 grams, 55 of them belonging to *Eretmochelys imbricata*, and 88 to *Chelonia mydas*.

The hawksbill turtle showed an affinity index of 67.3% for soft animal meat, 20% affinity for sponges of the *Placospongia* and *Iircinia* genera, and the remainder corresponding to seagrass and algae. The green turtle presents an herbivorous habit, with preferences for *Thalassia testudinum* and red algae from the genus *Gracilaria*.

The information from tag returns showed that the turtles that visit these feeding grounds come from different regions throughout the Caribbean, including nesting beaches at Tortuguero, Costa Rica, Los Roques, Venezuela, Bocas del Toro, Panama and Bahamas.

A barnacle's perspective of the sea turtle lifescape: What can turtle-barnacle biology tell us about turtles?

John D. Zardus and Michael G. Hadfield

University of Hawaii, Kewalo Marine Lab, Honolulu, USA

Some barnacles on sea turtles are opportunistic hitchhikers; but the so-called turtle barnacles are obligate associates. How the latter have evolved and how their biology intertwines with that of sea turtles are intriguing riddles. Turtle barnacles attach to their hosts by various means: some cement to scutes and scales, others grip the skin and one bores into the shell. Previously, attention has focused mostly on their morphological variation and very little on their biology. We have recently closed the gap in understanding the life cycle of one species, *Chelonibia testudinaria*. Typical of most barnacles, it has seven microscopic larval stages that swim and grow in the plankton. After nine days or more the larvae reach a stage where they are ready to attach to a host. In addition, we found this species employs an unusual, facultative breeding system involving small complemental males (apparently dwarf protandric individuals) attached to large hermaphrodites. This system allows for a shorter time to reproduction, greater genetic out-crossing and perhaps a smaller cluster size that is less subject to hydrodynamic drag. We conducted settlement preference studies with the larvae of this species and found differential selection among five species of sea turtles. Preference for some host species over others may be a factor determining barnacle population structure. We are investigating this hypothesis with genetic studies of barnacle populations across host species boundaries. Where and when barnacles attach to sea turtles is discussed along with the plausibility of using these epizoites as natural tracking devices.

Intra-beach seasonal and micro-habitat factors influencing incubation duration and hatching success in loggerheads on Zakynthos Island (Greece)

Judith Zbinden[1], Dimitris Margaritoulis[2], and Raphaël Arlettaz[3]

[1] University of Bern, Switzerland and ARCHELON, The Sea Turtle Protection Society of Greece
[2] ARCHELON, The Sea Turtle Protection Society of Greece
[3] University of Bern, Switzerland

Incubation duration and hatching success are two main characteristics of reproductive output of sea turtle populations. Incubation duration is known to be a good indicator of incubation temperature and thus hatchling sex ratio. The loggerhead nesting habitat in the Bay of Laganas (Zakynthos Island, Greece) consists of six distinct beaches within a small geographical area. A long-term monitoring program and an ongoing research project indicate that there are pronounced differences in incubation duration and hatching success amongst individual beaches. Here we focus on small-scale (within an individual nesting beach) variation of incubation duration and hatching success of clutches with respect to their vertical (distance of a clutch to the shoreline) and horizontal (distance of a clutch along the beach) location, and laying date.

Among the three factors tested (horizontal and vertical location relative to shoreline, respectively, and laying date), only laying date significantly accounted for variation in incubation duration, whereas hatching success correlated positively with nest distance to the shoreline.

At this beach scale, variation in sex ratio is therefore principally caused by temporal distribution of nests rather than local microclimatic conditions. This has direct implications for conservation strategies aiming to increase hatching success: the latter can be best optimized by relocating clutches laid close to the shoreline to the upper part of the beach. Although we are aware that this method might have other drawbacks, our results suggest that hatchling sex ratio is not considerably affected by this type of relocation.

SEA TURTLE ASSESSMENT AND MONITORING

Plasma steroids and thyroxine levels in hatchlings of green turtles (*Chelonia mydas*) at Ras Al-Hadd Reserve, Oman

Abdulaziz Y. A. AlKindi, Ibrahim Y. Mahmoud, Matar Al-Maani, Sultan S. Al-Siyabi, Saif N. Al-Bahry, and Charles S. Bakheit

Sultan Qaboos University, Muscat, Oman

Plasma estradiol (E2), Progestrerone (Pro), testosterone (T) and thyroxine (T4) levels were monitored immediately after hatching. Eggs were collected at random from 5 nests. The eggs were placed in incubators 16 hours after oviposition and set at 26-27^{o}C for producing male hatchlings and at 30-31°C for producing female hatchlings. The method of Mrosovsky (1987) was used for the incubation procedure. Blood was collected after sacrifice. Chemiluminescence immunoassay was used for determination of plasma hormone levels, using Beckman Coulter Access-2-immunoassay and reagents (Beckman Coulter, Inc.). In males, T levels were positively correlated with temperature (rho=67, $P<0.001$). However, E2 levels were negatively correlated with temperature (rho=0-396, $P<0.05$). There was no correlation between temperature and either Pro or T4. In females, there was no correlation between temperature and any of the four hormones. In addition, there was no significant difference in Pro, E2 or T4 concentrations between the sexes; however, T was significantly higher in males ($P<0.05$). The significance of these findings will be discussed.

Assessment of sea turtle health in Peconic Bay of eastern Long Island

Alonso Aguirre[1], Michele Sims[1], Kimberly Durham[2], Katie McGonigle[1], Rob DiGiovanni[2], and Steve Morreale[3]

[1] Wildlife Trust, 61 Route 9W, Palisades, NY 10964, USA
[2] Riverhead Foundation, 467 East Main Street, Riverhead, NY 11901, USA
[3] Cornell University, Dept. of Natural Resources, Ithaca, NY 14853

As part of the New York Bioscape Initiative, Wildlife Trust, Cornell University, and the Riverhead Foundation are assessing sea turtle health in the Peconic Bay of eastern Long Island. Prior assessment of migrant juvenile turtles in Peconic Bay by Steve Morreale from 1988-1995 indicated that the turtles appeared to be in excellent health. In the face of rapid human development of the region, it has become especially important to reexamine health, status, and trends of the sea turtle populations in the New York Bioscape waters.

With the cooperation of local pound net fisherman, accidental captures have facilitated collection of important biological samples including blood, tissue biopsies, and scute samples, as well as provided an opportunity to perform physical examinations to assess overall condition of these animals. Twenty-nine turtles were captured during summer/fall 2002 and 2003. Of these 16 were green (*Chelonia mydas*), 11 were Kemp's ridley (*Lepidochelys kempii*), and two were loggerheads (*Caretta caretta*). This initial health assessment includes physical exam findings along with CBC, blood chemistries, histology, and evidence of exposure to turtle herpesvirus (THV), which has been implicated as a possible etiology for marine turtle fibropapillomatosis (FP). Archived biological samples can also later be analyzed to determine exposure to polychlorinated biphenyls (PCBs), Methyl Tertiary-Butyl Ether (MTBE) a gasoline additive, organophosphates (OPs), and heavy metals.

The results will both benefit sea turtle recovery management and provide a sentinel species view of contaminants, pathogens, and other stressors present in the Peconic Bay Estuary.

Caretta caretta in the northwestern coast of Morocco

Mustapha Aksissou and Wafae Benhardouze

Department of Biology, Faculty of Science, PO Box 2121, Tetouan 93002, Morocco

The northwestern coast of Morocco covers a distance of 160 km. It borders the Atlantic, Gibraltar Strait and the Mediterranean. This area does not currently have favorable zones to *Caretta caretta* laying because it does not have protected areas and the majority of the coast was not managed during the last two decades. However, this zone constitutes a very significant area for foraging and migration of *Caretta caretta*, including records of stranding cases. Observation of the area for one decade and investigations that we carried out on fishermen during three last years (2000-2003) showed: sea turtle interactions with fisheries, large turtles at sea, and stranding of several turtles in many localities like Sebta, Marina-Smir, Martil and M'diq. These results indicate that the northwestern coast of Morocco constitutes a significant area for nutrition and migration for *Caretta caretta*. Importance of this area for *C. caretta* nutrition is illustrated by the presence of young turtles and its high content in fish, mollusks, and shellfish. The migration of the turtles between the Atlantic and Mediterranean can be made only through the Strait of Gibraltar, and the observations of large turtles in this strait supports this hypothesis. Strandings observed in this coastal zone can be explained by oil pollution, plastics or accidents with boats. Consequently, policies of sea turtle conservation in Morocco should be applied within the framework of marine biodiversity conservation.

Analysis of polychlorinated biphenyls (PCBs) and organochlorine pesticides in loggerhead sea turtle eggs from Florida, U.S.

Juan José Alava[1], Jennifer M. Keller[2], John R. Kucklick[2], Larry Crowder[3], Jeanette Wyneken [4], and Geoffrey Scott[5]

[1] School of the Environment, University of South Carolina, Columbia, SC
[2] National Institute of Standards and Technology/Hollings Marine Laboratory, Charleston, SC
[3] Duke University Marine Laboratory, Beaufort, NC
[4] Florida Atlantic University, Boca Raton, FL
[5] Center for Coastal Environmental Health and Biomolecular Research/NOAA, Charleston, SC

Data on the concentrations of persistent organochlorine pollutants (POPs) in sea turtle eggs are scarce. This study measured POP concentrations in egg yolk samples from three loggerhead sea turtle (*Caretta caretta*), nests collected in Florida to determine if POP concentrations change through embryonic development. One to three egg yolk samples per nest were analyzed from each developmental stage (early, middle, and late) (n = 22 eggs total). PCB and pesticide concentrations were determined by gas chromatography and electron capture detection (GC-ECD). Mean concentrations (lipid based) of ΣPCBs (55 Congeners), ΣDDTs, Σchlordanes, and dieldrin in all eggs combined were 885 ng/g (range = 8.70-3800 ng/g), 318 ng/g (range = 7.41-1340 ng/g), 160 ng/g (rang e= 5.03-684 ng/g), and 16.1 ng/g (range = below limit of detection - 44.0 ng/g), respectively. Eggs from one nest, containing a two-headed embryo, had the highest concentrations (Σorganochlorines averaged 4890 ng/g lipid). About 5 eggs per nest are required to obtain an overall nest average of Σorganochlorines concentration within the 95 % confidence interval of a t-distribution. Early and middle stage samples had similar POP concentrations, but the concentrations doubled by the late stage. This increase is most likely attributable to a 50% increase of lipids in the late stage. These findings indicate that an early stage sample from one nest cannot be directly compared to a late stage sample from another nest. More research is required to elucidate the influence of nesting location on contaminant concentrations and health effects (i.e.; abnormalities) of these contaminants on sea turtle development.

Bacterial contamination in freshly laid eggs of green turtles (*Chelonia mydas*) at Ras Al-Hadd Reserve, Oman

Saif N. Al Bahr, Ibrahim Y. Mahmoud, Asilah Al-Harhty, Abdulkadir Elshfie, Abdulaziz Y. A. AlKindi, and Issa Al-Amrii

Sultan Qaboos University, Muscat, Oman

A total of 54 eggs were collected from 22 nests and 2-3 eggs were taken from each nest at Ras Al-Hadd, Oman. The eggs were immediately processed for total bacterial count. The percentages of the total counts were estimated in different egg compartments with some variations. The percentage total counts were as follows: eggshell and membrane 25%, albumen 20%, yolk 41%. Low vacuum SEM (LVSEM) micrographs revealed that bacteria found their way through the pores. When eggs were exposed to 106ml of *Salmonella typhimurium*, the results revealed that 28% of salmonellae were in shell, 18% in albumen and 25% in yolk. LVSEM micrographs also revealed that unique aggregates were formed in albumen and yolk. The significance of this finding will be discussed.

Three successful years of the embedded roadway lighting project in Boca Raton

Robert Albury, Callie M. Walker, and Kirt W. Rusenko

Boca Raton Sea Turtle Conservation and Research Program, Boca Raton, FL, USA

Following renourishment of the northernmost 1 ½ miles of beach in Boca Raton in 1998 hatchling disorientations increased ten-fold in 1999 and 2000. Due to the very large amount of disorientated hatchling deaths in 1999, the sea turtle permit holder requested that the city of Boca Raton turn off the streetlights in the area. The request was turned down because of public safety concerns but resulted in FPL repositioning the directional Cobra-head streetlights away from the beach in late 1999. Even though this reduced the amount of hatchling death due to disorientation, it did not meaningfully reduce the amount of disorientations in 2000. FDOT responded with grant funding for the installation of the Embedded Roadway Lighting Project in which light-emitting diode (LED) modules were installed into the middle of the roadway and ground-level high-pressure sodium bollards were installed on both sides of the road. This project began on June 8, 2001,with the lighting of the LED and the extinguishing of streetlights in the same 0.65-mile of A1A along Spanish River Park.

In 2001, no disorientations occurred while the project was active, even though disorientations where on the same trend as the years before in the areas north and south of Zone B. In 2002, the only two disorientations that occurred had lighting sources outside of Zone B. In 2003, no lighting-related disorientations occurred. Despite the success of this form of roadway lighting, maintenance of the bollards is an issue that may jeopardize continuation of the project.

Records of leatherback turtle bycatch from Peru

Joanna Alfaro-Shigueto[1], Peter Dutton[2], Diana Vega[1], Jeffrey Mangel[1], Luis Santillan [1], and Nelly de Paz[3]

[1] Pro Delphinus, Peru
[2] National Oceanographic and Atmospheric Administration NOAA
[3] Universidad Nacional Mayor de San Marcos

The population of leatherback turtles (*Dermochelys coriacea*) at nesting beaches along the Pacific coast of Mexico has declined precipitously over the last decade. Information suggests that fisheries in Peru and Chile may be one of the causes of this decline.Peru was once described as having the largest leatherback fishery in the world. The capture of leatherbacks has been prohibited in Peru since 1976. However, this conservation measure was never fully implemented.Over the last decade, fragmentary information on sea turtle bycatch has been gathered (i.e. tons of turtle meat landed or number of turtles captured). There is, however, no specific reference to the capture of leatherbacks that can confirm that individuals from Central America nesting beaches were caught in Peru.We present information on leatherbacks incidentally caught in artisanal fisheries. From 1985 to 1999, information was gathered opportunistically. From 2001 to 2003, information was collected systematically using a network of observers as part of a bycatch monitoring program.

Leatherbacks were captured mainly in artisanal gillnets targeting sharks and rays. A peak in leatherback bycatch is observed from December to March. Standard length (SL) of carapaces ranged from 111-165cm. From 2001 to 2003, leatherbacks represented 5.1% of the total number of turtles caught at the 8 ports sampled.

This work stresses the need for programs to monitor bycatch, to enforce regulations for sea turtle capture, and to increase the environmental awareness of artisanal fishermen.

Feeding ecology of black sea turtles (*Chelonia mydas agassizii*) in the Gorgona Island National Park of the Colombian Pacific

Diego F. Amorocho[1], Duván D. Quiroga[2], and Richard Reina[1]

[1] Monash University, Clayton VA, Australia
[2] CIMAD, Cali, Colombia

Sea turtle research in the Colombian Pacific protected areas had been focused on the reproductive biology of females, eggs and hatchlings on the nesting beaches. However, such studies, whilst of value in understanding the terrestrial phases of reproduction, make up just one side of the process required to ensure the long-term survival of marine turtles in the Colombian Pacific. Sea turtles spend the majority of their lives at sea, and little is known about what they do after they migrate to the feeding areas where they remain for long periods.

The Gorgona National Park in the Colombian Pacific has been identified as an important feeding ground for black sea turtles (*Chelonia mydas agassizii*). During October and December 2003, three habitats (sandy bottoms, coral reefs and superficial waters) have been assessed for population structure, diet composition, sex ratio and maturity status of foraging individuals through gastric lavages, laparoscopies, and tissue/blood sampling for DNA analyses. Preliminary data suggest that captured, tagged, measured and weighed turtles correspond mainly to subadults of this species. The following components have been identified as the main source of food for black sea turtles in Gorgona National Park: 1) mangrove fruits; 2) tunicates; and 3) algae.

Direct observation of their gonads indicates that feeding black sea turtle population in Gorgona Island is mostly composed of immature individuals, making this natural park an important development area for the species in the eastern Pacific. Tissue and blood samples for further mixed stock analyses have been taken from all captured individuals.

Preliminary morphometric comparisons of the black sea turtle (*Chelonia mydas agassizii*) population at the Gorgona Island National Park in the Colombian Pacific (years 1999, 2000 and 2003)

Diego Amorocho [1], Duvan Quiroga[2], and Richard Reina[3]

[1] Ph.D. Candidate, Monash University
[2] Associate Researcher, CIMAD
[3] Lecturer, Monash University

Between October 1999 and March 2000, the first morphometric characterization of an established contingent of foraging black sea turtles (*Chelonia mydas agassizii*) was carried out in Gorgona Island National Park (2° 47' N and 78° 06' W) by Sanchez & Quiroga (2001). From a total of 55 measured individuals, 51 were sub adults (X = 59.6 cm SCL, D.E + 6.64 cm; weigh = 24.82 Kg) and 4 adults (X = 73.3 cm SCL, D.E + 3.44 cm; weigh = 43.5 Kg). This poster will present comparative data of 12 morphometric parameters evaluated in 2001 and those that have been obtained during the current 2003 assessment. Preliminary results from 11 individuals assessed between October and December 2003 indicate that the foraging black turtle population in Gorgona is made up of immature juveniles and subadults. Comparisons between years will help to identify size class differences among individuals in Gorgona's foraging habitats.

Sea turtle protection and conservation program at Quintana Roo, México

Alejandro Arenas[1], Roberto Herrera[2], Catalina Calderón[3], Leonel Gómez[1], and Rodolfo Raigoza[3]

[1] Flora, Fauna y cultura de México A.C. Carretera Chetumal Pto-Juarez Km 282 Cp. 77710. Playa del Carmen Qroo. México
[2] Colegio de la frontera Sur. A.V. Centenario Km 5.5 Cp. 77000. Chetumal Qroo. México
[3] Parque Xcaret, Carretera Chetumal Pto Juarez Km 282.Cp 77710 Playa del Carmen Qroo. México

During the nesting season of 2003, the Asociation Flora, Fauna y Cultura de México, A.C. undertook the sea turtle conservation and protection activities started in 1982 that cover twelve beaches between Playa del Carmen (20° 29' N and 87° 13' W) and Punta Allen (19° 51' N and 87°26' W). From May to September, nocturnal patrols were made along the main beaches (Aventuras DIF, Chemuyil, Xcacel, Xel-ha, Kanzul and Cahpechen) and diurnal patrols made twice a month along Punta Venado, Paamul, Punta Cadena, Tankah, Yu-yum and San Juan beaches.

During these patrols, 1,203 loggerhead turtle (*Caretta caretta*) nests were registered and 946 of these were successful; 106,024 eggs were incubated. Also, 1,360 green turtle (*Chelonia mydas*) nests were registered with 859 of them successful and 105,126 eggs incubated.

About 90,595 loggerhead and 85,802 green turtle hatchlings reached the ocean at the end of the season. The global survival index registered reached 83.45 % for loggerhead and 81.98 % for green turtle.

A brief evaluation of turtle natal site philopatry since 1996 - 2003 is presented with focus on the backsliders and the neophyte nesting females related with specific beaches.

Descriptive observations from recaptured loggerheads in the southeast United States

Michael D. Arendt, David W. Whitaker, Phil P. Maier, and Al Segars

SCDNR, Marine Resources Division/217 Fort Johnson Road/Charleston, SC 29412

Regional (Winyah Bay, South Carolina, to St. Augustine, Florida) and localized (Brunswick, Georgia; Charleston, South Carolina) trawl surveys conducted in summers 2000-2003 to assess the health and relative abundance of sea turtles resulted in the collection of 936 individual loggerhead (*Caretta caretta*) sea turtles. Eleven loggerheads (1.2%) were previously tagged and released by other programs; these turtles were recaptured 6.3 to 412.3 km from where previously released after 16 to 3,269 days at large. Twelve loggerheads (1.3%) tagged and released during this study were subsequently re-encountered, all but two of which were recaptured during sampling efforts associated with this trawl survey. Days at large between release and recapture for these loggerheads ranged from 24 to 1,091 days and distance between initial release location and release location following recapture varied from 0.3 to 64.6 km. Annual increase in minimum straight-line carapace length from recapture data was estimated to be 1%. Spatial and temporal differences in recapture rates were observed. Recapture rates were much lower than recapture rates reported for loggerheads at opportunistic foraging sites and near harbor entrance channels in the southeast United States. Low recapture rates were not suspected to represent poor survival or poor tag retention. Low recapture rates were most likely related to sampling design and distributional patterns of loggerheads in coastal waters. In an effort to better understand the distributional habits of loggerheads in coastal waters, localized repetitive trawling efforts coupled with telemetry investigations (acoustic, satellite) of residence and movement patterns will be initiated in 2004.

Skeletochronological analysis of Kemp's ridley and loggerhead scleral ossicles

Larisa Avens and Aleta Hohn

National Marine Fisheries Service, Beaufort, North Carolina, USA

Skeletochronological analysis of the humeri of known-age Kemp's ridley and loggerhead sea turtles has demonstrated that growth marks in bone are deposited annually, making it theoretically possible to obtain age estimates by counting the number of marks present in the humeri. However, age estimates for older turtles are often confounded by the resorption of early growth marks. Also, in contrast to the humeri of hard-shelled turtles, few growth marks are present in leatherback humeri due to the increased cortical bone resorption that is characteristic of the leatherback skeleton. Marks that are thought to be growth marks have been found in the scleral ossicles of leatherbacks and preliminary observations suggest that resorption may not be as great in ossicles as in other bones, which would potentially allow for more accurate aging of older turtles. However, the character and the frequency of deposition of these marks have not yet been validated. As a first step toward determining whether these marks are deposited annually, ossicles from 65 Kemp's ridley and 40 loggerhead turtles were decalcified, thin-sectioned using a microtome, and stained using hematoxylin. Examination of these stained sections demonstrated that marks similar to those found in humeri were present in the ossicles. In addition, we compared the number of marks present in the ossicles to the number present in the humerus of each turtle and found that the numbers were comparable, indicating that the marks in the ossicles are annual growth marks.

Marine turtle nesting at the Archie Carr National Wildlife Refuge, Florida, USA in 2003: The most unusual season to date

D.A. Bagley, J.A. Elliott, W.E. Redfoot, and L.M. Ehrhart

University of Central Florida, Orlando, Florida, USA

The 21 km stretch of beach in South Brevard County, Florida, USA, known as the Archie Carr National Wildlife Refuge, has been surveyed during each nesting season since 1982 to enumerate nest production for three species of marine turtles: loggerheads *(Caretta caretta)*, green turtles *(Chelonia mydas)* and leatherbacks *(Dermochelys coriacea)*. Loggerhead nest production has dropped each year for the previous five years and finished in 2003 as the lowest season (10,091 nests) since 1990. This still represents an 8.5% increase above the long-term average of the 1980s. Florida green turtle nesting has been growing exponentially since 1990 and, although 2003 was to be a "low" year, it was the highest "low" year to date (569 nests) with three and one half times as many nests as the previous "low" year. Leatherback nest production at 37 nests was the highest to date. Extremely cold water during most of the summer extended the nesting season until 15 October. Long-term trends and related issues will be discussed.

Marine turtle nesting in the Cayman Islands: Update after 5 years of monitoring

Catherine D.L. Bell[1], Joni L. Solomon[2], Janice M. Blumenthal[1], Timothy J. Austin[2], Gina Ebanks-Petrie[2], Annette C. Broderick[3], and Brendan J. Godley[3]

[1] Department of Environment, POBOX 486 GT, Grand Cayman, Cayman Islands, B.W.I & Marine Turtle Research Group, Centre for Ecology and Conservation, Department of Biology, University of Exeter, Exeter EX4 4PS, UK.
[2] Department of Environment, POBOX 486 GT, Grand Cayman, Cayman Islands, B.W.I.
[3] Marine Turtle Research Group, Centre for Ecology and Conservation, Department of Biology, University of Exeter, Exeter EX4 4PS, UK

A fractional rookery for four species of marine turtle, *Chelonia mydas*, *Caretta caretta*, *Eretmochelys imbricata* and *Dermochelys coriacea* still exists today in the Cayman Islands (Aiken et al 2001, Bell et al 2002). In this poster we provide an overview of five years of standardized monitoring data and illustrate the temporal and spatial patterns of nesting emergence. Additionally, recent monitoring of sand temperatures at mean nest depth has been carried out on Grand Cayman in 2003, and, in conjunction with data on incubation duration, allow a preliminary assessment of the likely primary sex ratio in this critically reduced population.

Reproductive output and nest location of olive ridley turtles (*Lepidochelys olivacea*) at Old Ningo Beach, Ghana, West Africa

Kathleen M. Beyer

Centre for Marine Tropical Ecology, University of Bremen, Bremen, Germany

Information on marine turtles in Ghana is rudimentary and not sufficient to guide much needed conservation measures. This investigation was conducted from September 2001 to January 2002 at Old Ningo Beach, Ghana. The study site is part of an 80km stretch of coast in the east of the country that is thought to be the primary sea turtle nesting area. To obtain data on abundance, nesting emergences were recorded and nest location was reported in reference to the high tide line and vegetation cover. In addition to environmental variables (slope, grain size distribution, moisture content and sediment temperatures), five quantitative variables (carapace size, nest dimension parameters, incubation period, clutch and egg size) were collected for a total of 30 olive ridley turtles. The percentage of nests (52.56%) deposited below the high tide line and with no vegetation was greater than previously recorded. Similar to other studies in the Gulf of Guinea region, the females studied exhibited larger body sizes than olive ridleys nesting in other parts of the world. The olive ridleys examined also exhibited considerably higher clutch size and hatching success than documented otherwise. The results of this study, including the comparably high nesting density and great hatching success, coupled with the great reproductive effort of the turtles at Old Ningo Beach suggest that these are an important source of recruits for the nesting populations in the Gulf of Guinea. Furthermore, the results illustrate the importance of the conservation of marine turtles and such key nesting habitats.

Determination of the sex ratios of loggerhead sea turtle (*Caretta caretta*) hatchlings produced along the southeastern Atlantic coast

Kimberly Blair[1], Lesley Stokes[1], Jeanette Wyneken[1], Jesse Marsh[2], Jerris Foote[3], Thane Wibbles[4], and Larry Crowder[2]

[1] Florida Atlantic University, Boca Raton, FL USA
[2] Duke University Marine Laboratory, Beaufort, NC USA
[3] Mote Marine Laboratory, Sarasota, FL USA
[4] University of Alabama at Birmingham, Birmingham, AL USA

The loggerhead nesting along the western North Atlantic coast of the United States is represented by several subpopulations based on mtDNA. These subpopulations differ demographically. The smaller northern subpopulation is decreasing, while the larger southern subpopulation south of Cape Canaveral is roughly stable. To meaningfully interpret and manage these subpopulations, accurate sex ratios of the hatchlings recruiting to the next stage must be determined. The purpose of this study was to empirically determine the sex ratios of loggerhead sea turtle nests from both major subpopulations using endoscopic analysis of gonadal morphology. Eleven study sites distributed along a latitudinal gradient were sampled 3 times during the season. Hatchlings were raised to a minimum size of 120g, and then their sex was determined by several morphological characters. To verify the identification of the gonads, a subsample of the animals was biopsied for histological analysis. A 1-2 mm small biopsy was taken of the cranial end of one gonad for histological examination. Based upon our samples, the percentage of males produced in the southern subpopulation (pooled from 7 beaches) was higher than previous studies suggested 21.5 % M: 78.5% F. Perhaps of more concern is the low percentage of males hatching in the northern subpopulation. The sex ratios of the northern subpopulation were also skewed strongly toward females; these differed little from the southern subpopulation, producing 22% M: 78% F. Our results confirm that U.S. loggerhead sea turtles have highly skewed sex ratios. These data, once scaled by beach or region, are provided for management options.

Cayman Islands hawksbill population assessment

Janice M. Blumenthal[1], Catherine D.L. Bell[1], Timothy J. Austin[2], Gina Ebanks-Petrie[2], Annette C. Broderick[3], and Brendan J. Godley[3]

[1] Department of Environment, Cayman Islands and Marine Turtle Research Group, University of Exeter, Exeter, UK
[2] Department of Environment, Cayman Islands
[3] Marine Turtle Research Group, University of Exeter, Exeter, UK

Results will be presented for an intensive in-water research program, focusing on hawksbill foraging aggregations in the Cayman Islands. Secondary sex ratio, size distribution, and other parameters will be presented and compared for foraging grounds near the islands of Grand Cayman and Little Cayman, elucidating fine-scale differentiation between foraging aggregations. On a broader scale, preliminary outcomes of comprehensive transect surveys will be presented, including habitat mapping, identification of key foraging grounds, and baseline data for detection of trends in abundance. Throughout the fieldwork, genetic sampling is undertaken but these data will be reported elsewhere. With ongoing research, we aim to provide a robust reference point for diverse aspects of the ecology of hawksbills in the western Caribbean.

Sea turtle nesting beach monitoring programs in Venezuela. Workshops towards a standardized data collection, quality assurance and data management system

Joaquin Buitrago[1], Hedelvy Guada[2], Maria Rondon[3], and Ricardo Hernandez[4]

[1] EDIMAR. Fundacion La Salle de Ciencias Naturales. Isla de Margarita, Venezuela
[2] CICTMAR - WIDECAST. Caracas, Venezuela.
[3] CICTMAR . Caracas, Venezuela.
[4] EDIMAR. Fundacion La Salle de Ciencias Naturales y CICTMAR

Nesting beach monitoring programs are the most common turtle-related research and conservation activity. In Venezuela, although some projects have continued for two decades, there has not been any fine-tuning of techniques between or within projects through the years. As a consequence, results are widely unknown, with low scientific production and a small impact, other than environmental education, on the national strategies comprised in the recovery action plan. In order to strengthen the technical and scientific skills of beach projects staff, a workshop to homogenize the great variety of definitions and techniques was held at Margarita Island in March 2002. Most projects involved common activities: beach patrols, nest censuses, female tagging and measuring, egg relocation, hatchery building, in situ protection, hatchling success evaluation and release or head-starting. In spite of the fact that these efforts' final objective is mainly to accurately assess population size and trends, very few evaluations have been made, depriving decision makers of a much-needed piece of information. Researchers' lack of expertise in some tasks is the main factor inhibiting more useful data acquisition and processing. Thus, a second workshop, called "After such a long beach walk…. What shall I do with those datasheets?" was held. Special emphasis was made on maintaining focus on objectives when conducting monitoring and tagging programs, inference of population parameters, minimization of errors, and confidence estimates. Workshops results, and analysis of similar programs in the region show that terms and techniques consensus, and data gathering and processing training, could significantly increase the usefulness of beach work with turtles.

Morphometric analysis of the northern subpopulation of *Caretta caretta*

Julia I. Byrd[1], Sally R. Murphy[2], and Amber Von Harten[3]

[1] Master's of Environmental Studies Program, College Of Charleston, 115 Coming St., Charleston, South Carolina, USA
[2] South Carolina Department of Natural Resources, P.O. Box 12559, Charleston, South Carolina, USA
[3] University of South Carolina Beaufort, Center for Coastal Ecology and Pritchards Island, 801 Carteret St., Beaufort, SC, USA

Sea turtle researchers use morphometric measurements to compare body dimensions in sea turtles. However, some researchers measure curved carapace lengths with a measuring tape, and others take straight carapace measurements with the use of calipers. In order for researchers to compare the body dimensions of sea turtles from various geographic regions, a conversion formula is needed. Using morphometric measurement data gathered on adult loggerheads nesting on Cape Island and on Pritchards Island, South Carolina, an equation was derived to convert curved carapace length (CCL) to straight carapace length (SCL). Regression was used and preliminary results showed the equation as: SCL = 3.61 + (0.892 * CCL), (n=125; R2=.90; p=0.00). This equation was then compared to other similar equations published by Teas (1993) and Frazer and Ehrhart (1983). Preliminary results showed there were differences between the

conversion equations. One reason for the differences may be the variation in turtles studied. This study measured adult females from the northern subpopulation, the Teas data measured stranded turtles throughout the southeast, including many juveniles, and the Frazer and Ehrart data measured adult females at the Kennedy Space Center, Florida. In addition, carapace width (SCW and CCW) and body depth (BD) measurements were also analyzed at both sites. Regression equations were derived and results were compared with formulas computed by Epperly and Teas (1999) converting SCL to SCW and SCL to BD. Preliminary results showed differences between the equations, indicating that the same formula may not be applicable to all size classes and subpopulations.

Tail measurements of loggerhead turtles (*Caretta caretta*) from Italian waters: Size at male puberty, sexing methods, and sex ratio in adult-sized specimens

Paolo Casale [1], Daniela Freggi [2], Roberto Basso [3], and Roberto Argano [4]

[1] via Antonio Calderara 29, 00125 Roma, Italy
[2] Sea Turtle Rescue Centre WWF Italia, CP 92010 Lampedusa, Italy
[3] Museo Civico Storia Naturale del Po, via Roma 4, Ostellato, Italy
[4] Dipartimento di Biologia Animale e dell’Uomo, Università

Tail length is the main secondary sexual characteristic of adult sea turtles. In order to assess the size at which this sexual dimorphism becomes evident, six different measurements of tail length were collected or calculated from 2,630 *Caretta caretta* specimens found in the waters around Italy. These data suggest that an average male develops a longer tail at a size of 70 cm CCLn-t, and attains sexual maturity at a size of 75-80 cm. So, adult sex ratio studies based on tail measurements should be restricted to specimens > 75 cm. The distance from the cloaca to the posterior margin of the carapace appears to be the most effective measurement for sexing turtles of this size among the six investigated. In the sample, females are estimated to be 60.9% of the specimens > 75 cm (n=69).

Trends decrease for clutch size and corporal size in olive ridley sea turtles (*Lepidochelys olivacea*) nesting in the East Pacific, Jalisco, Mexico

Rodrigo Castellanos-Michel[1], Cecilia Martinez-Tovar[2], and Javier Jacobo-Perez[3]

[1] División de Ciencias Biológicas y Ambientales, Universidad de Guadalajara. Carretera a Nogales km 15.5, 45110 Zapopan, Jalisco, México. Tel/fax: ++ (52 33) 3682 0230 e-mail: rodcaste@cucba.udg.mx / Departamento de Zoología, Facultad de Ciencias Biológicas, Universidad Complutense de Madrid, Ciudad Universitaria 28040 Madrid, España
[2] Dirección General de Vida Silvestre-SEMARNAT / Fundación Ecológica Selva Negra, A.C., Manuel Acuña 3359-A, Col. Monraz CP 44670 Guadalajara, México. Tel: ++ (52 33) 36 42 65 11, 36 42 6512 Fax 3642 5360 e-mail: selvanegra@selvanegra.org / www.selvanegra.org
[3] División de Ciencias Biológicas y Ambientales, Universidad de Guadalajara

The olive ridley (*Lepidochelys olivacea*) is abundant in the world today, but the population in Playón de Mismaloya, Mexican East Pacific, has been dramatically reduced during the last fifty years. Historically, a large number of turtles was seen nesting on these beaches; Pritchard reported an arribada with 30,000 females nesting in 1968 and Casas-Andreu registered 30,000

turtles in July of 1970. Today, only 800 olive ridley females are recorded nesting each year on close to 90 km of beach. An unknown number of males and females of this species and *Dermochelys coriacea*, *Chelonia mydas agassizii* and *Eretmochelys imbricata* are captured with nets during the reproductive period. No papers reviewed about this species, and especially about this population, indicated any values for traits like clutch size and length of carapace (Pritchard, 1969; Casas-Andreu, 1978; Hirth, 1980; Godínez, 1989; Márquez, 1990; Millar, 1997). We measured these features during the last nine years in Playón de Mismaloya (Tehuamixle, Mismaloya, Majahuas and Chalacatepec) and we found decreasing trends in these values. We think these data are indicators of the fragile status of this population in this region and it is necessary to continue and to strengthen works for protection and restoration of this and other species. Other important findings are population structure trends, because small sizes in nesting females have indicated the presence of new turtles in reproductive activity, and may be a result of our years of conservation work on these beaches. We believe that when these values have stability and trends begin to show an increase, we can suggest that recovery has started.

Presence of unusual epibionts on juvenile green turtles (*Chelonia mydas*): Are they evidence of brumation in Uruguayan waters?

Jessica Castro Prieto[1], Martín Laporta[1], Fabrizio Scarabino[2], Milagros López Mendilaharsu[1], Alejandro Fallabrino [1], and Gustavo Riestra [2]

[1] CID/Karumbé, Tortugas Marinas del Uruguay, J. Paullier 1198/101, Montevideo, Uruguay
[2] Dirección Nacional de Recursos Acuáticos, Montevideo, Uruguay

---

Brumation can be defined as the state of lethargy or dormancy of ectothermic organisms during winter months as a response to low temperatures (15º C or less) to reduce the use of energy during prolonged periods of inactivity. This state produces physiological and behavioral alterations. Records of winter dormancy or brumation in sea turtles are very scarce. Between July 2001 and June 2003, six green turtles with unusual epibionts were found in the region of Rocha, on the Atlantic coast of Uruguay. Stranded individuals encountered in September-October had part of their carapaces covered by *Balanus sp.* and the green algae *Ulva lactuca*, indicating the first stages of ecological succession on hard substrate. Other individuals found in December-January presented an advanced stage of succession characterized by the mussel *Mytilus edulis* and *Ulva lactuca*. One of these contained a diverse community of macroinvertebrates inhabiting the matrix of *M. edulis*, indicating the presence of a relatively stabilized community that coincides with the fauna of sub-tidal rocky bottoms in the area. The mussels found on that individual were about 3 months old. These findings represent, along with another one for the south of Brazil, the only ones of this kind reported for *C. mydas*. The permanence of sea turtles on the bottom favors the establishment of mollusk larvae on their carapaces. The hypothesis of work stated here, considers that the development of those epibionts on the turtles occurs because the individuals are brumating in the proximity of the place where they were found.

Night of the living dead: Debilitated sea turtles in North Carolina, USA

Wendy M. Cluse[1] and Matthew H. Godfrey[2]

[1] North Carolina Wildlife Resources Commission, Atlantic Beach, NC, USA
[2] North Carolina Wildlife Resources Commission, Beaufort, NC, USA

Over the past few years in the southeast United States, there has been an increase in the number of stranded sea turtles that exhibit signs of severe debilitation (emaciation, heavy epibiota load, etc.). These characteristic strandings have been coined "living dead" turtles, as many have been found still alive, shortly before perishing. Here we report on the temporal and geographic occurrence of this problem in North Carolina coastal waters, based on records collected by the North Carolina Sea Turtle Stranding Network. These strandings account for approximately 2-3% of the state's total strandings; however, it is thought that these debilitated turtles are more likely to become incidentally captured in fishing gear, dredges, or power plants, or get struck by boats. This analysis will also include information regarding strandings that show debilitation together with entanglement, boat strike, and/or entrainment. Thoughts on what the source of the problem is and how wildlife managers can better monitor the problem will also be presented.

Florida's marine turtle holding facilities: A five-year overview (1999-2003)

Meghan E. Conti[1], Robbin N. Trindell[2], Edward P. DeMaye[3], and Tim Woody[2]

[1] Florida Fish & Wildlife Conservation Commission, Division of Wildlife, Bureau of Protected Species Management, 19100 SE Federal Highway, Tequesta, Florida 33469
[2] Florida Fish & Wildlife Conservation Commission, Division of Wildlife, Bureau of Protected Species Management, 620 S. Meridian Street, Tallahassee, Florida 32399
[3] Florida Fish & Wildlife Conservation Commission, Florida Marine Research Institute, 19100 SE Federal Highway, Tequesta, Florida 33469

The Florida Fish and Wildlife Conservation Commission (FWC) authorizes twenty-five facilities to house marine turtles for the purpose of public education, research, or rehabilitation of sick/injured animals. From 1999 to 2003, a total of 32,746 individual turtles (including hatchlings) were held in these facilities. Almost 68% (22,255) of those animals were treated for illness or injury. Of the turtles undergoing rehabilitation, over 82% (18,359) were successfully rehabilitated and released, 16.8% (3471) of cases ended in death or euthanasia, and less than 1% (154) continue to undergo treatment. Excluding hatchlings, the total number of turtles requiring rehabilitation decreases to 1,636, and the rate of successful rehabilitation and release falls to roughly 64% (1,048). Excluding hatchlings, over 10% (168) of turtles requiring rehabilitation stranded outside of Florida.

Of the marine turtles currently in captive facilities, 6.5% (65) are ineligible for release due to severe disability, genetic origin that does not match Florida's population, or acquisition prior to the Endangered Species Act. Approximately 2% (22) of turtles are in captivity for educational purposes and 83% (824) are being held for research activities.

All facilities housing marine turtles for rehabilitation, educational display, or research purposes must be permitted in accordance with the Florida Marine Turtle Protection Act (Florida Statute 370.12) and the Florida Administrative Code for permits for collection and possession of indigenous marine organisms for scientific, educational, or conservation purposes. All facilities must comply with housing, care, and reporting standards designated in FWC's Sea Turtle Conservation Guidelines.

Occurrence and distribution of fibropapillomatosis in Hawaiian green sea turtles

Michael S. Coyne

SEATURTLE.ORG, Silver Spring, MD, USA

Since January of 2001, the Reef Environmental Education Foundation (REEF) has been collecting sea turtle observation data around the Hawaiian Islands. REEF is a non-profit organization of volunteer divers that follow standard protocols for recording fish and sea turtle sighting while SCUBA diving. As part of their program in the Hawaiian Islands, REEF has asked their divers to distinguish between turtles with fibropapillomatois (FP) and those without. To date, 1,372 surveys have been conducted around the islands. Of those, green turtles were observed during 431 surveys. Green turtles with FP were observed during 91 surveys. This analysis looks at the distribution and relative occurrence of FP in green turtles throughout the main Hawaiian Islands.

Barnacle colonization of the carapace of the loggerhead sea turtle (*Caretta caretta*): Can it be used in the field as an indicator of a turtle's condition?

Christina M. Davy

University of Guelph, Guelph, ON, Canada

Loggerhead sea turtles (*Caretta caretta*) sometimes carry barnacles on their carapace and flippers. Turtles may carry none, or many. If a correlation existed between barnacle load on the carapace and the total degree of injury sustained by a turtle, field workers could use barnacle load to approximately estimate a turtle's condition. This study aims to determine whether there are significant correlations between barnacle load, injury, nesting behavior (distance from the sea that the turtle nested), and turtle size, measured as straight carapace length (SCL). Loggerhead turtles (n=34) were observed nesting on Zakynthos Island, Greece, in the course of a long-term tagging program by ARCHELON. Total number of carapace barnacles (sp. *Chelonibia testudinaria*), SCL, distance from nest to sea, and any injuries to carapace, flippers or head were recorded. Total severity of injury was assigned a score, and data on these four parameters were used to generate a correlation matrix. Where significant correlation was found, linear regression was used to test its strength. There is a significant correlation ($r=0.430$, $p<0.05$) between degree of injury and distance from nest to sea. This finding suggests that even seemingly trivial injuries may affect turtles' reproductive behavior. Neither size, injury, nor barnacle load were related to each other; therefore, barnacles would not be a good indicator of turtle condition, and some other factor must affect the carapace barnacle load of individual turtles. Investigation into the mechanism by which barnacles colonize the carapace is recommended, as this may provide more insight into turtle-barnacle ecology.

Comparison of past and present turtle catch rates by longliners in the Gulf of Taranto, Mediterranean: Are sea turtles really declining?

Michele Deflorio[1], Paolo Casale[2], Aida Aprea[1], and Gregorio De Metrio[1]

[1] Department of Animal Health and Well-being, University of Bari, Bari, Italy
[2] via A. Calderara 29 00125 Roma, Italy

In the Mediterranean, data useful for detecting possible trends of sea turtle abundance consist in nest counts from some long-monitored nesting beaches, but indexes of abundance at sea are the only ones which can give information of the present situation, and they are very difficult to obtain. Catch rates of commercial fishing vessels can represent a useful index of abundance at sea, and data about longline interaction with loggerhead turtles (*Caretta caretta*) are available for two periods (1978-1981 and 1999-2000) from the Gulf of Taranto, north Ionian. With the same port being investigated in the two periods, the sources of variability were reduced at minimum and different target species and periods were accounted for. While a decline could be expected after 20 years of anthropogenic impacts on the populations, results do not show an evident negative trend of catch rates between the two periods. Although interannual variability can partially confound such comparisons, it seems unlikely that sea turtle abundance in the Gulf of Taranto declined substantially during the last 20 years. Naturally, these findings alone cannot have implication for the conservation of Mediterranean sea turtles as a whole, as they can be due to several factors concealing at local level an actual decline occurring at the Mediterranean scale. As long-term studies are required to detect trends, it is very urgent to start monitoring programs in several different Mediterranean areas, especially at sea and through collaboration with fishermen, in order to have the necessary base for proposing or adjusting conservation measures.

Preliminary approach to the hatchling sex ratio of a population of *Caretta caretta* of Boa Vista Island, Cape Verde Archipelago (western Africa)

Cláudia Delgado[1], Thomas Dellinger[1], Nuria Varo[2], Daniel Cejudo[2], and Luis F. Lopez-Jurado [2]

[1] Laboratório de Biologia Marinha e Oceanografia, Universidade da Madeira, Portugal & Centro de Estudos da Macaronésia
[2] Departamento de Biología, Facultad de Ciencias del Mar, Universidad de Las Palmas de Gran Canaria, Spain

A nesting population of loggerhead sea turtles *Caretta caretta* has recently been described for Boa Vista Island, Cape Verde Archipelago (Western Africa). Since 1998, "Projecto Cabo Verde Natura 2000" has monitored three beaches during the turtle breeding season. The beaches being monitored - Calheta, Ervatão and Ponta Cosme - are located in the southeast part of Boa Vista Island.

This work intends to give a first insight into the Boa Vista Island sea turtle population's sex ratio using a histological approach, as sexual determination in sea turtles is known to be temperature-dependent (TSD or temperature-dependent sex determination).Between 16th August and 29th September 2003, recently dead hatchlings from the beaches mentioned above were collected and necropsied for gonad withdrawal. Only hatchlings found dead due to natural death or predation were collected. 49 hatchlings were necropsied and duplicate gonads were preserved in Bouin's preservative and 10% formaline for histological sex assignment.This is the first preliminary assessment of this population's sex ratio. In 2004, field-season data on this subject will need to be further improved and eventually compared with incubation temperature data.

Assessment of nesting beaches and several feeding areas in the Archipelago Los Roques National Park

Verónica de los Llanos [1], Pedro D. Vernet [2], Luis G. Morales [3], Hedelvy J. Guada [4], and José M. Martinez [2]

[1] Escuela de Biología, Universidad Central de Venezuela, Caracas, Venezuela
[2] Fundación Científica Los Roques. Apdo. N 1139-Caracas 1010-A. Venezuela
[3] Instituto de Zoología Tropical, Universidad Central de Venezuela. Apdo 47058-Caracas 1041-A. Venezuela
[4] CICTMAR/ WIDECAST. Apdo. 50.789. Caracas 1050-A. Venezuela

In the Archipelago Los Roques National Park (11º48´ - 11º58´N and 66º32´ - 66º52´W), four species of marine turtles were found, with nesting observed on 12 of the islets. The purpose of the project was to increase the information on marine turtles in relation to nesting activity and feeding areas in order to recommend further investigation and conservation measures. Field trips were undertaken between August and November of 2001 in order to evaluate reproductive activity. The study of the feeding areas was done between August and December in four selected sites on the basis of interviews and type of marine bed. A census was obtained using light diving equipment in half hour periods. Sample sites were chosen using GPS and compasses. The observed specimens were identified and classified by size and gender. Type of marine bed and turtle activity was registered. 13 new nesting beaches were discovered. The species with the most reproductive activity was *Eretmochelys imbricata* (61.9% of total nests), followed by *Chelonia mydas*. The coral patch of the Dos Mosquises horseshoe was found to be a potential feeding area for young sea turtles, predominantly female. Few *Chelonia mydas* individuals were observed on the two meadows of sampled marine phanerogamous.Continuation of beach surveys, nest monitoring, evaluation of reproductive success and increase in sampling effort in order to detect other potential feeding areas are recommended.

Population ecology of the Caribbean green turtle: Results of in-water surveys at Culebra Island, Puerto Rico

Carlos E. Diez[1], Ximena Velez-Zuazo[2], and Robert P. van Dam[3]

[1] Programa de Especies Protegidas, DRNA-PR, San Juan, Puerto Rico
[2] Departamento de Biologia, Universidad de Puertor Rico, Rio Piedras, Puerto Rico
[3] *Chelonia*, Inc. P.O. Box 9020708, San Juan, Puerto Rico

Studies on an aggregation of green turtles at feeding grounds around the Culebra Archipelago, Puerto Rico, indicate that the area is important developmental habitat for the western Atlantic green turtle population. Long-distance tag recoveries have provided evidence linking this aggregation with others and justifying its inclusion as an important element of a wider green turtle metapopulation model. Also, somatic growth rates are much higher than other aggregations of immature green turtles, suggesting that adjustment in size-density model parameters previously reported for the species may be required. Habitat effect on growth rates and habitat descriptions will be discussed. Additional information on sex ratios and health of the animals captured in this feeding ground is presented. The Culebra Archipelago is one of the very few study sites within the Caribbean where efficient capture and recapture studies of immature green turtles can be conducted.

A review of cold stun strandings on Cape Cod, Massachusetts from 1979-2003

Kara Dwyer Dodge[1], Robert Prescott[2], Don Lewis[2], Dennis Murley[2], and Constance Merigo[3]

[1] NMFS Northeast Regional Office, Gloucester, MA, USA
[2] Massachusetts Audubon Wellfleet Bay Wildlife Sanctuary, South Wellfleet, MA, USA
[3] New England Aquarium, Boston, MA, USA

Cold-stunning of sea turtles in Cape Cod Bay was first recognized in the mid 1970s and has been documented for the last quarter century by rescuers organized by Massachusetts Audubon under the auspices of the NMFS and USFWS. Each fall and winter, juvenile and subadult sea turtles strand after experiencing cold-stunning. Sudden cooling of ocean water temperatures leaves the turtles torpid and allows them to be tossed by strong sustained storm winds onto the lee shore.
From 1979 to 2002, 1,289 cold-stunned sea turtles were stranded on Cape Cod beaches. Kemp's ridleys account for 76.3% of these strandings, followed by loggerheads (21.1%), greens (2.3%), and hybrids (0.3%). Averaging in the mid-teens to the high-twenties throughout the 1980s, the number of cold-stun strandings rose markedly to an average of 61 turtles in the mid 1990s. Strandings have continued to increase from 1998 to 2002, climbing dramatically to a 5-year average of 133 turtles a year. In recent years, the percentage of Kemp's ridleys has reached over 90% of all cold-stunned turtles, rising in numbers in proportion to the number of hatchlings released from nesting beaches two years earlier. Most of the Kemp's ridleys are comparably sized to two-year old Kemp's ridleys of known age based on wire tags found in their flippers. Live turtles are taken to New England Aquarium for rehabilitation, and most are transported south for release into warmer waters. Of the sea turtles recovered, rehabilitated, tagged and released, none have stranded a second time in Cape Cod.

Evaluation of incubation temperatures in green turtle nests at French Frigate Shoals, northwest Hawaiian Islands

Jennifer Estes[1], George Balazs[2], and Thane Wibbels[1]

[1] University of Alabama at Birmingham, Birmingham, Alabama, USA
[2] National Marine Fisheries Service, Honolulu, Hawaii, USA

The green sea turtle, *Chelonia mydas*, possesses temperature-dependent sex determination (TSD) in which the incubation temperature of the egg determines the sex of the hatchling. This form of sex determination is of evolutionary significance because it has the potential of producing a wide variety of sex ratios that do not always conform to a 1:1 sex ratio. Hatchling sex ratios resulting from TSD are also of conservational and ecological interest, since they can affect the recovery of endangered populations. French Frigate Shoals (FFS) is an atoll located approximately 800 km northwest of Oahu in the Hawaiian Archipelago. Over 90% of Hawaiian green turtle nesting occurs on FFS. The purpose of this study was to evaluate nest temperatures in an effort to estimate sex ratios. Sand and nest temperatures were monitored on FFS during the 1998-2002 nesting seasons. The average incubation temperatures during the middle third of incubation were used to predict sex ratios. The pivotal temperature of sex determination for Hawaiian green turtles is unknown. If the pivotal temperature for Hawaiian green turtles is similar to that of green turtles in Suriname and Costa Rica, where the pivotal temperatures have been estimated, then the majority of temperatures recorded in this study would be below the pivotal. This would suggest an overall male-bias. Alternatively, the Hawaiian green turtles may have evolved a lower pivotal temperature, which could result in unbiased or even female-biased sex ratios at these temperatures.

Influence of weather and nest location on the sex ratio of hatchling hawksbill sea turtles inhabiting Buck Island Reef National Monument, U.S. Virgin Islands

Jennifer Estes[1], Thane Wibbels[1], Zandy Hillis-Starr[2], Brendalee Phillips[2], Philippe Mayor[2], and Kimberly Woody[2]

[1] University of Alabama at Birmingham, Birmingham, Alabama, USA
[2] National Park Service, St. Croix, U.S. Virgin Islands

The hawksbill sea turtle, *Eretmochelys imbricata*, possesses temperature-dependent sex determination (TSD) in which the incubation temperature of the egg (during the approximate middle third of incubation) determines the sex of the hatchling. This form of sex determination has the potential of producing a wide variety of sex ratios. Hatchling sex ratios resulting from TSD are of conservational interest, since they can affect the recovery of endangered populations. Buck Island Reef National Monument (located approximately 2 km north of St. Croix) represents a major natural nesting beach in the Caribbean for endangered hawksbill sea turtles. The purpose of the current study was to monitor beach and nest temperatures and estimate hatchling sex ratios of hawksbill sea turtles on Buck Island Reef during the multiple nesting seasons, and further determine possible influence of weather and nest location on these sex ratios. Incubation temperatures were monitored in a total of 74 nests over the 1995-1999 and 2002 nesting seasons. The average incubation temperature during the middle third of incubation was used as a predictor of the overall clutch sex ratio. The results suggest an overall female-bias during each of the nesting seasons. However, the results also suggest that some male-biased clutches were produced due to temperature decreases associated with tropical weather systems passing through the U.S. Virgin Islands and due to nest site location.

Variation of dermic scutes on Cheloniidae turtles in Uruguay and their implications on management programs

Andrés Estrades

CID/ Karumbé, J. Paullier 1198/101, Montevideo CP 11200, Uruguay

Cheloniidae turtles have shells composed of bone overlaid by keratinous plates or scutes. The number and arrangement of these scutes are species-specific. It is accepted that the dermic variation is generated by alterations of ambient condition during the embryonic development. This work starts on the revision of all specimens included in the historic database of the Karumbe Project. During the first stage, 121 individuals of *Caretta caretta* and 214 individuals of *Chelonia mydas* were analyzed, recording 33 individuals (CC =14; CM =19) that presented variations in the arrangement and number of scutes. Many variations were observed in the scute arrangements of both species, with individuals having between one and four “extra” scutes. Recently, on the summer-fall 2003 field season, over a total of 103 stranded and captured juvenile green turtles, 11 individuals (10%) with presence of supernumerary scutes could be recorded. As the presence of abnormal scute patterns is a little-known phenomenon, there are diverse applications suggested to sea turtle management and conservation programs. In nesting beaches, monitoring of supernumerary females and their hatchlings is suggested, as well as ambient parameters and the possible incidence of nest translocations. In feeding areas, it is suggested to complement the

existing database with a standardized photo identification of each individual. In areas of consumption and carapace traffic, the creation of an individualized database with photo identification is suggested. This will allow the better fiscalization of illegal trade. These suggestions have been implemented in the national monitoring program of sea turtles developed by Karumbé Project in Uruguay.

Implementation and advances of the first sea turtle national tagging program in Uruguay

Andrés Estrades[1], Martin Laporta[1], Milagros López-Mendilaharsu[1], Alejandro Fallabrino[1], and Andrés Domingo[2]

[1] CID/Karumbé, Juan Paullier 1198/101, Montevideo, Uruguay.
[2] Dirección Nacional de Recursos Acuáticos. Ministerio de Ganadería, Agricultura y Pesca, Constituyente 1497, 11200 Montevideo, Uruguay

Since July 2001, the Sea Turtle National Tagging Program (PNMTM) has been in development. The PNMTM in Uruguay is coordinated by the Karumbé Project, with the participation of onboard observers from the Pelagic Resources Department (DINARA), trawl fishermen from the "Onboard Tagging and Data Collection Program", artisanal fishermen, and field assistants of Karumbé. The objective of this program is to collect useful data through the tagging of sea turtle individuals in order to allow their identification. Metallic tags are useful for obtaining information about movements, mark-recapture data, distribution, and growth rates of the tagged individuals. Our tagging program differs from other tagging programs that work with females or hatchlings at nesting beaches because the PNMTM had to accept the challenge of capturing individuals at sea. Thanks to the cooperation of many members of the program, and collaborators, we tagged an important number of individuals through the use of different techniques and fishing gear. From July 2001 to June 2003, a total of 135 sea turtles were tagged: 74 green turtles (*C. mydas*), 59 loggerhead turtles, (*C. caretta*) and two leatherback turtles (*D. coriacea*). Regarding the size classes of the three species captured, 98.5% were juveniles (or immature). To date, two turtles have been recaptured that were previously tagged by the PNMTM, both juveniles of *C. mydas*. All the information recorded has been compiled in the database of the "Cooperative Marine Turtle Tagging Program (CMTTP)," directed by the Archie Carr Center for Sea Turtle Research (ACCSTR) from the University of Florida, USA.

Microsatellite DNA analysis of green turtle populations in West Africa

Angela Formia and Michael W. Bruford

School of Biosciences, Cardiff University, Cardiff CF10 3TL, UK

Genetic analysis can be an essential tool in the conservation and management of endangered species such as the green turtle (*Chelonia mydas*). Green turtle adults and juveniles occur along most of the West African coastline between Morocco and Namibia, including substantial nesting and feeding populations in Mauritania, Guinea Bissau, Equatorial Guinea, São Tome and Gabon. Individuals are frequently captured at sea, either intentionally or incidentally, by industrial and artisanal fisheries, as well as on land by coastal villagers. Recent evidence from mitochondrial DNA analysis of samples collected from a vast geographic region has allowed us to expand prior descriptions of green turtle phylogeography in the Atlantic, to estimate patterns of gene flow and describe the genetic composition of nesting and mixed assemblages. However, mtDNA studies

yield limited amounts of genetic diversity and provide little fine-scale resolution. Here we will present preliminary analysis of ten polymorphic microsatellite loci in approximately 500 tissue samples from 12 African countries, used to estimate nuclear genetic variation within and between populations, and male and female-mediated gene flow at a spatial scale. In addition, we will use microsatellite data for stock identification and assignment analysis at the individual and population levels. We expect these results to be useful in the inference of demographic threats on individual populations and to make recommendations toward appropriate conservation strategies.

Genetic evaluation of juvenile and hatchling loggerhead sea turtles from the Alabama coast

Alyssa Geis[1], Thane Wibbels[1], Dawn Fletcher[2], Bill Gates[2], Randy Swilling[2], and Allyne Askins[2]

[1] University of Alabama at Birmingham, Birmingham, Alabama, USA
[2] Bon Secour National Wildlife Refuge, Gulf Shores, Alabama, USA

The loggerhead sea turtle (*Caretta caretta*) is a protected species that inhabits subtropical and tropical oceans throughout the world. Previous studies have identified several distinct genetic groups of loggerheads in the Atlantic coastal waters of the United States and the Gulf of Mexico. The current project evaluated the genetics of juvenile loggerhead sea turtles inhabiting the coastal waters of Alabama and hatchling loggerheads from nests at the Bon Secour National Wildlife Refuge (BSNWR) on the coast of Alabama. Specifically, mitochondrial DNA control region sequences were analyzed from juvenile and hatchling turtles. Blood samples were obtained from juvenile loggerheads that were captured by tangle net in the Alabama bay systems. Tissue samples were obtained from hatchlings that were found dead in nests at BSNWR approximately 72 hours after the live hatchlings had emerged. Preliminary analysis of the data from the juvenile turtles in this study suggests that these turtles may be from stocks common to the management units referred to as the South Florida nesting subpopulation (occurring from northeast Florida to Sarasota on the west coast of Florida) and the Florida panhandle nesting subpopulation (occurring at Eglin Air Force Base and the beaches near Panama City, Florida). We are currently analyzing the DNA sequences from relatively large numbers of hatchlings from multiple nests at BSNWR. The results of this study have significant management implications for loggerhead sea turtles in the northern Gulf of Mexico.

Evaluation of Kemp's ridley hatchling sex ratios at Rancho Nuevo over six consecutive nesting seasons

Alyssa Geis[1], Thane Wibbels[1], Lila Vega[2], Diana Lira[2], Rodolfo Acosta[2], Jaime Peña-V[2], Patrick Burchfield[2], Sergio Gomez[3], and Barbara Shroeder[4]

[1] University of Alabama at Birmingham, Birmingham, Alabama, USA
[2] Gladys Porter Zoo, Brownsville, Texas, USA
[3] SEMARNAT, Aldama, Tamaulipas, Mexico
[4] National Marine Fisheries Service, Silver Springs, MD, USA

The Kemp's ridley (*Lepidochelys kempii*) is an endangered sea turtle that inhabits the coastal waters of the Gulf of Mexico and the Atlantic coast of the United States. The Kemp's ridley possesses temperature-dependent sex determination. This type of sex determination has the potential of producing highly biased sex ratios. The primary nesting beach for the Kemp's ridley is located near Rancho Nuevo, Mexico, where a conservation program has relocated the majority of nests to protected egg corrals. As such, it is of ecological and conservational interest to monitor the hatchling sex ratios produced at Rancho Nuevo. The current study monitored nest incubation

temperatures within the egg corrals throughout six consecutive nesting seasons. Additionally, over the past three years, incubation temperatures were monitored in a subset of nests that were left on the natural nesting beach to incubate (in situ). Sex ratios were predicted based on the average incubation temperature during the middle third of incubation. Overall, nest incubation temperatures were relatively warm in a majority of the egg corral nests, suggesting the production of a strong female bias during each nesting season. The incubation temperatures of the in situ nests were lower than those within the egg corrals; however, the temperatures were still high enough to produce a female bias in a majority of nests.

Visual spectral sensitivity of loggerhead (*Caretta caretta*) and leatherback (*Dermochelys coriacea*) hatchlings: A comparative study

Judith P. Gocke[1], Mike Salmon[1], and Ken Horch[2]

[1] Florida Atlantic University, Boca Raton, FL, USA
[2] University of Utah, Salt Lake City, UT, USA

Available lighting in the ocean varies with habitat. The spectral sensitivity of marine animals to that light depends upon their visual ecology. Green turtles see visible light with almost equal sensitivity at wavelengths between 400 and 700 nm. These wavelengths are available to animals living in clear, shallow tropical water where green turtles are typically found. Our objective in this study was to determine how loggerheads and leatherbacks, both of which frequent deeper water, differ in spectral sensitivity from green turtles.
Electroretinograms from hatchling loggerhead and leatherback eyecup preparations were used to generate dark-adapted spectral sensitivity curves. The average spectral sensitivity curves for each species were fitted to a multiple photopigments model based on the Dartnall nomogram.
Loggerheads (n = 8) were most sensitive to 520 nm, with a secondary sensitivity peak at 380 nm. Leatherbacks (n = 2) were most sensitive to 500 nm, with a secondary peak at 380 nm. Sensitivity curves for both species were too broad to be fit by a single visual pigment, but could be satisfactorily fit by three visual pigments. Thus, the three species are trichromatic. The curves of loggerheads and leatherbacks were more sharply tuned to wavelengths shorter than those detected by green turtles. These wavelengths were those most likely to be transmitted to the depths where loggerheads and leatherbacks routinely feed. Tuning was most pronounced in leatherbacks that routinely feed at night, and at greater depths, than loggerheads.

Estimating loggerhead sea turtle abundance in the Spanish Mediterranean using aerial surveys

Amaia Gomez de Segura[1], Jesús Tomás[2], Susana N. Pedraza[3], Enrique A. Crespo[3], and Juan A. Raga[1]

[1] Cavanilles Research Institute, University of Valencia, Valencia, Spain
[2] Cavanilles Research Institute, University of Valencia, Valencia, Spain, and Facultad de Ciencias Humanas y de la Educación, Fundación Agrupación EDETANIA, Godella, Valencia, Spain
[3] Centro Nacional Patagónico (CONICET) and Universidad Nacional de la Patagonia, Puerto Madryn, Chubut, Argentina

During two years (2001- 2003), we have performed seasonal aerial surveys in the central Spanish Mediterranean waters following the transect line methodology to determine the abundance and

distribution patterns of loggerhead turtles. We surveyed a total of 16,700 km, collecting 769 turtle sightings during sampling effort. We used the program Distance 4.0 to estimate overall and seasonal changes in abundance of turtles. The average density of loggerhead turtles in the whole study area was 0.188 turtles/km^2 (95%CI: 0.155- 0.288) and the mean abundance was 6,020 turtles (95%CI: 4,970- 7,293). This abundance is probably underestimated because a high proportion of turtles might be submerged while surveying and are undetected by observers. Despite this, these results are essential in order to carry out conservation measures for this endangered species. Loggerhead turtles were present in the area in high abundance all year around, with densities varying from 0.045 to 0.431 turtles/km^2 depending on the survey. Although there is large variation in density, only the densities of two surveys (spring 2001 and summer 2002) were significantly different. We did not find any migratory pattern in the area, although we observed that density in the first survey year was higher than in the second one, and that, within each year, the density in spring was always higher. These comparisons have to be considered with care since the estimated densities are highly dependent on weather and sea conditions, which varied greatly between surveys.

Stock structure and gene flow among green turtle nesting populations in the eastern Pacific based on microsatellite analysis

Lauren Hansen[1], Patricia Zarate[2], Omar Chassin[3], George Balazs[4], Laura Sarti[5], and Peter H. Dutton[1]

[1] National Marine Fisheries Service, La Jolla, CA, USA
[2] Charles Darwin Research Foundation, Galapagos, Ecuador
[3] Universidad Autonoma de Mexico (UNAM), Mexico DF, Mexico
[4] National Marine Fisheries Service, Honolulu, HI, USA
[5] SEMARNAT, Mexico

This study extends previous genetic studies of green turtle stock composition in the Pacific, which have been based on mitochondrial DNA by analyzing nuclear DNA using microsatellite loci. Microsatellites are useful for defining fine scale population structure and enable examination of extent of male mediated gene flow, when compared with mtDNA results. We present allele frequencies for 8 microsatellite loci for a total of 400 green turtles from key nesting populations (approximately 100 individuals per population) in the central and eastern Pacific, including French Frigate Shoals (Hawaii), Galapagos, Michoacan (Mexico), and Islas Revillagigedos (Mexico) in order to more finely differentiate the already existing stock structure described using mtDNA, and examine patterns of gene flow. We discuss the utility of this dataset for resolving ambiguities that have arisen in using mtDNA for assigning nesting stock origin of green turtles at foraging areas.

The impacts of beach development on hatchling survival in hawksbill turtles (*Eretmochelys imbricata*)

A. Harewood and J.A. Horrocks

The University of the West Indies, Cave Hill, St. Michael, Barbados, West Indies

Extensive tourism-based development of the west and south coasts of Barbados has led to the reduction in quality of nesting beaches used by critically endangered hawksbill sea turtles, *Eretmochelys imbricata*. Females nesting on developed beaches often fail to find the native beach

vegetation in which they prefer to nest, and encounter sea walls, pavements and other anthropogenic obstructions which prevent them from reaching higher elevations on the beach. Previous research has demonstrated that females make more unsuccessful attempts at nest construction before finally nesting on developed beaches compared to undeveloped beaches, and that hatching success is lower from these nests. In the current study, we investigate the effects of nest location on hatchling survivorship. Although average clutch size did not differ between developed and undeveloped beaches, hatchling size was significantly smaller from nests made on developed beaches. Hatchlings produced on developed beaches had slower mean crawl speeds upon emergence, potentially exposing them for longer to terrestrial predators. Hatchlings leaving developed beaches were found to spend more time in near shore waters due to light disorientation and were therefore exposed to higher levels of mortality during their swim from the beach. Higher hatchling mortality on developed beaches due to nests being located closer to nearshore fringing coral reefs is also discussed.

The affects of beach renourishment on sea turtle nesting activity on Anna Maria Island

Glenn R. Harman[1] and Suzi Fox[2]

[1] Clearwater Marine Aquarium, Clearwater, Florida, USA
[2] Anna Maria Island Turtle Watch, Anna Maria Island, Florida, USA

During the spring of 2001, roughly 75% of the island of Anna Maria was renourished. The sand source for the renourishement was an offshore borrow site. The sand was pumped onto the beach hydraulically in a sand-seawater mixture. Prior to the renourishment and two years after the renourishment sand samples, cone penetrometer readings and nest evaluation data were taken to evaluate the effects of the beach renourishment project. In addition, detailed maps of nesting activity were generated to show the nesting activity on the renourished beach in comparison with the remaining natural beach on the north and south ends of the island. One more year of data collection is required by the Florida Fish and Wildlife Conservation Commission to fully evaluate the impacts of beach renourishment on Anna Maria Island. However, preliminary results show that sea turtle nesting was negatively impacted due to a combination of heavy rains, poor drainage, improper sloping of the beach and poor quality material. These factors contributed to lowered nesting activity and lowered hatchling production on Anna Maria Island.

Fibropapillomas in loggerhead sea turtles in North Carolina, USA

Craig A. Harms[1], Gregory A. Lewbart[2], Jean F. Beasley*[3], Angela M. Mexas[2], Taylor L. Reynolds[4], David E. Malarkey[5], and Lawrence H. Herbst[6]

[1] North Carolina State University, College of Veterinary Medicine, Department of Clinical Sciences, Center for Marine Sciences and Technology, 303 College Circle, Morehead City, NC 28557, USA
[2] North Carolina State University, College of Veterinary Medicine, Department of Clinical Sciences, 4700 Hillsborough Street, Raleigh, NC 27606, USA
[3] Karen Beasley Sea Turtle Rescue and Rehabilitation Center, P.O. Box 3012 Topsail Island, NC 28445, USA
[4] North Carolina State University, College of Veterinary Medicine, Department of Population Health and Pathobiology, 4700 Hillsborough Street, Raleigh, NC 27606, USA
[5] National Institute of Environmental Health Sciences, MD B3-06, P.O. Box 12233, Research Triangle

Park, NC 27709, USA
[6] Department of Pathology and Institute for Animal Studies, Albert Einstein College of Medicine, 1300 Morris Park Avenue, Bronx, NY 10461, USA

Fibropapillomatosis is a disease of green turtles and, to a lesser extent, loggerheads, olive ridleys and others. A herpes virus may play an important role in the development of the disfiguring external and internal masses characteristic of the disease.
Fibropapillomatosis occurs mainly in low latitudes, with no previous confirmed reports in the Atlantic Ocean as far north as North Carolina, USA. Here we report histologic and molecular findings consistent with fibropapillomatosis from two loggerhead sea turtles undergoing rehabilitation in North Carolina. Two loggerhead sea turtles admitted to the Karen Beasley Sea Turtle Rescue and Rehabilitation Center developed lesions suspicious of fibropapillomatosis. An adult female that appeared emaciated and lethargic developed a pedunculated mass 3 mm diameter x 1 cm long on the lower left eyelid. A juvenile that appeared thin and with a large hook in the upper esophagus developed respiratory dyspnea from a papillomatous flap 5 x 3 x 1 mm with a smooth, irregularly-shaped sessile base integrating into the glottis. Masses from both turtles were biopsied for histopathology and PCR-based diagnostics to detect fibropapilloma-associated herpes virus sequence. The eyelid mass was diagnosed as a spindle-cell sarcoma, and the glottis mass as a fibropapilloma. Both were positive for fibropapilloma-associated herpes virus sequence. The small size of the masses in these cases, and the lack of reports of large disfiguring fibropapillomas in North Carolina sea turtles to date, suggest that the disease syndrome may differ from that described further south, possibly as a result of lower average water temperatures.

The post nesting migratory movements of 4 adult loggerhead sea turtles from southeastern North Carolina, USA

Lucy A. Hawkes[1], Brendan J. Godley[1], Annette C. Broderick[1], Matthew H. Godfrey[2], and Michael Coyne[3]

[1] Marine Turtle Research Group, University of Exeter, UK
[2] North Carolina Wildlife Resources Commission, Beaufort, North Carolina, USA
[3] Seaturtle.org, Maryland, USA

The post-nesting migratory movements of four adult female loggerhead sea turtles from North Carolina, USA, were investigated for the first time using satellite telemetry. Three turtles were tracked using Telonics ST-18 Platform Terminal Transmitters and 1 turtle was tracked using a Satellite Relay Data Loggers developed by SMRU. Three turtles stayed in North Carolina waters, using the northernmost portion of the outer banks for foraging grounds. The fourth turtle headed to Cape May, New Jersey and used the inshore waters of the Cape for forage for 3 months. The foraging grounds for this part of the northern sub-population were previously unknown. Findings were concurrent with previous investigations of the migratory movements of the Northern population of loggerheads from the southeastern United States. This study was hosted on seaturtle.org and live tracking updates were made available to visitors to the site raising awareness of sea turtle conservation and promoting public education.

Embryonic mortality in leatherback turtle (*Dermocheys coriacea*) translocated nests in Querepare, Venezuela

Ricardo A. Hernández S.[1], Bruno Iglesias[2], Alba Tudela [2], and Maria Rondón[2]

[1] CICTMAR (Centro de Investigación y Conservación de Tortugas Marinas) / WIDECAST. Apdo. 50.789. Caracas 1050-A. Venezuela, Estación de Investigaciones Marinas, Fundación La Salle de Ciencias Naturales (EDIMAR-FLASA), Campus Margarita. Punta de Piedras. Isla de Margarita. Estado Nueva Esparta. Venezuela.

[2] CICTMAR (Centro de Investigación y Conservación de Tortugas Marinas) / WIDECAST. Apdo. 50.789. Caracas 1050-A. Venezuela

The leatherback sea turtle is the main nesting species in the Paria Peninsula (Sucre state, Venezuela). Querepare (62º52'W and 10º42'N) is one of the main nesting beaches on the Venezuelan mainland, where, between May and September 2003, 58 leatherback clutches were moved to a protected hatchery. In mid-July, a strong sea swell caused drastic beach erosion in the protected hatchery zone; consequently, a new hatchery was built in a safe place and the eggs of 25 nests, with 13 to 32 days of incubation already completed, were transferred. To find out the effect of this additional relocation, hatchling success was compared with clutches laid earlier or later in season and only relocated once. Embryonic development at death was quantified in single and double moved eggs using a growth scale of eight morphological stages, level I being the least-developed embryos and stage VIII being full-term embryos. Development at death was considered evidence of incubation time at mortality. In twice-reburied eggs, stages IV and V showed a greater amount of embryonic mortality (33.7 and 24.1 %), indicating death at 20 to 30 days. In singlely relocated clutches, embryonic mortality was higher at level III (17.5 %). An ANOVA showed significant difference ($P<0.001$) between the hatching success in doublely (35,2% n=25) and singlely relocated clutches (73,3% n=24). Eggs' translocation to a second hatchery was an appropriate decision, since the risk of nest loss with a hands-off option could be up to 100%, while with this method 35.2% hatching success was obtained.

Monitoring of nesting marine turtles: Distribution and fisheries interaction in the Ecuadorian mainland

Mario Hurtado and Gustavo Yturralde

Hurtado & Asociados, Guayaquil, Ecuador

A marine turtle nesting beach aerial survey along the Ecuadorian coastlines was made in February 2002 between the Colombia and Peru borders. A comparison of this data with the historical nesting beach distribution data from the 80's is included. In brief, incremental nesting habitat loss was confirmed and nesting of *C. mydas* and *E. imbricata* was restricted to the surroundings areas of the Machalilla National Park on the central coast of Ecuador. Unplanned coastal development, increased human presence, and beach mining were the principal marine turtle threats identified along the coastline of Ecuador. Of course, during the survey we observed beach mining in Napo-Canoa, a relevant nesting beach of *C. mydas*, *D. coriacea* and *E. imbricata* reported in the 80's. On the other hand, new record of *C. mydas* was registered in La Plata Island, and other isolated beaches in the protected area. Additionally, data of the marine turtle bycatch in boats of longline artisanal fisheries around the marine area of the Machalilla National Park was documented too. Data collected onboard 5 longline artisanal fisheries registered a CPUE of 0.0442 turtles/100 hooks for *C. mydas*; and 0.0885 turtles/100 hooks for *L. olivacea*. An overview of the marine turtle conservation in Ecuador is also included. The monitoring was made with NMFS financial support and Ecociencia logistical support.

Incidence of environmental variables on sea turtles in the province of Buenos Aires, Argentina

Maria Natalia Irurita

Facultad de Filosofía, Historia y Letras, Universidad del Salvador, Buenos Aires, Argentina. Projecto Peyu, La Plata, Argentina

For the province of Buenos Aires, Argentina three species of sea turtles are reported: *Chelonia mydas*, *Caretta caretta*, and *Dermochelys coriacea*. Research on sea turtles here is in its early stages. We chose to study the possible variables that condition the presence of sea turtles in our study area. The objective of this work was to determine the environmental variables that serve as conditioners to sea turtles in Buenos Aires, Argentina. The compilation of registries (locality, date) of the three species present in the area was compared with different environmental variables: salinity and water temperature, air temperature, relative humidity, precipitation and wind speed. The results were conclusive; the temperature of the water is the restricting factor. This is most interesting considering that in most of the published studies to date, water temperature would have to remain over 20°C (68°F) for adult individuals. The salinity in the zone influenced by the Río de La Plata diminishes for the same period of the year, despite the damage seemed to be nonexistent. The presence of these species in average latitudes below 35° indicates that many doors need to be opened in relation to their ecology, fundamentally in zones of feeding where the works of investigation are more arduous to carry out.

Anatomical localization of the magnetoreception system in sea turtles

William P. Irwin and Kenneth J. Lohmann

University of North Carolina, Chapel Hill, NC, USA

Sea turtles are able to detect the Earth's magnetic field and use it as a cue in orientation and navigation. Little is known, however, about how turtles and other animals perceive magnetic fields; indeed, even the anatomical location of magnetoreceptors has not been determined. As a first step toward localizing the region of the body where magnetoreception occurs, we attached small magnets to different locations on hatchling loggerhead turtles and studied the effects on orientation behavior. Four groups of hatchlings were tested under conditions in which turtles are known to rely on magnetic orientation to maintain a consistent heading. Control turtles, which had non-magnetic brass bars attached to three test locations (head, mid-carapace, and posterior carapace), were significantly oriented toward the east, a direction that corresponds with the normal offshore migration. Turtles in the other groups had a magnet attached to one of the three locations and brass bars to the other two. Hatchlings with a magnet on either the posterior carapace or the mid-carapace swam eastward like the controls. In contrast, turtles with a magnet attached to the head oriented randomly. These results imply that the magnetoreception system of sea turtles is located in or very near the head.

100 hours swimming with turtles: Looking in on a population of greens

Kirstin R. Jones, Julia E. Moriarty, and Kirt W. Rusenko

Boca Raton Sea Turtle Conservation and Research Program, Boca Raton, FL, USA

In the summer of 2002, a previously undocumented population of green turtles was discovered on an area of near shore, hard-bottom reef in Boca Raton, Florida. In May 2003, a visual monitoring project was started with the objectives of establishing the number of turtles present, estimating their growth stages, observing their behavior and assessing the opportunity for further study.

Observations were made while snorkeling in the same location several times per week. Digital photographs were taken of as many turtles as possible on each occasion and scute patterns, particularly on the head, were compared to positively identify individuals. Twenty-five different turtles have been recorded so far. The majority of these are juveniles. However, several sub-adults have also been documented and between May and August three mature females were seen repeatedly.

Certain turtles, including one sub-adult, have displayed foraging site fidelity. These have been followed frequently, permitting close observation of their dietary habits and breathing patterns. Interaction between individuals has been noted a number of times. There are no visible signs of fibropapillomas and the population appears healthy except for a high incidence of turtles being fouled by fishing tackle.

The turtles appear to move into and out of the area randomly. Some were seen regularly over a short period while others were seen sporadically over several months. One sub-adult, consistently present in the summer of 2002, disappeared for the winter then returned in the spring of 2003. Further study of the movements of these green turtles could be useful.

Repeatability of nesting preferences in the hawksbill sea turtle (*Eretmochelys imbricata*) and their fitness consequences

Stephanie Kamel and N. Mrosovsky

Department of Zoology, University of Toronto, Toronto, Ontario, Canada

Where an animal places its nests has important consequences for its reproductive success, most often through the survival of its offspring. For sea turtles, the environment in which the nest is laid greatly influences the probability of a successful reproductive outcome. With so much dependent upon the choice of a nest site, it is likely that this behavior is or has been under strong selection. As little is known about nest site choice in sea turtles, we investigated individual nest placement patterns for female hawksbills nesting at Trois-Ilets, Guadeloupe.

In addition, the thermal consequences of the nesting patterns were determined. The nesting patterns revealed that hawksbills nest in thermally diverse habitats. This is of particular relevance as sea turtles display temperature-dependent sex determination, with females being produced at warmer temperatures. Evolutionary and conservation implications in the context of current environmental changes are discussed.

Population and health assessment of sea turtles in the Maryland portion of the Chesapeake Bay

Tricia L. Kimmel[1], Cindy P. Driscoll[1], Mark A. Matsche[1], Larry H. Pieper [1], and David G. Kimmel[2]

[1] Maryland Department of Natural Resources, Cooperative Oxford Lab, Oxford, Maryland, USA
[2] University of Maryland Center for Environmental Science, Horn Point Laboratory, Cambridge, Maryland, USA

The Chesapeake Bay has been identified as an important region to study sea turtle distribution, habitat requirements, genetic origin, baseline health, sex and growth rates. In 2001, the Maryland Department of Natural Resources (MD DNR) and the National Marine Fisheries Service (NMFS) initiated a sea turtle tagging and health assessment study in the Maryland portion of the Chesapeake Bay. Sea turtles were obtained through the cooperation of commercial watermen and were incidentally captured in pound nets, a type of passive, stationary fishing gear utilized in the Chesapeake Bay to catch finfish. Since 2001, 39 sea turtles (22 loggerheads and 17 Kemp's ridleys) have been examined as part of this study. The loggerheads ranged in size from 52 to 105 cm (ccl) and the Kemp's ridleys ranged in size from 32 to 54 cm (ccl). Each animal was photographed, measured, weighed, sampled for tissue and blood, tagged (flipper and PIT tags) and released. Recaptures of tagged sea turtles have occurred within and between sampling seasons, indicating site fidelity. Blood samples are being analyzed to aid in establishing hematology reference ranges for loggerhead and Kemp's ridley sea turtles, which are currently limited for these species. Analysis of tissue samples will be performed to determine the genetic origin of sea turtles in the Chesapeake Bay. The results of this study will contribute to a more comprehensive understanding of sea turtles on a regional and global scale, which is important for the development of effective management strategies for these endangered and threatened species.

Nesting hawksbill turtles (*Eretmochelys imbricata*) on the island of Maui, Hawai'i from 1996-2003

Cheryl S. King[1], William Gilmartin[1], Skippy Hau[2], Hannah Bernard[1], Suzanne Canja[1], Glynnis Nakai[3], Mary Jane Grady[1], Steven Williams[3], and Alastair Hebard[1]

[1] Hawai'i Wildlife Fund, P.O. Box 70, Volcano HI 96785
[2] Hawai'i State Dept. of Land and Natural Resources, 130 Mahalani St., Wailuku, HI 96793
[3] U.S. Fish and Wildlife Service, Maui NWR Complex, P.O. Box 1042 (Milepost Hwy), Kihei HI 96753

Critically endangered hawksbills predominately nest on Hawai'i Island, but lower numbers also nest on the islands of Maui and Molokai, with a statewide estimate thought to be at least fifty reproductive females. Hawksbill nesting activities were first documented on Maui in 1991, and an organized effort to systematically monitor these occurrences began in 1996. A multi-agency collaboration has been essential for protecting this small population from dangers caused by human disturbance, coastal lighting, non-native vegetation, predators, and vehicular collisions. From 1996-2003, an average of 1.4 nesting females/year have utilized four distinct beaches for nesting. Tagging began in 1997 resulting in the identification of six different females (one/year) ranging in size from 84.5-93.4cm CCL (x=89.1cm) and 78.2-87.0cm CCW (x=83.4cm). No recaptures have been documented, raising the potential remigration interval to two to seven years. The total ratio of nests to aborted attempts was 1.3:1 with 80% of these "false crawls" occurring on the narrow, eroded Kealia Beach (1:1.7). Females laid an average of 4.0 clutches/season, with

a 20.1-day mean internesting interval. All twelve clutches (from three different females) that have been deposited at Kealia Beach since 1997 have had 0% hatching success, whereas in prior years' nests had been productive. Kawililipoa and Oneloa Beaches have been successful, with incubation periods averaging 57.5 and 60.5 days. Four hatchlings, presumably from Maui, have been found in the waters surrounding Molokini crater. Increased survey coverage with heightened community awareness and involvement will continue to broaden our understanding of nesting hawksbills on Maui.

Distribution and abundance of hawksbill sea turtles (*Eretmochelys imbricata*) on the western bank reef of Barbados, West Indies

Barry H. Krueger, Jennifer A. Beggs, and Julia A. Horrocks

University of the West Indies, Cave Hill, St. Michael, Barbados

Hawksbill turtles ranging in size from 23.8-97.8 cm CCL (n=563) have been caught at 27 reef sites along the west coast of Barbados using SCUBA between 1998-2003. More animals were caught on northern reef segments than southern segments. Most animals captured fell in the size range 45.0 – 49.9cm CCL. The CPUE of sub-adult turtles (i.e. less than 80 cm CCL) was similar year round, but the capture of adult females was markedly seasonal and increased during the nesting season (May-September). The size distribution at all dive sites was biased to smaller sized turtles (30-50cm CCL), suggesting that larger juveniles are generally more scarce on the bank reef. Of the 563 turtles, 253 have been sighted more than once. Smaller turtles were more likely to have been sighted multiple times than larger turtles over the same time period, suggesting that smaller turtles are resident for longer on the reef. The recovery of tagged juveniles from other countries suggests that hawksbills may leave Barbados as large juveniles and seek other foraging grounds in neighboring islands. The unsuitability of the bank reef as foraging habitat for large hawksbills is further supported by the relative scarcity of adults outside of the breeding season.

Bioaccumulation of metals in tissues of loggerhead sea turtle, *Caretta caretta*, from eastern Adriatic Sea

Bojan Lazar[1,2], Maja Blanusa[3], Drasko Holcer[1,2], and Nikola Tvrtkovic[1]

[1] Department of Zoology, Croatian Natural History Museum, Zagreb, Croatia
[2] Blue World Institute of Marine Research and Conservation, Veli Lošinj, Croatia
[3] Institute for Medical Research, Zagreb, Croatia

Concentrations of Hg, Pb, Cd, Zn, Cu and Se were determined by atomic absorption spectrometry in the soft tissues (liver, kidney, pectoral muscle, heart) and humeri of 40 loggerheads. Among soft tissues analyzed, the highest concentration was found for Zn > Cu or Se > Cd > Hg > Pb, with difference in the concentration pattern in kidney (Zn > Cd > Se > Cu > Hg > Pb). No significant difference was found in tissue distribution of Hg, while the kidney accumulated significantly more Cd than other organs analyzed. Among soft tissues, the highest concentrations of Pb were found in the liver and kidney, which were significantly higher than in muscles. Liver also accumulated significantly higher concentrations of Cu and Se than all other tissues. The mean concentration of renal Cd (60.86 μg/g d.w.) was two fold higher than in other Mediterranean loggerhead populations, whereas the mean Hg in pectoral muscle (1.77 μg/g d.w.) was the highest concentration of Hg found in muscle in all sea turtle species worldwide.

Significant correlations between Pb and Se, Cd and Se, and Zn and Cu in liver, Zn and Cd, Hg and Se, and Cd and Se in kidney, and Hg and Zn, Hg and Cu, and Cu and Se in pectoral muscle suggest the existence of detoxification processes. Significant positive growth-dependent variations in concentrations were found for renal Hg, and heart Pb, whilst concentrations of hepatic Zn and Cd decreased with growth.

Predation by the small Indian mongoose (*Herpestes javanicus*) on hawksbill sea turtle nests in Barbados, West Indies

Patrick A. Leighton[1], Julia A. Horrocks[2], Barry Krueger[2], Jen Beggs[2], Diorys E. Perez[2], and Donald L. Kramer[1]

[1] McGill University, Montreal, Quebec, Canada
[2] University of the West Indies, Barbados, West Indies

Mongooses impact sea turtle populations through predation on eggs and hatchlings, and are probably the most significant vertebrate predator of sea turtle nests in many Caribbean islands. The behavior of mongooses foraging at Bath Beach, an active hawksbill nesting site in Barbados, was studied. Movement and activity of mongooses on the beach were monitored using radio telemetry, and several nest-raiding events were observed and filmed. Mongooses were found to be highly vigilant while foraging, and their activity on the beach was concentrated in and around taller beachside vegetation, allowing them to remain hidden. Five years of data collected by the Barbados Sea Turtle Project showed that mongoose predation on hawksbill nests at Bath Beach is significant and that predation risk increases with proximity of nest to vegetative cover. In an experiment where artificial sea turtle nests were set up both in and out of cover, the proportion of nests that were predated and the efficiency of predation were found to be much greater in cover than out of it. The relevance of these findings to possible sea turtle conservation techniques such as nest relocation, mongoose control, and alteration of beachside vegetation are discussed.

Stock composition of sea turtles caught in the Hawaii-based longline fishery using mtDNA genetic analysis

Robin A. LeRoux[1], George H. Balazs[2], and Peter H. Dutton[1]

[1] National Marine Fisheries Service, La Jolla, CA, USA
[2] National Marine Fisheries Service, Honolulu, HI, USA

Several species of sea turtles are incidentally captured in the Hawaii-based longline fishery. This study aims to determine the stock origin of turtles captured from 1997 through 2003. Genetic samples were taken from approximately 130 loggerheads, 15 green turtles, 20 leatherbacks, and 50 olive ridley sea turtles. Mitochondrial DNA (mtDNA) control region sequences were analyzed to determine the stock origin of these turtles by comparing data with the haplotypes from key nesting beaches throughout the Pacific. This analysis allows inferences to be made on migration and distribution of sea turtles in the pelagic realm, and enables an assessment of the fisheries impacts on particular stocks in the North Pacific. Conservation implications will be discussed.

Genetic stock composition of nesting hawksbill turtles, *Eretmochelys imbricata*, in Guadeloupe

Robin A. LeRoux[1], Johan Chevalier[2], and Peter H. Dutton[1]

[1] National Marine Fisheries Service, La Jolla, CA, USA
[2] ONCFS, France

The hawksbill turtle (*Eretmochelys imbricata*), listed as Critically Endangered on the IUCN Red List of Threatened Animals, is widely distributed throughout the Caribbean. Recent studies have presented a foundation for understanding the mitochondrial (mtDNA) genetic make-up of several major nesting beaches in this region. This study attempts to fill in a portion of the genetic map by reporting haplotype frequencies obtained from samples collected from approximately 60 nesting females on the island of Marie Galante, Guadeloupe. We compared results with data published for other Atlantic rookeries to examine regional population sub-structuring. In addition we use Bayesian methods to re-analyze published data on stock contributions to foraging areas around the Caribbean, to see if contributions from Guadeloupe could be detected. We discuss the implications to our understanding of recruitment and gene flow within the region as it relates to conservation issues.

Solving an apparent paradox of the reproductive biology of the olive ridley turtle at its northernmost limit in the eastern Pacific

Melania C. López-Castro and Axayácatl Rocha-Olivares

Centro de Investigación Científica y de Educación superior de Ensenada, Ensenada, B.C. México

Little is known about the nesting of olive ridley turtles in the Baja California Peninsula, the northernmost limit of its reproductive range in the eastern Pacific. An earlier study revealed that nesting behavior is greatly affected by the low humidity and high temperature that characterizes this arid region, forcing female turtles to nest closer to the high tide line to ensure proper conditions for the development of their clutch. Furthermore, hatchling sizes in this area were significantly higher than the average size recorded in other nesting areas in México. The "paradox" here is that even though female turtles appear to behaviorally compensate humidity and temperature in the nest, under elevated temperatures and limited humidity in which embryonic development occurs in Baja California, physiological theory predicts that hatchlings should be smaller; however they are larger than the average size. This apparent paradox could be explained if these turtles were genetically different from those in the rest of our country. Therefore, the aim of the present study is to genetically characterize the nesting colony of Baja California Sur, using mitochondrial DNA (mtDNA). We sampled nesting females, dead hatchlings or eggs in four different nesting sites in the south of the peninsula during the 2002 and 2003 reproductive seasons. We present the results from 60 genotyped turtles from which total genomic DNA was extracted and the mtDNA control region was PCR amplified and sequenced. Mitochondrial haplotypes were compared with those previously found in the eastern Pacific.

Home range and movements of juvenile Atlantic green turtles (*Chelonia mydas*) on shallow reef habitats in Palm Beach, Florida

Christopher Makowski[1], Michael Salmon[2], Ryan Slattery[2], and Jeffrey Seminoff[3]

[1] Florida Atlantic University, Boca Raton, Florida, USA; Coastal Planning & Engineering, Inc., Boca Raton, Florida, USA
[2] Florida Atlantic University, Boca Raton, Florida, USA
[3] NOAA-National Marine Fisheries Service, Southwest Fisheries Science Center, La Jolla, California, USA

Juvenile green turtles return to shallow-water "developmental" habitats after 1-2 years in the open ocean. In Hawaii, Baja California, and Florida (estuarine habitats), the turtles occupy home ranges. Our objective was to determine if coastal (shallow-water, oceanic reef) populations in Florida also occupy home ranges, and how these compare in size and resource availability with those studied elsewhere. Six turtles were captured and their stomach/esophagus flushed to determine diet. Each was released with an ultrasonic transmitter used to track its movements between August and November. Four turtles were recaptured and fitted with a time-depth recorder. Diving activity of each turtle was monitored for 24 h so that cycles of activity and inactivity could be related to range of movement and fidelity to specific areas of the reef.
All turtles occupied distinct home ranges, largely restricted to the reef itself. Home ranges of neighbors showed some overlap. Home range size varied from 1.51 to 4.10 km^2. Four of six turtles returned to the same "sleeping" site; two turtles occupied two separate sleeping sites, each for intervals of 1-2 days. Diving activity peaked during the day (many short dives); at night, dives were long in duration and few in number. All six turtles ate similar species of macroalgae. Results support the hypothesis that juvenile green turtles occupy stable home ranges, at least during the summer and fall. We hypothesize that they learn the location of food patches and safe resting sites. These adaptations probably increase foraging efficiency, growth rates, and survival.

The marine turtles of the eastern coast of Mexico: Abundance, distribution, protection and capture

Rene Marquez-M.

Consultant, Scientific Commitee, CIAPCTM

Five species of marine turtles visit the eastern Mexican coast: green, loggerhead, hawksbill, Kemp's ridley and leatherback. Protection began in 1966, through the creation of turtle camps. For Kemp's ridley, in 1978, Mexico and the United States began a program to promote investigation and protection, including an experiment to reestablish a colony in south Texas. Eggs were donated to the United States and incubated on Padre Island, hatchlings were reared in Galveston, Texas, and juveniles were released in coastal localities. This project was initially created for 10 years and renewed for 10 more. Collaboration in Rancho Nuevo, the primary Kemp's ridley nesting beach, continues today. Other successful programs are related to hawksbill and green turtles, coordinated by INP and INE, and supported by NGO's, universities, state governments and fishing sectors.
Commercial rearing has not been developed, but rather the rearing of hatchlings for a few weeks to a few months has been implemented to reduce their predation. However at release the potential for infections, mutilations, and appropriate release locations for different life stages are addressed. Recently "eco-tourist" cultivation has been developed, joined with beach protection, here some hatchlings are reared one year and released by tourists.

Commercial exploitation (1964-1981) during registered years was: green 67.9% (17 years), loggerhead 24.8% (13), hawksbill 1.13% (9), leatherback 5.56% (8), oil 0.6% (7). Distribution by states, same years: Tamaulipas 0.08%, Veracruz 2.29%, Tabasco 0.23%, Campeche 14.01%, Yucatan 6.1% and Quintana Roo 74.73%. In 1972-1973 a ban was declared and again a total ban of exploitation was declared in 1990. Uses: meat, skin and oil were marketed regionally. Hawksbill handcrafts had great acceptance. Green turtles were exported to the US.

Estimation of date of death for finding out causes of egg mortality

Yoshimasa Matsuzawa[1], Naoki Kamezaki[1], and Kiyoshi Goto[2]

[1] Sea Turtle Association of Japan, Hirakata, Osaka, Japan
[2] Sea Turtle Research Group, Minabe, Wakayama, Japan

Establishment of causes of death for unhatched eggs is vital to improving hatching success of sea turtle nests in situ. Estimation of the date of death is a hot lead. In the 2002 season, 1,252 unhatched eggs from 16 loggerhead clutches nested in Minabe-Senri Beach, Wakayama, Japan were opened to classify their developmental stages. The date of death for each egg was determined in the following way. First, we calculated the day-degree, the accumulated incubation temperature above the developmental zero of 17.6 degrees, required for embryos to develop from ovipositional stage to the specific developmental stage based on Miller (1985). Then, the estimated time of death is determined as the time to when the integral of the sand temperature above 17.6 degrees from the oviposition reached the specific value for the developmental stage. The date of death for many unhatched eggs coincided with the closest approaches of two typhoons in the middle of July. However, many more eggs died at the end of July and at the beginning of August, when sand temperature at nest depth exceeded 33 degrees. These results suggest that inundations induced by typhoons and excessive heat were major causes of death for most of the unhatched eggs, and that many embryos lived through the typhoons. Not only relocation of nests laid near the sea, but also some precautionary measures against heat-related mortality (Matuszawa et al., 2002) are required in rookeries where sand temperatures are as high as at our study site.

Displacement and subsequent homing of juvenile green turtles to highly productive foraging areas

Erin McMichael[1], Jeffrey A. Seminoff[2], and Raymond R. Carthy[1]

[1] Florida Cooperative Fish & Wildlife Research Unit, University of Florida, Gainesville, Florida, USA
[2] NOAA-National Marine Fisheries Service, La Jolla, California USA

Green turtles navigate the marine environment using long distance migrations and shorter distance movement patterns to reach predetermined and perhaps preferred destinations. Adult female turtles return to their natal areas, both when displaced from their nesting grounds during a nesting season, and after traveling long distances between each nesting season. Although we are beginning to document homing in adults, little is known about homing abilities of juvenile turtles. In this study, we examine the homing behavior observed in 45 juvenile green turtles (mean SCL = 43.9 cm, range = 34.4 cm to 61.1 cm) in the northeastern Gulf of Mexico. Turtles were rescued in a moribund state from St. Joseph Bay, a temperate foraging area along the Florida panhandle, during two separate cold-stun events in 2001 and 2003. After rehabilitation (5 to 15 days), turtles were released into the warmer waters of the Gulf of Mexico. Despite being displaced by a

minimum swim distance of 50 km from their original stranding locales, turtles returned to St. Joseph Bay in 225 to 880 days (mean = 606 days). All turtles experienced an increase in mass and SCL, although their overall growth rates appear less than those of turtles not displaced during these events. St. Joseph Bay is a highly productive coastal embayment that has recently come to light as an important developmental habitat for this species. The homing movements documented here indicate that juvenile green turtles prefer specific foraging habitats, compromising short-term growth for successful long-term energy acquisition.

Bogue Banks sea turtle monitoring project-Establishing a baseline to determine impacts of beach nourishment

A. Nicole Mihnovets[1] and Matthew Godfrey[2]

[1] Duke University Marine Lab, Beaufort, North Carolina, USA
[2] NC Wildlife Resources Commission, Beaufort, North Carolina, USA

As part of an ongoing beach nourishment project conducted by the United States Army Corps of Engineers, the island of Bogue Banks, North Carolina is in the midst of receiving dredged beach fill material on its beaches in three phases over the course of several years. Phases one and two were completed in 2002 and 2003, respectively, and phase three is expected to commence in 2004. A sea turtle monitoring project was established in order to assess the potential impact of nourishment activities on sea turtle reproduction. Consistent monitoring throughout each phase of nourishment and beyond allows a unique opportunity to compare affected versus unaffected areas in a "before and after" paradigm.
Sand compaction, nest and sand temperatures, and loggerhead sea turtle (*Caretta caretta*) activity were recorded during the course of the 2002 and 2003 nesting seasons. Additionally, nest inventories, hatching emergence success, and GPS coordinates for all crawls were recorded in an effort to establish a thorough foundation of baseline information to be used in future comprehensive analysis in promoting sea turtle conservation on the island.

Sea turtles migration study from the tagging program in Cuba

Felix Moncada [1], Gonzalo Nodarse [1], Charlie Manolis [2], Grahame Webb [3], Erich Escobar[4], and Ana M. Rodriguez[5]

[1] Centro de Investigaciones Pesqueras, Ministerio de la Industria Pesquera, 5ta Ave y 248, Barlovento, Santa Fé, Ciudad Habana, Cuba, Tel: 2097875, Fax 2049827, e-mail: tortugas@cip.telemar.cu
[2] Wildlife Management International, PO Box 530, Sanderson, NT 0813, Australia, Tel.: 61.8.89224500, Fax.: 61.8.89470678, e-mail: cmanolis@wmi.com.au
[3] Wildlife Management International, PO Box 530, Sanderson, NT 0813, Australia, Tel.: 61.8.89224500, Fax.: 61.8.89470678, e-mail: gwebb@wmi.com.au
[4] Centro de Investigaciones Pesqueras, Ministerio de la Industria Pesquera, 5ta Ave y 248, Barlovento, Santa Fé, Ciudad Habana, Cuba, Tel: 2097875, Fax 2049827, e-mail: tortugas@cip.fishnavy.inf.cu
[5] Empresa Nuevimar. Nuevitas. Camaguey. Cuba

The tagging program of sea turtles nesting in Cuba was initiated in 1989 by the Fisheries Research Center, Ministry of the Fishing Industry. A total of 1,962 sea turtles (1,005 hawksbill turtles, 746 green turtles and 211 loggerhead turtles) were tagged from 1989 to 2002 in different sites (nesting beach and foraging areas) of the Cuban shelf, with 155 (8.0 %) recoveries (129 in Cuban waters). Twenty green turtles were recaptured in the waters of Costa Rica, EU, Nicaragua, Honduras and Panama, two loggerhead turtles in Nicaragua and Honduras' waters and two hawksbill turtles in waters of Colombia and Nicaragua. This tagging program also included, 14

hawksbill turtles studied by satellite tracking between 1996 and 2000: 7 in foraging areas, that were recaptured in Gran Caymán - Cuba, Guadalupe, México and Colombia and 7 in nesting beach (Doce Leguas keys), 5 of which stayed in the area after nesting and 2 were found in Honduras waters.

Relative abundance of nesting marine turtles on the coasts of Guatemala from July to December 2002

Nancy L. Montes-Osorio[1], Mario R. Jolon-Morales[2], Roberto Ruíz-Fumagali[1], and Regina Sanchéz-Castañeda[2]

[1] Universidad de San Carlos de Guatemala, Ciudad Guatemala
[2] PROBIOMA, Ciudad de Guatemala

From July to December 2002, 11 beaches were surveyed in Guatemala, 9 on the Pacific coast and 2 on the Caribbean coast. A total of 14,284 km were walked during 1,123 surveys. We reported direct sightings and signs of *Lepidochelys olivacea* (99.94%) and *Dermochelys coriacea* (0.06%) in the Pacific, and *Eretmochelys imbricata* (66%), *Chelonia mydas* (3.5%) and unidentifiable tracks (30.5%) on the Caribbean coast. Significant differences ($p < 0.05$) were found in the temporal and spatial distributions of the relative abundance of marine sea turtles that nest in Guatemala. The most important months for nesting of *L. olivacea* were August and September. The only report for *D. coriacea* occurred in December. The months that *E. imbricata* presented the most nesting activity were July and August. The only observation of *C. mydas* occurred at the beginning of August. September was the month with the most detection of unidentified signs. Physical condition examined in turtles presented external parasites (63 %), blows or blunt force trauma (26%, N = 156) and mutilations (10%, N = 156) that could considerably affect the populations of marine sea turtles. The main causes of death in the carcasses found were extraction of eggs (opening the abdomen) (39%, N=31), blows or blunt force trauma (26%, N=31), mutilations (19%, N=31) and injuries from fishing nets (13%). This data is an indicator of the high impacts that commercial and local fishing (shrimp, shark and others) have on the sea turtles of the area.

Geographic distribution of the sea turtles in the Gulf of Venezuela

Ma. Gabriela Montiel-Villalobos[1] and Héctor Barrios-Garrido[2]

[1] Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV)
[2] Postgrado en Ecología Aplicada. Facultad de Ciencias. La Universidad del Zulia

The Gulf of Venezuela represents one of the most important sea turtle feeding zones in the Caribbean. It has a surface of 18.500 km^2 and a coastal perimeter of 784 km^2. Its high productivity offers a diversity of ecosystems with specific conditions and characteristics, offering the different species of sea turtles an ecological niche adapted to their needs. The Gulf of Venezuela contains the green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), loggerhead turtle (*Caretta caretta*), leatherback turtle (*Dermochelys coriacea*) and olive ridley turtle (*Lepidochelys olivacea*). The unequal distribution of these species across varying ecosystems includes areas of sea grass, coral reefs, zones with muddy funds and open water, respectively. Insufficient data exist for *Lepidochelys olivacea* in this zone. Another factor that affects the geographical distribution of these species is influenced by the ecological diversity, alimentary requests and the different methods of fishing that exist in each locality, determining the abundance of each species according to the area. The importance of these data situates in the

implementation of work methodologies that facilitate the monitoring of the populations of the different species in the different localities, permitting detection of possible time limited population fluctuations and the main threats for each species according to the locality. This allows for the determination of methods of conservation individually adapted to each locality, its conditions and the species present there.

Genetic evidence on the convergence populational of green turtle (*Chelonia mydas*) in the Gulf of Venezuela

Ma. Gabriela Montiel-Villalobos[1] and Héctor Barrios-Garrido[2]

[1] Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV)
[2] Postgrado en Ecología Aplicada. Facultad de Ciencias. La Universidad del Zulia. Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV)

Diverse antecedents exist that show that the green turtle are the species of sea turtle that carries out the longest migrations. This fact has been verified among nesting beaches and zones of diet through the coverage and recapture of animals. In recent years, this has been verified through molecular markers. The Gulf of Venezuela constitutes one of the most important feeding areas for sea turtles in the Caribbean. Recently, the first genetic investigation in the Gulf of Venezuela was carried out, determining through molecular polymorphisms that there exist three genetically different populations that converge in the zone. The high energy levels that the seagrass contributes to the the Gulf of Venezuela, as well as the strategic geographical location with similar distances among the main nesting beaches for green turtle in the Caribbean (Tortuguero, Isla de Aves, Mexico and Surinam) place a priority on this region for the protection, management and conservation of sea turtles, considering the fact that there exist large quantities of sea turtles that are exploited as economic and alimentary resources by the indigenous Wuayuú. It is recommended to further investige monitoring and conservation in the Gulf of Venezuela, while continuing molecular monitoring.

Project Pasoso - Baseline data collection and conservation education in central Sulawesi, Indonesia

Abigail Moore, Harto Darwinto, Rusdin Sinaling, and Andi Sofyan

Yayasan Adi Citra Lestari, Palu, Central Sulawesi, Indonesia

The authors are members of a team that has been awarded a small grant from the BP Conservation Program for a one-year green turtle population data collection project at Pulau Pasoso Reserve and surrounding area in Balaesang District, Central Sulawesi, Indonesia. This program, named "Project Pasoso," is the first marine turtle data collection project in this area, and so constitutes a "baseline" study.

The presentation will give the methodology used, and summarize the survey results to date, including numbers of nesting turtles, nesting and hatching success, seagrass (foraging habitat) survey results, and other information gathered during the course of the project. Points of interest include the involvement of the local inhabitants in the survey and in conservation measures, and the progress of the MPA towards being more than a "paper park," an "obstacle course" which requires patience and dedication.

Training/education materials using simple cartoons in both English and Indonesian for training community members in data collection methods and for promoting general awareness and behavior change in local people and visitors, and samples of audio-visual materials produced will be shown.

Marine turtles nesting in the Natural National Park Tayrona (PNNT) Santa Marta, Colombia (1999-2003)

Alvaro Andrés Moreno [1] and Guiomar Aminta Jauregui [2]

[1] Student of pregrado University Jorge Tadeo Lozano, Colombia
[2] Investigator educational University Jorge Tadeo Lozano, Colombia

Assisting the recommendations made by specialists in the handling of marine turtles regarding counting for the implementation of conservation programs, with annual pursuits of biological processes as the nesting activity on beaches, a structured database is believed, of the eastern sector of the PNNT (Arrecifes and Cañaveral), using as interpretation tool SIGs that facilitate the correlations among the registrations has more than enough to arrive accumulated in the last five years (1999-2003) with some environmental aspects that directly influence the nesting events.
As results one has that although the arrival number had maintained relatively constant (30), a gradual decrease of 65% is evidenced in the broods and the reduction of species nesting, for he/she doesn't witness it of *C. mydas* in the five seasons. It is observed that the nesting activity concentrates on beaches Cañaveral, Cuchicampo, El Saco and La Gumarra, responding to the effect that it has more than enough of the geomorphological conditions (wide and inclination of strata and grain type) it exercises the high energy of the sea registered in the erosion and dynamics peculiar of each beach; it is as well as in 2001, El Saco presents 50% of the arrivals of *E. imbricata* contrasting with the data for the 2003 where on the same beach he/she doesn't register event some, due to the disappearance of the half stratum for the increase of the laundry area. It is also had physiochemical pursuits of nests and morfometría of females and neonatos of *D. coriacea* and *C. caretta*.

Compilers and editor unsure of meaning, left abstract as submitted.

Monitoring of ambient conditions in sea turtle hatcheries on the Pacific coast of Guatemala

Colum Muccio[1], Gloria Guevarra[2], Scott Handy[1], Francesca Barker[1], and Rob Nunny[3]

[1] ARCAS, 4 Ave 2-47 Sector B5 Zona 8 San Cristobal Guatemala
[2] FUNDAECO
[3] AMBIOS

The history of sea turtle conservation in Guatemala is one based almost entirely on the use of hatcheries. Since the establishment of the first hatchery in 1971, the number of hatcheries in the country has fluctuated year-by-year between 16 and 24. It is very probable that Guatemala is the country with the most hatcheries per kilometer of coastline of any country in the world. These hatcheries necessarily have a community focus based on the fact that the majority of the eggs collected are the result of voluntary donations on the part of local egg collectors. Hatcheries are typically managed by local personnel who lack any formal scientific training.

ARCAS, FUNDAECO and AMBIOS have collaborated to carry out research on the adequacy of current sea turtle hatchery management techniques on the Pacific coast of Guatemala. Temperature, humidity and other environmental conditions were monitored over two nesting seasons, comparing measurements in hatcheries with those on the beach in an effort to replicate natural conditions as closely as possible. The goal of this research is to offer suggestions on how to better manage hatcheries in Guatemala. These ambient conditions were also analyzed to see if there was any correlation with nesting frequency.

Connectivity and intra-population structure of western South Atlantic green sea turtle (*Chelonia mydas*) foraging populations

Eugenia Naro-Maciel[1], Eduardo Moreira Lima[2], Jose Henrique Becker[3], Maria Angela Marcovaldi[4], and Rob DeSalle[5]

[1] Columbia University/AMNH, NY, NY, USA
[2] Projeto TAMAR-IBAMA, Almofala, Ceara, Brazil
[3] Projeto TAMAR-IBAMA, Ubatuba, SP, Brazil
[4] Projeto TAMAR-IBAMA, Praia do Forte, BA, Brazil
[5] AMNH, NY, NY, USA

Green sea turtle (*Chelonia mydas*) foraging populations in the western South Atlantic (WSA) region were analyzed using population genetic methods. Within this approach major objectives were to: 1) Determine relationships between the study groups and other green turtle populations; and 2) Examine rarely addressed aspects of intra-population genetic structure. Population connectivity as revealed by genetic markers can provide otherwise unobtainable insight into migration, dispersal, genetic variation, disease, and mortality. Establishing connectivity further addresses the serious conservation-related concern that groups protected in one area will be harvested or caught in or en route to another location. The present research can thus inform prioritization of management strategies, while additionally assessing the distinctiveness of protected populations and establishing a baseline for forensic work. Assessment of finer-scale patterns within populations increases the resolution of broader connectivity studies, and sheds light on poorly understood yet important processes. The need to enhance understanding of connectivity and intra-population structure is especially pronounced in the WSA. One of greatest *C. mydas* feeding aggregations in the world is located in this region, and includes the Almofala study site. The Brazilian coastline also encompasses a significant portion of the regional feeding habitat for green turtles, including the southern Ubatuba population. Genetic characterization of these two foraging populations was undertaken for the mtDNA control region and polymorphic nuclear microsatellites. Natal origins of foraging individuals and departures from homogeneity in genetic composition within and between Atlantic foraging populations were assessed.

Marine turtles nesting in the Cuban archipelago in 2002 and 2003

Gonzalo Nodarse Andreu[1], Félix Moncada Gavilán[1], Carlos Rodriguez Castillo[1], Erich Escobar González[1], Fernando Hernández Orozco[2], and Octavio Ávila López[3]

[1] Centro de Investigaciones Pesqueras, 5ta Ave. y 246, Barlovento, Playa. La Habana Cuba. 19100

[2] Empresa Nacional para la Protección de la Flora y la Fauna, 7ma ave. y 42, Playa. La Habana. Cuba 19100

[3] Marina Gran Caribe, Cayo Largo del Sur. Cuba

Nesting of marine turtles arriving at the Cuban archipelago beaches during the 2002 and 2003 nesting season is described. The number of nests and tracks observed in species such as the green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), and loggerhead turtle (*Caretta caretta*) are quantified. Cayo Largo del Sur beach is still highlighted as the most important nesting area of green turtles with more than 1,000 nests in each nesting season and Doce Leguas keys for hawksbill turtles. The two last storm effects and their influence are described.

Sea turtle conservation project Gamba, Gabon

B. H. J. D. Oosting, M. Korthorst, and S.B. Verhage

Biotopic Foundation, Amsterdam, The Netherlands

In November 2003, Biotopic Foundation started a new sea turtle conservation project in Gabon in cooperation with the local NGO Ibonga. Supported by WWF, the Dutch Treub Society for the Advancement of Research in the Tropics and the Dutch ASN Bank, an assessment and monitoring study is executed during the nesting season. The main objective is the conservation of the leatherback. The study area is a six-kilometer long beach near the town of Gamba, in the vicinity of an oil terminal. This area lies close to the Gamba Complex of Protected Areas. Studies are executed on nesting ecology, numbers of nesting turtles, predation and human threats. The results of the study will be used to improve conservation activities and to develop a conservation strategy for the coming years. Aspects of this program will be monitoring, tagging, studies on population dynamics, conservation, education and capacity building, as well as the participation of local people. The study should conclude with a collection and interpretation of brief monitoring data, the further establishment of working relationships with partners in Gabon, the development of the outlines of a four-year program/conservation strategy, and an inventory of the equipment needed for this program. The partners are working according to the international sea turtle program KUDU. This program is set up following the implementation of the international Abidjan Agreement on sea turtle protection for African countries along the Atlantic Ocean.

First histopathological confirmation of fibropapillomatosis in juvenile green turtles in Uruguay

M. Victoria Pastorino[1], A. Alonso Aguirre[2], M. Noel Caraccio[1], Alejandro Fallabrino[1], and Antonio Moraña[3]

[1] CID/Karumbé – Tortugas Marinas del Uruguay. Juan Paullier 1198/101, Montevideo, Uruguay
[2] Wildlife Trust, Columbia University, 61 Route 9W, Palisades, New York 10964, USA
[3] Departamento de Patología, Facultad de Veterinaria, Universidad de la República, Montevideo, Uruguay

Marine turtle fibropapillomatosis (FP) is a disease characterized by multiple cutaneous masses that has primarily affected green turtles (*Chelonia mydas*). In addition, the condition has been confirmed in other species of sea turtles. The disease has a worldwide, circumtropical distribution and has been observed in all major oceans. The etiology is unknown although a herpes virus, a papilloma virus and a retrovirus have been implied as possible causative agents. The size of these tumors varies from a few millimeters to more than 32 cm. The most frequently affected areas are the axillary and inguinal regions, eyes and neck and less frequently the carapace, plastron and internal organs. During 2003, we collected tumor specimens from two green turtles captured in the area of Cerro Verde, Uruguay. The tumors in the turtles were located at both front and hind flippers, ranging in size from 0.5 cm. to 2.0 cm, and with a cauliflower shape. The color of the tumors varied from gray to pink and violet. The basic histopathological features of these skin tumors were confirmed as cutaneous FP. Fibropapillomas from these juvenile turtles were similar to those previously described in other parts of the world for *Chelonia mydas*. The tumors showed a papillary pattern. Acanthosis and orthokeratotic hyperkeratosis were present with a moderate pseudoepitheliomatous hyperplasia. This is the first histopathologic diagnosis of FP for sea turtles in Uruguay these two cases are considered the southernmost records (33° 56'S and 53° 30'W) within the southwestern Atlantic Ocean to date.

Sea turtle rehabilitation program in Uruguay

María Victoria Pastorino[1], Andres Estrades[1], Alejandro Fallabrino[1], Virginia Little[2], Ricardo Rossi[2], Daniel Del Bene[2], and Alfredo Le Bas[2]

[1] CID/Karumbé – Tortugas Marinas del Uruguay, J. Paullier 1198/101, Montevideo, Uruguay, email: karumbe@adinet.com.uy
[2] Protección de Fauna Marina (PROFAUMA), Montevideo, Uruguay, email: profauma@adinet.com.uy

Since July 2001, with the implementation of the "Sea Turtle Stranding Network," Karumbe Project and PROFAUMA have received 83 phone calls from people who report alive and dead sea turtles on the Uruguayan coast. Veterinarian treatment was required in eight cases. Seven were *Chelonia mydas* from 34.4 to 42.3 cm. CCL, and one was *Caretta caretta* of 65.0 cm. CCL. All the turtles presented low weight, one of the cases presented ecto-parasites, and another case showed generalized edema and difficulty breathing. Individuals were treated with glucose solution, ecto-parasites were removed, and the edema treated with diuretics. Three of the cases were individuals presenting hypothermia, low weight and depressed behavior. In these cases, the individuals were hydrated and calcium and vitamins were administrated. The remaining case corresponds to an individual of *C. mydas* that was found floating on a polluted beach, Montevideo, in a very delicate situation with signs of dehydration, bone structures exposed and other damage on various body regions. This individual was hydrated, the wounds disinfected, and antibiotics were administrated. In this case the rehabilitation was unsuccessful, and the animal died 2 months after being found. In all cases, turtles were maintained under adequate conditions, in tanks from 500L to 2000L of 30 ppt salt water at 20-25 °C, fed with algae and spinach for *C. mydas*, and fish and crab for the *C. caretta*. Success was obtained in 87% of the cases, releasing all the individuals back into their environments.

Preliminary assessment of hawksbill sea turtle (*Eretmochelys imbricata*) beach usage in Nevis, W.I.

Emile Pemberton[1], Charles Parris[2], Rene Walters[2], Craig David[3], Kayno David[2], Angela Walters[2], Audra Barret[1], Arthur Anslyn[1], Shawn Isles[1], Alex Percival[1], Olivia Kelly[1], and Ellen Beaumont[4]

[1] Department of Fisheries, Nevis, West Indies
[2] Department of Physical Planning, Natural Resources and Environment, Nevis, West Indies
[3] Information Technology Department, Nevis, West Indies
[4] Terramar Foundation, Nevis, West Indies

Monitoring of sea turtles on Nevis has been done in a rather ad hoc manner in the past. In this year (2003), an attempt has been made to carry out a survey of nesting turtles on the island. Ten beaches on the island have been monitored. The main turtle nesting beaches are located on the north and west coasts of the island and are Seahaven Beach, Cades Bay to Cotton Ground along Pinney's Beach and Jones Bay Beach. The main type of turtle found nesting on the island's beaches is the hawksbill.

Among the reasons that have prompted the commencement of the monitoring program are the absence of data on turtles, the exploitation of turtles as a source of food on the island, the predation of nesting turtles and the poaching of turtle eggs. As hawksbill turtles are critically endangered worldwide and believed to be over-exploited on Nevis, the collection of such data is critical to the management of the species. The laws of St. Christopher and Nevis specify that there is a five-month open season for turtle harvesting on Nevis. The lack of baseline data on the number of turtles in our waters and on turtles nesting on the island would suggest that the precautionary approach be used in the harvesting of turtles. Plans for the future include comprehensive monitoring of the main turtle nesting beaches on Nevis, and the involvement and education of key stakeholders.

First nesting report of black sea turtle (*Chelonia mydas agassizii*) in Baja California Sur, Mexico

Tiburcio Pintos Graciela, Pedro Márquez Almansa, José M. Sandez Camilo, and Juan R. Guzmán Poo.

H. VIII Ayuntamiento de Los Cabos, B.C.S. (Coordinación para la Protección de la Tortuga Marina)

Baja California Sur (B.C.S.), Mexico is an important feeding area for sea turtles. Five of the seven existing species are found here, but this nesting has been neglected considering that only two species have been reported as breeding on the south end of the peninsula of Baja California. Starting in the 2000 season, a monitoring and conservation program was started in order to discover the number of turtles nesting in the study area. This program is funded by the Municipal Government of Los Cabos, B.C.S. and supported by local private businesses. During the four years reported in this study, we have found two species nesting: leatherback (*Dermochelys coriacea*) and olive ridley (*Lepidochelys olivacea*). All the previous studies and reports mention the same two species. In the last two breeding seasons we have found two nests, one in each season (2002 and 2003), of black turtles (*Chelonia mydas agassizii*). Thus, this is the first-ever report of this species nesting on the peninsula of Baja California Sur. This finding becomes very important when considering that all sea turtles in Mexico are threatened and their populations are decreasing rapidly.

The effect of egg location on developmental success of leatherback turtles

Cameron Ralph[1], Richard Reina[1], Bryan Wallace[2], Paul Sotherland[3], James R Spotila[2], and Frank V Paladino[4]

[1] Monash University, Melbourne, Victoria, Aus
[2] Drexel University, Philadelphia, PA, USA
[3] Kalamazoo College, Kalamazoo, MI, USA
[4] Indiana-Purdue University, Fort Wayne, IN, USA

Leatherback hatching success worldwide is low (~50%) compared to that of other sea turtle species. The cause for this high embryonic mortality is not due to infertility, but the effects of characteristics of the nest environment on embryonic development is unknown. Quantification of physical and biological parameters that influence embryonic development is important in order to understand the developmental environment of leatherback nests. We measured CO_2, O_2, humidity and temperature using real time sampling equipment in different regions of the nest chamber throughout incubation. We also recorded the three-dimensional position of each egg within a clutch and related the above parameters to regional differences in hatching success. Our results describe the effect of physical conditions of the nest environment on the development of leatherback embryos and also identify regional differences in hatching success. These findings will provide insight on the leatherback nest environment and inform management of beach hatcheries as effective conservation tools.

Assessing the feeding behavior of the loggerhead turtle in the western Mediterranean through stable isotope analysis

Mónica Revelles[1], Luis Cardona[1], Asunción Borrell[1], Gloria Fernández[2], Manu San Félix[3], and Alex Aguilar[1]

[1] Department of Animal Biology, Faculty of Biology, University of Barcelona, Avda. Diagonal 645, E-08028 Barcelona, Spain.

[2] Fundación Marineland, C/Garcilaso de la Vega, 9 E-07181 Costa d'en Blanes, Calvià, Spain.
[3] Marine Biology Laboratory, Department of Zoology, Faculty of Biology, University of Valencia, C/ Dr. Moliner 50 E -46100 Burjasot (Valencia), Spain

The western Mediterranean is a developmental habitat for loggerhead sea turtles (*Caretta caretta*). Stomach content analysis is the classical approach to study the transition from pelagic to neritic food webs. However, results might be biased as soft preys are underestimated. Stable isotope analysis is an alternative approach because it can be used for identifying the contribution of different prey species to the diet of the considered organism, hence overcoming the limitations of stomach contents analysis. Stable isotope analysis might be very useful for studying the transition of loggerhead sea turtles from pelagic to benthic feeding, as soft prey are thought to be intensely consumed by the species. Samples from turtles and other marine organisms from different trophic levels were collected in the Balearic Islands (western Mediterranean) in order to study the diet of loggerhead turtles. ∂15N and ∂13C values were obtained from each sample using a mass espectrometer. Turtles caught by professional fishermen with drifting long-lines and those caught with trammel nets foraged at the same trophic level, as they have similar ∂15N values. However, they have different ∂13C values, hence suggesting that they forage on different food webs. Study funded by EU-LIFE project 00NAT/E/7303.

Nesting hawksbills show significant population trends at Jumby Bay, Antigua, W.I. Analysis of 17 years of saturation tagging

James I. Richardson, Rhema Bjorkland, Peri Mason, Kimberly Andrews, Rebecca Bell, and Heidi Gerstung

WIDECAST, Institute of Ecology, University of Georgia, Athens, Georgia, USA

Hawksbills nesting at Jumby Bay, Long Island, Antigua, West Indies, have been monitored since 1987. We present an update on population trends since Richardson et al. (1999). Up to that point, time series analysis of nesting numbers has indicated a stationary population. Now, using data from subsequent years (2000-2003), we find a statistically significant upward trend in numbers of nesting adults. However, we cannot ascribe this upturn to increased reproductive output resulting from the protection afforded to the Jumby Bay population without examining trends on adjacent beaches and islands that should be within the influence of the increased Jumby Bay reproductive output. We discuss the implications for designing monitoring programs within archipelagic systems.

Ecology and feeding habitat characterization of the marine turtles at San Bernardo Archipelago, Colombia

Martha P. Rincón-Diaz and Clara J. Rodríguez – Zárate

Universidad Jorge Tadeo Lozano, Bogotá, Colombia

San Bernardo Archipelago has been recognized as a potential feeding habitat for sea turtles, but it was not until last year (2002) that research was conducted to determine the importance of this habitat. Our main objective was to characterize the geomorphological and biological aspects of this habitat and to identify the composition and structure of sea turtle species present in these areas. We also included an inventory of food items used by the sea turtles in the archipelago. Finally, we documented the threats of habitat degradation and turtle poaching. The archipelago is composed mainly of two species of sea turtle, the green turtle and the hawksbill turtle, with a population structure of juvenile, sub-adults and adults. Twenty feeding grounds were identified for both species; these areas were characterized by shallow waters (1-9 meter depth). Green turtle feeding habitats were located at the main areas with soft bottoms and sea grass beds. *Thalassia testudinum* was the principal food item found in the stomach contents of green turtles. The feeding areas of hawksbill turtles were found in the coral reef zone, mainly in the north zone of the archipelago. The prey items documented for hawksbills were almost exclusively sponges, being *Eicionemia sp*. the most frequently encountered. In conclusion, our study suggested that there are adequate feeding habitats for the green and hawksbill turtle population to recover. However, local authorities should prevent turtle poaching, which is the major threat for the marine turtles in this archipelago.

Aerobic bacterial flora in the nesting leatherback sea turtles (*Dermochelys coriacea*)

Mario Santoro[1], Giovanna Hernández[2], Fernando García[3], and Magaly Caballero[2]

[1] Ph. D. program in Biomedical Science, Universidad de Costa Rica, San José, Costa Rica
[2] Department of Bacteriology, Veterinary Medicine School, Universidad Nacional, Heredia, Costa Rica
[3] Centro de Investigación en Enfermedades Tropicales, Facultad de Microbiología, Universidad de Costa Rica, San José, Costa Rica

Aerobic bacteria flora was documented from 70 nesting females of the leatherback sea turtle (*Dermochelys coriacea*) at the Pacuare Reserve, Caribbean coast of Costa Rica during March through May 2003. All cloacal and nasal samples analyzed were positive for aerobic bacteria. A total of 185 bacterial isolates, including 110 Gram-negative and 75 Gram-positive bacteria were identified. The most common species from cloaca was *Aeromonas salmonicida* (22.8%). Others species isolated from cloacal samples included *Pseudomonas aeruginosa* (12.8%), *Enterobacter agglomerans* (10%), *Enterococcus faecalis* and *Proteus mirabilis* (8.5% each), *Salmonella spp*., *Klebsiella pneumoniae* and *K. oxytoca* (7.1% each). The most common isolate in nasal cavity was *Bacillus firmus* (38.5%). Others species isolated from nasal cavity included *Bacillus spp*. (27.1%), *Enterobacter agglomerans* (17.1%), *Klebsiella pneumoniae* (11.4%), *Corynebacterium spp.* (5.7%), *Aeromonas salmonicida*, *Pseudomonas aeruginosa* and *Staphylococcus intermedius* (4.2% each).

The aim of this study was to analyze the aerobic bacterial flora from apparently healthy nesting female leatherback sea turtles.

Blood chemistry values for nesting female leatherback sea turtles (*Dermochelys coriacea*)

Mario Santoro[1] and Ana Meneses[2]

[1] Ph.D. Program of Biomedical Sciences, Universidad de Costa Rica, San José - Costa Rica
[2] Laboratory of Clinical Analysis, Veterinary Medicine School, Universidad Nacional, Heredia - Costa Rica

During May 2003, twenty-three serum biochemistry values were determined for clinically healthy female leatherback sea turtles from Pacuare Reserve nesting beach on the Caribbean coast of Costa Rica. The blood was sampled by dorsal cervical sinus while the turtles were terminating nesting. Serum concentration of glucose, sodium, potassium, magnesium, chloride, calcium, phosphorus, urea nitrogen, creatinine, BUN/creatinine ratio, uric acid, total protein, albumin, globulin, albumin/globulin ratio, total bilirubin, alkaline phosphatase, lactic dehydrogenase, AST, ALT, cholesterol, triglycerides and iron were reported. Obtaining data on blood parameters for healthy nesting sea turtles is an important and relatively easy method to evaluate health and illness within wild endangered populations, especially for species like the leatherback which are difficult to catch and study in the wild. The serum analyses performed established reference ranges, which can be used as indicators of health status.The purpose of our study was to determine the blood chemistry values for a Caribbean population of nesting female leatherback sea turtles.

Population dynamics of loggerhead turtles in North Carolina

Christopher R. Sasso[1], Joanne Braun-McNeill[2], and Sheryan P. Epperly[1]

[1] National Marine Fisheries Service, Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami, FL 33149, USA
[2] National Marine Fisheries Service, Southeast Fisheries Science Center, Beaufort Laboratory, Beaufort, NC 28516, USA

To monitor in-water trends of sea turtles, an index of abundance is performed by the National Marine Fisheries Service in the Pamlico and Core Sounds of North Carolina. Mark-recapture data is collected using the pound nets in the sounds to track these trends. The program MARK was used to analyze this mark-recapture data and investigate the population dynamics of sea turtles in the sound system. The results presented here are based on mark-recapture data of more than 600 individual loggerheads tagged over six years.

Over-wintering strategies of juvenile green sea turtles (*Chelonia mydas*) in the northeastern Gulf of Mexico

Russell A. Scarpino[1], Erin McMichael[2], Raymond R. Carthy[3], Dean A. Bagley[4], and Jeffrey A. Seminoff[5]

[1] University of Florida, Gainesville, FL USA (scarpino@ufl.edu)
[2] University of Florida, Gainesville, FL USA (emcmich@aol.com)
[3] University of Florida, Gainesville, FL USA (rayc@zoo.ufl.edu)
[4] University of Central Florida, Marine Turtle Research Group, Orlando, FL USA (de315786@pegasus.cc.ucf.edu)
[5] NOAA-National Marine Fisheries Service, La Jolla, California USA (jeffrey.seminoff@noaa.gov)

Hypothermic stress, or cold-stunning, has resulted in mass stranding events of marine turtles in shallow coastal waters throughout the Gulf of Mexico and western Atlantic Ocean. During January 2001 and January 2002, unusually cold temperatures in the northeastern Gulf of Mexico caused the stranding of hundreds of juvenile sea turtles. These events suggest that juvenile turtles use this area as a significant over-wintering habitat. Five satellite transmitters, along with sonic transmitters, were deployed on five juvenile green turtles (mean SCL = 39.9 cm) in St. Joseph Bay in the fall of 2003 to document the over-wintering movements of turtles in this region. Juvenile green turtles in the western Atlantic are known to migrate out of cold-water areas and move south to access warmer foraging grounds. Why turtles in the northeastern Gulf of Mexico risk winter stranding, instead of migrating, is still unknown. Coastal embayments, such as St. Joseph Bay, may provide favorable over-wintering conditions such as year-round abundance of food, undisturbed sea grass beds, and suitable mean water temperatures. Turtles preferring to reside in such temperate habitats during the winter are thought to become torpid, but very little direct evidence supports this assumption. We studied this phenomenon in juvenile sea turtles to ascertain whether sea turtles migrate out of this area to avoid colder winter temperatures, or rather brumate during colder months.

Habitat utilization by juvenile hawksbills at Desecheo Island Marine Reserve, Puerto Rico

Michelle T. Schärer[1], Carlos E. Diez[2], and Robert P. VanDam[3]

[1] Department of Marine Sciences, University of Puerto Rico, P.O. Box 5906, Mayagüez, Puerto Rico 00681
[2] Departamento de Recursos Naturales y Ambientales Programa de Especies Protegidas, P.O. Box 9066600,
[3] Chelonia, Inc. PO Box 9020708, San Juan, Puerto Rico

The designation of critical habitat is an important tool for the conservation of marine turtles in the United States Caribbean region. Due to various habitat shifts during the ontogenetic development of these species, no single habitat can be identified as critical for the effective management of the species. A better understanding of the basic ecology, habitat utilization and the linkages between habitats is essential for the management strategy's effectiveness. A wider scope of these habitats will help identify the connectivity issues that will ensure sea turtles complete ontogenetic migrations successfully. In-water surveys at various locations in Puerto Rico have provided an opportunity to analyze the basic ecology and habitat requirements of sea turtles, and to help determine the critical habitats for these species. Desecheo Island is a small (360ha) United States Fish and Wildlife Service National Refuge located to the west of Rincón, Puerto Rico, surrounded by 0.5 nm of marine reserve designated by the Department of Natural and Environmental Resources of Puerto Rico in 2001. In-water surveys around Desecheo Island began in 1999, and have provided information for 57 individual turtles (56 hawksbills and one green) and the habitats they occupy. This presentation will describe the spatial distribution, abundance, habitat utilization and connectivity between habitats for Desecheo Island Marine Reserve. Information provided from this analysis may help identify important criteria for the design of marine reserve networks that include critical habitats for the different life cycle stages of marine turtles.

Assessment of photo-identification and GIS as a technique to collect in-water information about loggerhead sea turtles in Laganas Bay, Zakynthos, Greece

Gail Schofield[1], Kostas A. Katselidis[1], and John D. Pantis[2]

[1] National Marine Park of Zakynthos, Zakynthos, Greece
[2] Aristotle University of Thessaloniki, Thessaloniki, Greece

Laganas Bay, on the island of Zakynthos, is a protected area with one of the densest nesting rookeries for loggerheads in the Mediterranean. Nesting females have been studied extensively on these beaches, but little information is available about population dynamics. Until 2003, sea based studies of sea turtles were not attempted due to National Marine Park of Zakynthos (NMPZ) policy to minimize harassment of sea turtles. In 2003, the NMPZ conducted a non-invasive in-water survey gathering preliminary information about the sea turtle population. The natural marking technique of photo-identification was used in combination with a global positioning system (GPS) to identify individual turtles and record sighting locations during daily surveys. In one month, multiple identifications of 161 sea turtle individuals were acquired from 460 sight-mark-resight records. About one-third of all reproductive females in the 2003 nesting season were identified. The findings of this study are used in this presentation to assess:

- The importance of selecting reliable physical features for photo-identification for repeated recognition in a long-term database.
- The uses of photo-identification to investigate population size, sex ratio, reproductive activity, return rates and residency.
- The potential of photo-identification combined with geographic information system (GIS) technology to identify trends in turtle distribution with biological, environmental and geographical parameters.
- The behavior response of the turtles to photo-identification oriented research activity.

In conclusion, this presentation will consider the potential future applications of photo-identification as a technique to study sea turtle populations on a national and international scale.

The threats on sea turtles in Togo

Gabriel H. Segniagbeto[1], E. J. Bowessidjaou [2], J. Fretey [3], H. Segniagbeto [2], F. K. Akpamou[4], and A. Formia [5]

[1] University of Lomé, Togo, West Africa
[2] Département de Zoologie et Biologie Animale, Faculté des Sciences, Université de Lomé, Lomé, Togo
[3] Comité français pour l'UICN, Muséum national d'Histoire Naturelle, Paris, France
[4] Association pour l'Etude et la Conservation des Tortues marines au Togo, Lomé, Togo
[5] School of Biosciences, Cardiff University, Cardiff, United Kingdom

Togo is a coastal country situated in the Gulf of Guinea whose sandy beaches represent potential sea turtle nesting sites. Four species of sea turtles have been identified along the Togolese coast: the green turtle (*Chelonia mydas*), the hawksbill (*Eretmochelys imbricata*), the olive ridley (*Lepidochelys olivacea*) and the leatherback (*Dermochelys coriacea*). The females of *C. mydas*,

L. olivacea and *D. coriacea* are known to nest in Togo, while nesting of *E. imbricata* has not been confirmed. Juvenile *C. mydas* and *E. imbricata* are captured regularly along the Togolese coast. During the nesting season, from September to February, accidental or deliberate capture of sea turtles in fishing nets occurs almost daily, particularly where special devices are added to the nets to prevent turtles from escaping. Captured individuals are often destined for domestic food consumption and commercialization. Similarly, eggs are systematically collected for consumption or sale. Sea turtles in Togo are subject to other physical threats in addition to these anthropogenic pressures, including coastal erosion and the uncovering of beach-rocks, the extraction of sand and gravel from the beach, coastal pollution by plastic bags and other debris, marine industrial and urban pollution (urban gutters, industrials sewers such as OTP, ITP, Nioto; and the Harbour of Lomé, etc.).

Loggerhead and Kemp's ridley diet in Virginia, U.S.A. during 1980 to 2002: Changing with the times?

Erin E. Seney[1] and John A. Musick[2]

[1] Virginia Institute of Marine Science, Gloucester Point, VA, USA (previous); Texas A&M University, College Station, TX, USA (present)
[2] Virginia Institute of Marine Science, Gloucester Point, VA, USA

The Chesapeake Bay and coastal waters of Virginia, U.S.A. serve as seasonal foraging grounds for loggerhead (*Caretta caretta*) and Kemp's ridley (*Lepidochelys kempii*) sea turtles. The Virginia Institute of Marine Science has collected diet data and gut samples from sea turtles in Virginia since 1979. Examination of turtles that stranded during the late 1970s and early 1980s indicated that loggerheads fed primarily on Atlantic horseshoe crab (*Limulus polyphemus*) and Kemp's ridleys primarily on blue crab (*Callinectes sapidus*).

During 1980 through 2002, 128 whole digestive tract samples and 41 partial gut samples were collected from loggerheads, and general diet information was noted for an additional 134 loggerheads. Twenty-three whole samples and 10 partial samples were collected from Kemp's ridleys during 1983 to 2002, and data were available on an additional 26 ridleys. Diet analysis indicated a shift in loggerhead diet from predominantly horseshoe crab during the early to mid-1980s to blue crab during the late 1980s and early 1990s. Diet in the mid-1990s and 2000 to 2002 was dominated by finfish, particularly menhaden (*Brevoortia tyrannus*) and croaker (*Micropogonias undulatus*). These shifts suggest that fishery-related declines in horseshoe crab and blue crab populations may have caused loggerheads to instead forage on fish caught in nets or on discarded bycatch. A slight seasonal effect on loggerhead diet was detected, and diet differed somewhat between juveniles and adults. The small ridley dataset suggests that blue crabs and spider crabs (*Libinia spp*.) were important components of ridley diet during 1987 to 2002.

Effects of individual nest site selection of leatherback sea turtles (*Dermochelys coriacea*) on incubation periods and inferred sex ratios at Playa Grande, Costa Rica

Annette E. Sieg[1], Megan E. Thynge[1], Bryan P. Wallace[1], James R. Spotila[1], Frank V. Paladino[2], Eric D. Nordmoe[3], Paul R. Sotherland[3], and Richard D. Reina[4]

[1] Drexel University, Philadelphia, PA, USA
[2] Indiana Purdue Fort Wayne, Fort Wayne, IN, USA
[3] Kalamazoo College, Kalamazoo, MI, USA
[4] Monash University, Melbourne, Australia

Temperature is an abiotic factor that has been well documented in its effects on sea turtle nests. Individual leatherback sea turtles (*Dermochelys coriacea*) nesting at Playa Grande, Costa Rica demonstrate a tendency to nest in locations of close proximity to previous nestings relative to the coastal axis (Nordmoe et al., 2004). Past comparisons of in situ nest temperatures, however, have focused on the ocean-to-vegetation axis, which is actually a landscape of homogenous nest site selection for leatherbacks on Playa Grande. In this study, we use temperature and nest location records collected over the past four seasons at Playa Grande to examine the effects of individual nest site selection relative to the coastal axis on incubation periods and inferred sex ratios as a measure of reproductive fitness. This adds to the characterization of reproductive biology in the natural beach environment and has implications on the current conservation practice of translocating nests.

Impact of commercial fisheries on sea turtle mortality in Florida

Karrie Singel[1], Allen Foley[2], Tony Redlow[3], and Ed DeMaye[1]

[1] Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, Tequesta, Florida, USA
[2] Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, Jacksonville, Florida, USA
[3] Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, St. Petersburg, Florida, USA

The Florida Sea Turtle Stranding and Salvage Network has been collecting data on dead or debilitated (i.e., stranded) sea turtles in Florida since 1980. From 1980 through 2002, over 18,000 stranded sea turtles were documented in Florida. We examined various aspects of the stranding data to evaluate the impacts of shrimp trawling, longlining, gillnetting, and pot fishing on sea turtle mortality. We compared an indicator of effort (landings) in the shrimp and long-line fisheries to the number of stranded turtles found near fishing areas. We evaluated the impact of TEDs (implemented around 1990) on the mortality of five species of sea turtles. The effect of a net ban that eliminated a nearshore gillnet fishery in Florida was determined by comparing the characteristics of green turtle mortality seven years prior and post net ban. The impacts of pot fishing (crab and lobster pots) was evaluated by tallying the number and species of sea turtles found tangled in buoy lines and by determining spatial and temporal trends. By combining the results of all these investigations, we estimated the overall contribution of commercial fisheries to the mortality of sea turtles in Florida.

Toxicants and their effect on hatching success of the leatherback turtle at Parque Nacional Marino Las Baulas, Costa Rica

Nathan S. Sill[1], Frank V. Paladino[2], and Jim R. Spotila[3]

[1] Purdue University
[2] Indiana-Purdue University of Fort Wayne
[3] Drexel University

The leatherback turtle is critically endangered in the Pacific, so an intensive effort has been made to prevent its' extinction. There is some data on the nesting ecology, hormone cycles, remigration intervals, and hatching success for this species, at Parque Marino Las Baulas, Costa Rica. Presently, there are no data about heavy metals and other potential toxicant levels found in this leatherback population. Most marine studies published on toxicants of sea turtles report levels in few adults and a baseline of data for eggs and hatchlings is just now beginning to develop. This study was designed to provide a baseline of toxicant data for the leatherback population nesting at Marino Las Baulas, Costa Rica. I have sampled non-viable eggs and hatchlings that died in the nest chamber, analyzed them for metals (Fe, Pb, Cu, Ni, Cr, Cd, Mn, Zn, As) and other toxicants (PCBs, organochlorines, DDT and it's metabolites), and related that data with hatching success for 30 females from which I have sampled at least 2 nests that are 4 nesting events apart. Interesting levels of some metals were found in these samples and indicate that this baseline data will be important for determining any possible influences these substances might have on the population biology of these endangered turtles. This data should also provide a foundation for further research on toxicant levels in eggs and hatchlings of leatherbacks and other marine turtles and may provide a way to monitor populations without taking viable egg samples.

The use of fringing reefs and inshore habitats for foraging sea turtles in and near Providenciales, Turks and Caicos Islands: A summary of dive sightings and snorkel observations, 2002 – 2003

Lorna M. Slade

PO Box 872, Providenciales, Turks and Caicos Islands BWI

Traditionally, turtles are consumed in the Turks and Caicos Islands, however, little is known about the status of turtle populations and to what extent the local marine habitats are used for turtle foraging. In conjunction with the United Kingdom Overseas Territories Marine Turtle Program (TCOT), a monitoring program has been established to document turtle sightings using dive and snorkel statistics to gauge turtle numbers in the waters of Providenciales and nearby islands to provide information towards a turtle management plan.

Three species of turtle are regularly seen in the Turks and Caicos Islands, green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*) and loggerhead (*Caretta caretta*). There have also been regular sightings of leatherback (*Dermochelys coriacea*) offshore. Analysis of preliminary data shows that both offshore fringing reefs and inshore habitats, including seagrass beds, patch reefs and mangrove creeks are frequently used foraging areas for green and hawksbill turtles, and for small numbers of loggerheads. Inshore habitats provide developmental habitat for green turtles in particular (straight carapace length ranging 25-56 cm), with site fidelity displayed by some individuals for periods of over 18 months. Fringing reefs are used commonly by both immature and breeding age hawksbills (86% of all sightings) with a recorded size range of 33-106 cm SCL. Loggerhead sightings only represented 2.7% of all sightings.

This paper documents and discusses the methods used for data collection and presents data on overall turtle numbers, distribution, seasonality and habitat usage in the survey area, and comments on the importance of protected areas in turtle conservation.

Seasonal and latitudinal assessment of early growth rates in northern and southeastern loggerhead sea turtles (*Caretta caretta*) from US beaches

Lesley Stokes[1], Kimberly Blair[1], Jeanette Wyneken[1], Jesse Marsh[2], Larry Crowder[2], and Corie Baird[3]

[1] Florida Atlantic University, Boca Raton, Florida, USA
[2] Duke University Marine Laboratory, Beaufort, NC, USA
[3] Mote Marine Laboratory, Sarasota, FL, USA

The purpose of this study was to systematically investigate how temporal and spatial nest origins influence initial loggerhead hatchling size and growth potential. Seasonal environmental fluctuations and maternal resource allocation may result in differential hatchling size and growth. Ten sites from North Carolina to Florida were sampled during 3 phases of the season. The largest hatchlings came from the northernmost site, with initial size (WT, SCL and SCW) decreasing as latitude decreased. Turtles hatching during the earliest phase of the nesting season generally grew faster than those from the later phases of the season. Differences in initial size and growth potential could influence early stage duration and/or survivorship through size-based predation.
Growth data and its variability are fundamental to our understanding of loggerhead life history. Particularly important are the factors affecting the duration of each age/stage class and survivorship. One implication of a more robust understanding of growth is further refinement of vital rates (life stage durations, spatially and temporally explicit stage parameters). The results of this study point to the need for separate consideration of northern and southern subpopulations when constructing population models. Thus, understanding variability in growth may enhance conservation efforts.

Status update from St. Maarten, St. Eustatius and Saba, Netherlands Antilles

Jeroen L. Swinkels[1], Andy Caballero[2], Nicole Esteban[3], and David Kooistra[4]

[1] Institute for Biodiversity and Ecosystem Dynamics, University of Amsterdam, Kruislaan 318, 1098 SM, Amsterdam, the Netherlands
[2] St. Maarten Nature Foundation. Great Bay Marina, Unit #3, P.O. Box 863, St. Maarten, Netherlands Antilles
[3] St. Eustatius National & Marine Parks. Gallow Bay, St. Eustatius, Netherlands Antilles
[4] Saba Marine Park. Fort Bay, Saba, Netherlands Antilles

In the summer of 2003, a survey was done on St. Maarten, St. Eustache and Saba, Netherlands Antilles, to update information about the actual main nesting and foraging sites and to establish population estimations and trends. All beaches on all three islands were visited and described as well as several reef sites. Five 'target' beaches on the Dutch side of St. Maarten were monitored daily. All information possible was gathered.

On the St. Maarten beaches nesting does occur on the least tourist-influenced beaches, though in small numbers with no spatial or temporal patterns. The hawksbill turtle is the only frequent visitor, but green turtles and leatherbacks have been observed nesting as well. On most beaches, tourist facilities, resorts and estates are dominantly present or still being developed. Turtle sightings underwater, mainly hawksbill, are common, though in much fewer numbers than decades ago. During the annual Carnival festivities, turtle meat and soup is still available. Zeelandia Beach is the only beach on St. Eustatius. Hawksbills, green turtles and leatherbacks have been observed on the beach yearly in very small numbers, though recordings of successful nestings are very rare. Underwater sightings of hawksbill turtles are very common. The St. Eustatius reefs are in a very good condition and contain a high diversity of sponges and (soft) coral.
This is also the case for Saba, so encounters with foraging hawksbill turtles are very frequent. Because of its volcanic geomorphology, Saba lacks beaches. Sporadic nesting on temporary sand deposits have been reported.

Virginia Key nesting, 1990-2003

Wendy G. Teas and Lisa C. Belskis

NOAA/NMFS Southeast Fisheries Science Center, Miami, FL, USA

Marine turtle nesting surveys have been conducted on Virginia Key, Miami-Dade County, Florida from 1990 through 2003. Survey results are summarized, including nest numbers and hatching and emergence success. Nest predators and predation levels are detailed. Nesting density on Virginia Key is discussed and compared with other nesting beaches in Miami-Dade County.

Nesting activity and conservation of leatherback (D*ermochelys coriacea*) sea turtles, in the Río Escalante-Chacocente Wildlife Refuge, Pacific coast of Nicaragua

José R. Urteaga Augier[1] and Didiher Chacón[2]

[1] Fauna & Flora International, Km 12.5 Carretera Norte, Managua, Nicaragua
[2] ANAI, Vargas Araya, San José, Costa Rica

Between September 25 2002 and February 28 2003, conservation and monitoring actions were conducted to protect the nests and females of Pacific leatherbacks, *Dermochelys coriacea*. This conservation effort was carried out on the northern coast of the Rio Escalante – Chacocente Wildlife Refuge, Nicaragua, Central America (N11° 30' 33" and W86° 14' 43"). During this work, the beach was patrolled each night looking for nesting females and collecting information about poaching frequency on sea turtles. We recorded 404 sea turtle nests, the most abundant belonging to olive ridley, *Lepidochelys olivacea* (379 nests), followed by leatherback (24 nests) and black turtle, *Chelonia mydas agassizii* (1 nest). 22 (92%) leatherback nests were protected in a hatchery. Olive ridley poaching rate was extremely high, near 90%. Four leatherbacks were tagged using PIT and Iconel tags. Observed average nest rate was 4.5 nests/turtle with intervals between 8 and 24 days, this fact and other information analyzed during the study suggest high fidelity to this nesting beach.

Comparing these results with other monitoring work carried out during the early 1980's in the same area suggests that the decline of leatherback nesting numbers on this beach follows the same tendencies as other nesting beaches in the eastern Pacific. Despite the low number of nesting leatherbacks recorded, conservation efforts conducted on these beaches could generate positive results for this population. This project was carried out with the support of Fauna & Flora International, NOAA, and the cooperation of Chacocente de Acayo SA.

Post-nesting migration of hawksbills from Bonaire

Robert P. van Dam, Gielmon Egbreghts, Imre Esser, and Jan Kloos

Sea Turtle Conservation Bonaire, PO Box 492, Bonaire, Netherlands Antilles

The movement of two hawksbill turtles nesting on Klein Bonaire, Netherlands Antilles, tracked through satellite telemetry, is presented.

Monitoring the leatherback sea turtle in Aruba

Richard W. van der Wal and Edith S. van der Wal

TURTUGARUBA, Oranjestad, Aruba

Aruba (12º30'N and 70ºW) is located 32 km north of Venezuela. Since 1986, Aruba has been an autonomous entity within the Kingdom of the Netherlands. Economically, Aruba is very dependent on tourism. The development of tourism is most visible along the western shores. This area was known as a category I (less than 25 nests a year) for *Dermochelys coriacea* in past decades. Nesting activity has been recorded since 1994, recording 4-18 nests a year. The monitoring procedures have been revised and improved since 1999. The data of 5 years (1999-2003) are presented.

In Aruba, the nests are protected "in situ". The Widecast volunteers have developed practical solutions: 1) for identification of the nesting females; 2) for the excavating of the nests after the spontaneous emerge at a specific time for egg and shell count and release of a possible late surviving hatchling; and 3) to reduce the disorientation of hatchlings by artificial lighting and to cope with the sea-finding problems. These strategies are described and discussed.

Development and characterization of novel microsatellite markers from the olive ridley sea turtle (*Lepidochelys olivacea*)

T.P. Velevan [1], D. Udaykumard [1], P. S. Hendre [1], Kartik Shanker [2], B.C. Choudhry[3], Lalji Singh [1], and Ramesh K. Aggarwal[1]

[1] Center for Cellular and Molecular Biology, Uppal Road, Hyderabad - 500007, India
[2] Ashoka Trust for Research in Ecology and the Environment, Hebbal, Bangalore - 560024, India
[3] Wildlife Institute of India, P.O. Box No.18, Chandrabani, Dehradun - 248001, India

Olive ridley turtles, although widely distributed globally and in Indian coastal waters, have undergone declines in recent years due to anthropogenic factors, particularly fishery related mortality. The extent and distribution of genetic variation within a species are of fundamental importance to its evolutionary potential and to determining its chances of survival. Assessment of genetic variability in existing populations is critical to the development of effective conservation

strategies. Here we describe the development of six highly polymorphic microsatellite loci from a simple sequence repeat-enriched genomic DNA library of the olive ridley turtle. Characterization of five of these loci using 83 individual olive ridley turtles revealed eight to 24 alleles per locus, high observed and expected heterozygosity values and broad cross-species amplifications with green turtle and hawksbill turtle species. The sixth microsatellite was found to be monomorphic in the olive ridley samples but was polymorphic in two related marine turtle species. The six microsatellite loci described provide potentially useful markers for the assessment of genetic variability within and across populations of olive ridley and other turtle species. This would help in understanding their population structure, reproductive behavior, phylogeography and species relationships, paving the way for their conservation and efficient management strategies. These markers will be most useful for studying the reproductive behavior of these species, e.g. multiple paternities, a highly debated aspect of sea turtle biology.

The recovery of hawksbill turtles at Mona Island, Puerto Rico: Report of record nesting seasons and its implications to the Caribbean region

Ximena Velez-Zuazo[1], Robert van Dam[2], and Carlos E. Diez[3]

[1] Dpto de Biología, Universidad de Puerto Rico, Rio Piedras, PR
[2] Chelonia Inc. PO Box 9020708, San Juan, Puerto Rico 00902
[3] Programa de Especies en Peligro, DRNA, P.O. Box 9066600, San Juan, Puerto Rico 00906-6600

Mona Island is considered one of the most important rookeries in the Caribbean for the critically endangered hawksbill sea turtle. A steady increase in the number of hawksbill nests in Mona Island has been reported since 1994. During 2002, we had a record number of nests (n=847) indicating a 60% increase compared to the previous year. During the current season (2003), nesting activity appears to be similar or even higher than in 2002 (data is still being collected). Total reproductive output for Mona Island for 2002 is estimated to be over 90,000 hawksbill hatchlings. An increasing number of nesting females visiting Mona has allowed us to collect detailed data on turtle morphometrics, nesting site fidelity, clutch size, internesting periods, re-migration intervals, nest incubation durations and hatching success. The following poster will present the results of the data mentioned above, with a discussion of the factors affecting the recovery of the hawksbill nesting population at Mona Island.

Spatiotemporal patterns of intra-annual sea turtle nesting along an east central Florida beach

John F. Weishampel, Dean A. Bagley, Llewellyn M. Ehrhart, and Kevin C. Paisley

University of Central Florida, Orlando, Florida, USA

The Florida coastline from Melbourne Beach to Wabasso Beach is one the most important nesting areas for loggerhead turtles (*Caretta caretta*) in the Western Hemisphere and for green turtles (*Chelonia mydas*) in the United States. Here, we quantified the intra-annual spatio-temporal patterns of numerous loggerhead (N>270,000) and green turtle (N>13,000) nests from 1989-2002 along a 40.5 km stretch of beach within this critical reproductive zone. For consistency, beach nesting surveys covering the Julian-day period 129 to 241 (May 10 to August 30) for each year were analyzed. To evaluate if the spatial distribution of nests changes throughout the season, we divided nesting into quartiles. Though autocorrelative patterns of nest distribution differed slightly among the species, loggerhead nesting followed a steeper gradient from the southern to the northern end of the beach than green turtle nesting, there were essentially

no spatial differences within each quartile. The median Julian day for nesting over this 14-year period was 176 ± 4.6 (~June 26) and 204 ± 5.5 (~July 23) for loggerheads and green turtles, respectively. Green turtles exhibit a two-year nesting cycle, i.e., a high number (~1730) of nests one year followed by a low number (~150) of nests. The median day for green turtle nesting significantly differed for the high (200) and low (205) years. The median date of loggerhead nesting became earlier by ~8 days during this time span perhaps reflecting ocean warming trends. However, a similar pattern was not apparent with green turtle nesting.

Evaluation of Kemp's ridley hatchling sex ratios using histological techniques

Marc Zelickson[1], Thane Wibbels[1], Lila Vega[2], Diana Lira[2], Rodolfo Acosta[2], Jaime Pena[2], Patrick Burchfield[2], Sergio Gomez[3], and Barbara Schroeder[4]

[1] University of Alabama at Birmingham, AL, USA
[2] Gladys Porter Zoo, Brownsville, TX, USA
[3] SEMARNAT, Aldama, Tamaulipas, Mexico
[4] National Marine Fisheries Service, Sliver Springs, MD, USA

The Kemp's ridley sea turtle inhabits the Gulf of Mexico and Atlantic coastal waters of the United States. Due to its endangered status, this species has been the subject of intense conservation efforts over the past three decades. These efforts include the moving of nests to protected egg corrals at the main nesting beach near Rancho Nuevo, Mexico. Since this species has temperature-dependent sex determination, it is advantageous to monitor the incubation temperatures and resulting sex ratios produced in the egg corrals. In the current study, histological analysis was used to sex hatchlings that were found dead in nests after all of the live hatchlings emerged. One to five hatchlings per nest were collected from a total of 50. Kidney/gonad tissue was preserved from each hatchling, and was then histologically processed. Each gonad was examined microscopically to determine if it was an ovary or a testis. The results indicate an overall female bias in the hatchlings examined. These results are consistent with a previous female-biased sex ratio prediction for the 2002 nesting season, based on incubation temperatures. The results also provide insight on the transitional range of temperatures during sex determination in the Kemp's ridley sea turtle. The result will be beneficial to the development of effective management strategy for the recovery of the Kemp's ridley sea turtle.

The systematic position of the Mexican Pacific hawksbill turtle (*Eretmochelys imbricata*) based on mtDNA control region sequences

Tania Zúñiga Marroquín[1], Samantha Karam Martínez[2], and Alberto Abreu Grobois[3]

[1] Departamento de Ecología y Comportamiento Animal, Instituto de Ecología, A.C. Xalapa, Veracruz, México
[2] Universidad del Mar, Puerto Ángel, Oaxaca, México
[3] Instituto de Ciencias del Mar y Limnología, Estación Mazatlán, UNAM, Mazatlán, Sinaloa, México

Although the sea turtles group is very reduced, controversies remain on the systematics of some species. While most authorities recognize no categories under the species level, others still support the existence of subspecies based on morphologic characteristics and geographical distribution. Due to the fact that the group's morphology is very conserved, molecular protocols have been used to resolve taxonomic hypotheses, providing an approach that analyzes differences that underpin the evolutionary processes. The hawksbill turtle also has been subject to these

controversies, with separate species or sub-species suggested for Atlantic and Indo-Pacific branches. We present mtDNA control region sequences from Mexican Pacific hawksbill individuals that were compared with previously reported molecular data for populations in the Indo-Pacific Oceans and in the Atlantic. The genetic distances suggest levels of mtDNA control region differentiation similar to those between *Lepidochelys olivacea* and *L. kempii* and between *Chelonia mydas* populations from different ocean basins (Indo-Pacific versus Atlantic-Mediterranean). The time of divergence estimated for the separation of the Pacific-Atlantic lineages (1.6-3.9 Ma) on the basis of the genetic analysis agrees with the better estimates for time of emergence of the Panama Isthmus. Thus, an allopatric mechanism for differentiation could be inferred. A complete phylogenetic tree generated with mtDNA control region sequences for the various species indicates a level of differentiation between the Pacific and the Atlantic hawksbill sequences that would be consistent with these two hawksbill lineages be considered at least separate sub-species.

SEA TURTLE MODELING AND PREDICTION

Internesting intervals of *Lepidochelys kempii* estimated by tag-recapture method

María del Carmen Jiménez- Q. [1] and René Márquez-M.[2]

[1] Instituto Nacional de la Pesca, Manzanillo, Colima, Mexico 28217
[2] Comite Consultivo, CIACPTM

The internesting intervals for *Lepidochelys kempii* were described. The females were tagged and those that nested two and three times at Rancho Nuevo, México were analyzed. The internesting intervals were from 10 to 70 days (1978- 1995). It is possible that the longest intervals were either from females not observed when they were nesting or from females that needed a longer recuperation lapse. On the contrary, the intervals less than 5 days were taken as errors during the reading of the tags. The frequency distribution of 40% of the analyzed years showed one mode; 50%, two modes and 10%, three modes. The most frequent intervals varied between 25 and 35 days, and it was a possibility that there were two intervals within a nesting season. The correlations between the internesting intervals and the date changed throughout the years. The physiological conditions and the environmental factors probably modified the interval.

Predicting the impact of sea level rise on Caribbean nesting habitat

Marianne R. Fish [1], Isabelle M. Côté [1], Jennifer A. Gill [1], Andrew P. Jones [1], Saskia Renshoff [2], and Andrew R. Watkinson [1]

[1] University of East Anglia, Norwich, Norfolk, UK
[2] Sea Turtle Club Bonaire, Bonaire, N.A.

Nesting beaches that are subject to a number of natural processes and anthropogenic activities will be brought under increased pressure from projected sea level rise. In the Caribbean, where tourism-related development is increasing, current sea level changes are taking place in a

significantly altered landscape and, as such, natural succession can no longer occur in many areas. Consequently, one of the major effects of projected sea level rise is likely to be a loss of beach habitat, and thus a loss of nesting areas. Although utilization of alternative beaches by nesting females may be possible, expanding coastal development means options will be increasingly limited.

This study examined the potential for using a geographical information system (GIS) to assess the impacts of sea level rise on nesting habitat in Bonaire. Beach profile measurements were used to develop elevation models of individual beaches that were then used to quantify areas of beach vulnerable to different sea level rise scenarios. Physical characteristics of the beaches were also recorded and related to beach vulnerability to flooding and to nesting frequency. Beaches were found to vary in physical characteristics and therefore in their vulnerability to flooding. Up to 32% of the total current beach area could be lost with a 0.5m sea-level rise, with lower, shallower, narrower beaches being the most vulnerable. We also found that vulnerability varied with land-use adjacent to the beach. Understanding how beaches are likely to be impacted by environmental changes such as these is essential for conservation planning.

The effect of renourishment sand on sea turtle nesting behavior

Jennifer L Mann, Julia E. Moriarty, Robert W. Albury, and Kirt W Rusenko

Boca Raton Sea Turtle Conservation and Research Program, Boca Raton, FL, USA

Restrictions exist to minimize the impact that beach renourishment projects have on nesting sea turtles. However, recently dredged sand still seems undesirable to female sea turtles. One possibility for the rejection of a renourished beach is the high salt content of the dredged sand. This study will investigate the relationship between high sand salinity and decrease of sea turtle nesting in a given area.

Beach renourishment is a popular solution to increasing beach width. Beach renourishment offers immediate though temporary results by pumping millions of cubic yards of sand dredged from the ocean floor right onto the beach. To sustain this wide beach additional renourishments are necessary every few years. Each renourishment dumps high salinity sand onto sea turtle nesting sites. The nesting season following a renourishment project usually sees a sharp decline in the number of nests. The number of nests usually returns to normal for the next nesting season.

This study examined a small area of renourished sand that was placed to protect the foundation of a single condominium. In addition to normal monitoring of nesting activity, rainfall measurements and surface sand samples were collected daily. These sand samples were then tested for salinity levels. Preliminary data shows that as sand salinity decreased the occurrence of turtle activity in the area increased. Initially, little nesting activity was recorded in the area until heavy rainfall caused the sand salinity to drop. Furthermore, it wasn’t until the sand salinity reached a stable value that a nest was recorded.

Evidence for a specialization of mole crickets to eat marine turtle eggs

Alexandra Maros, Alain Louveaux, Stéphane Caut, Pascal Jouquet, Julie Marmet, and Marc Girondot

Ecologie, Systématique et Evolution, Université Paris-Sud, Orsay, INRA, ENGREF et CNRS, Bât. 362, 91405 Orsay cedex, France

Experiments have shown that the mole cricket, *Scapteriscus didactylus*, found on beaches of French Guiana, is a potential predator of marine turtles eggs. To estimate the importance of this predation on natural nests, various experiments have been conducted. First, the damage of mole crickets on 99 natural nests of *Dermochelys coriacea* has been established. A strong relationship between the distance of the nest to vegetation has been found. Then, the acoustic characterization of various species of mole cricket in the region has permitted us to definitively identify that the same species, *Scapteriscus didactylus*, can be found both on the nesting beach and within the sandy soil of village. Then, we used stable isotope (delta N and delta C) to study the feeding habit of these two groups in relation to the month of capture. We show no temporal variation for village *Scapteriscus didactylus* but a strong signature for delta N identical to the one observed in eggs of leatherbacks during the nesting season of this species. This proves that *Scapteriscus didactylus* specializes in feeding on marine turtles eggs during the nesting season.

Assessing sea turtle population dynamics through a new quantitative framework using an individual based model

Antonios D. Mazaris[1], Øyvind Fiksen[2], and Yiannis G. Matsinos[1]

[1] University of the Aegean, Myitltne, Greece
[2] University of Bergen, Bergen, Norway

In the present study we describe the basic entries, features and functions of an alternative modeling approach used to assess sea turtle population dynamics. We developed an individual-based model applied to a theoretical sea turtle population. Super–Individual modeling approach (Schafer et al. 1995) is used. Different levels of environmental and demographic stochasticity are introduced for various life stages. The model also accounts for density dependent effects, while energetic rules have been developed and applied to control reproduction (sexual maturation, remigration interval, reproductive output). The importance of variable demographic rates is also examined. The model introduces a new framework on modeling sea turtle population dynamics by analyzing life cycle into an individual basis level.

Modeling sea turtle clutch temperature and development based on air temperature and sand characteristics

Mario Mota[1] and Ray Carthy[2]

[1] Dynamac Corporation, Kennedy Space Center, Florida, USA
[2] University of Florida, Gainesville, Florida, USA

Sea turtles bury their eggs throughout the world's sandy beaches where they undergo embryonic development. The substrate in which these eggs are buried plays a major role in determining hatchling growth rates, developmental times, and sex. Because abiotic factors, such as air

temperature and sand characteristics, influence the properties of the substrate, a model was developed to explain how these abiotic factors influence sea turtle embryonic development.
The model is divided into two major components. The first component illustrates the transfer of solar radiation from the beach surface through partitioned layers of the sand profile and into heat stores at different depths. It considers properties of the substrate, such as moisture content, compaction levels and conductance values, and models how their interactions create a resistor to heat flow. The resistance component of the model explains heat flow and provides temperature at clutch depth.
The second component of the model utilizes clutch temperature at different embryonic stages to calculate developmental transformation. This transformation can be used to predict embryonic growth, temperature-dependent sex determination and physiological death.
A model of storage and transport of heat in sand can be used by biologists and environmental managing agencies to predict potential detrimental impacts beach nourishment projects, or similar restoration activities, will have on a sea turtle nesting beach.

Northwest Florida loggerhead nesting preference for high geomagnetic field intensities

W.J. Rink, J. Boyce, and J. Pilarczy

School of Geography and Geology, McMaster University, 1280 Main St. W., Hamilton, Ontario, Canada L8S 4K1

Young loggerhead sea turtles (*Caretta caretta*) were shown to respond to changes in the declination, inclination and intensity of the earth's magnetic field (Lohmann et al., 1999, 2001). This ability has been inferred as a possible mechanism in natal homing scenarios among adult females, but thus far no demonstrated magnetic preferences have been shown among adults. We show here that nesting females prefer to nest in areas of stronger total magnetic field along the 30 km long shoreline of St. George Island, Florida along the north coast of the Gulf of Mexico. This behavior has been found on different scales, with the largest number of nests being laid in the zone of the maximum total field intensity, while two localized residual field anomalies (smaller zones of local magnetic highs) also show a corresponding higher nesting density. In our study, we combined aeromagnetic field intensity with maps of the shoreline and the distribution of nests in each of 2001 and 2002. In this region, a strong magnetic high exists near the central zone of the shoreline that decreases by about 500 nanotesla to both the east and west edges of the study area. The smaller local zones of increased field intensity are no more than 50 nanotesla larger than the nearby zones of lower field and extend laterally over only a few kilometers. Nesting densities range from 1 to 25 nests per kilometer of coastline.

First estimation of the annual female adult survival rate based on tagging data from French Guiana

Philippe Rivalan, Anne-Caroline Prevot-Julliard, and Marc Girondot

Laboratoire d'Ecologie, Systématique et Evolution, UMR 8079 CNRS, ENGREF et Université Paris-Sud XI, 91405 Orsay Cedex, France

Capture-Recapture (CR) data are commonly used to estimate life history parameters such as survival rate. For sea turtles, CR data come almost exclusively from tags applied to reproductive females on nesting beaches. However, as females nest every 2-3 years, males are not accessible

for tagging on nesting beaches, and rates of tag-loss in some sea turtles can be relatively large, tagging data from female sea turtles do not fit the normal underlying assumptions of CR.
To correct for this problem, we adapted a multi-state methodology developed to fit data with unobservable states to estimate survival rate in sea turtles without first correcting for tag-loss. We then adapted this model to develop a second model that also corrects for the bias associated with tag-loss. We used these models together to estimate annual survival rate in leatherbacks nesting on Aw:ala-Ya:lima:po beach, French Guiana. We used the first model that assumes zero tag loss to estimate survivorship based on data from PIT tags applied to turtles from 1995 to 2003. We used the second model that corrects for tag loss to estimate survivorship based on data from Monel tags applied to turtles from 1988 to 1994. Survival rate was estimated to be 0.97 (CI 95% 0.92-0.99) from 1995 to 2003 based on PIT tags and 0.70 (CI 95% 0.45-0.96) from 1988 to 1995 based on Monel tags. Because of the large confidence interval for survival rate estimated with Monel tags, the estimates were not significantly different.

How small is big? Minimum size of leatherbacks at reproductive maturity

Kelly Stewart[1], Chris Johnson[2], and Matthew H. Godfrey[3]

[1] Duke University Marine Laboratory, Beaufort, NC, USA
[2] Marinelife Center of Juno Beach, Juno Beach, FL, USA
[3] North Carolina Wildlife Resources Commission, Beaufort, NC, USA

Leatherbacks are the largest living turtle species, with at least one individual reported to have weighed over 900 kg. Less is known about the minimum size of reproductive female leatherbacks. This parameter is valuable for the construction of life history models, for properly defining age-classes of stranded leatherbacks, and for use in growth models. We present both original and published data on the range of sizes (curved carapace length - CCL) of different nesting populations around the world. Although the mean size for females is relatively conserved at around 155 cm CCL, we noted that small leatherbacks (<140 cm CCL) are regularly observed nesting in nearly every rookery for which data were available for us to consult. These smaller females lay viable eggs and contribute hatchlings to their specific population. Therefore we suggest that more attention be given to small adult leatherbacks in addition to large adults when considering building life history models or estimating age at sexual maturity.

The effects of two large-scale construction projects on a high density nesting beach in Palm Beach County, Florida - Results of a five year study

Leanne S. Welch, Paul Davis, Carly Pfistner, and Bud Howard

Palm Beach County Dept. of Environmental Resources Management, West Palm Beach, FL, USA

Juno Beach has long been recognized as one of the premier sea turtle nesting beaches in southeast Florida. Since 1997, two major construction projects have occurred on this beach, both with the potential to impact sea turtle nesting patterns and success. Construction of the 990-footlong Juno Beach Fishing Pier began in November 1997 and the pier became operational in January of 1999. Following the 2000 nesting season, approximately one million cubic yards of sand were placed

on Juno Beach as part of a nourishment project. A detailed assessment of the utilization of this beach by nesting sea turtles began in 1997, one year prior to construction of the pier, and has continued through the 2003 nesting season. Spatial nesting patterns, based on GPS data, were evaluated using an innovative analysis approach developed by Emory University. This technique calculates significant differences in nesting density from year to year, and then projects these differences directly onto aerial photographs of the beach. Results suggest that changes in sea turtle nest site selection due to nourishment activities greatly outweighed effects due to the pier. In the years following nourishment, there was an obvious shift in nesting away from the nourished beach. In addition, nests placed in the fill area are generally closer to the waterline, and as a consequence, have a greater chance of being lost to erosion. It is hoped that continued long-term monitoring of this beach may help in the design of "turtle-friendly" beach nourishment profiles in the future.

Surprising sex ratios in northwest Atlantic loggerhead hatchlings—An unexpected skew to females

Jeanette Wyneken[1], Kimberly Blair[1], Sheryan Epperly[2], Jason Vaughan[1], and Larry Crowder[3]

[1] Florida Atlantic University, Boca Raton, Florida, USA
[2] National Marine Fisheries Service, Miami, Florida, USA
[3] Duke University Marine Laboratory, Beaufort, North Carolina, USA

The loggerhead populations nesting on the United States' Atlantic coast include a reasonably small, still declining (2-3% per year) northern subpopulation and a 10-fold larger, approximately stable, southern subpopulation. Because sea turtle sex is environmentally determined, we expected sex ratios in the southern population to be strongly female-dominated, while the northern population would be male dominated, based largely upon predictions from nest temperatures. If overall sex ratios become strongly skewed to female, males produced in the declining northern population could be particularly important to population recovery. We modified existing non-lethal laparoscopic procedures to determine the sex of post hatchling (~120g) loggerhead sea turtles from 10 beaches representing both northwest Atlantic subpopulations in 2002. Our techniques for determining sex were ~95% accurate (verified by micro-biopsy). We found 70% females in the south and 80% females in the north. The surprisingly low proportion of males in the northern subpopulation is alarming. This genetically distinct group may be producing fewer males than are necessary to sustain the subpopulation structure. The confirmation of such highly skewed sex ratios continue to raise questions about the significance of large proportions of females. Interpretation is limited without additional understanding of loggerhead mating systems. Our results were surprising because they do not closely parallel sex ratios predicted by temperature studies and they suggest further refinement of our understanding of sex determination is warranted. These results are important because insufficient numbers of males may jeopardize the future recovery of the population and the genetic diversity represented by the two subpopulations.

SEA TURTLES AND SOCIO-ECONOMICS

Sea turtle ecotourism in the Ebodje region of Cameroon

Isidore Ayissi[1], A. Amougou[1], and Jacques Fretey[2]

[1] Département de Biologie et de Physiologie Végétales, Faculté des Sciences, Université de Yaoundé I-Cameroun
[2] Laboratoire d'Evolution, Muséum national d'Histoire naturelle, 36 rue Geoffroy St Hilaire, 75005 Paris France

The sea turtle study in the Ebodje region was developed in three phases: regional surveys to identify and describe the different nesting sites in the area, a census of the species occurring in the region and an evaluation of their threats, and evaluation of the tourist potential and its application to the protection of sea turtles and the sustainable development of the coastal fishing communities. We identified nine nesting sites in the Ebodje region, with variable levels of nesting density: Mbendji, Ebodjé, Tala, Likodo, Ndjongo, Ipenengé, Béyo, Elombo and Békolobé. Four species were found to occur here: *Chelonia mydas*, *Eretmochelys imbricata*, *Dermochelys coriacea* and *Lepidochelys olivacea*. Their slaughter and the collection of eggs represent serious threats for these species and have led to an evident population decline. The Ebodje region, as well as Kribi and its surroundings, have vast tourist potential which should be developed in conjunction with management plans for the conservation of these endangered sea turtle species, and the sustainable development of the village communities in the region.

Activities of integration communitary with the indigenous Wayuú: A hope for the conservation of the sea turtles in the Gulf of Venezuela

Héctor Barrios-Garrido[1], Ma. Gabriela Montiel-Villalobos[2], Yeni Barrios[3], José Castañeda[3], Gresly Castro[3], Luz Lisset[3], Leidy Morales[3], Paola Valero[3], Mary Sol Nuñez[3], José Zambrano[3], Sofía Álvarez[4], and Libicni Rivero[4]

[1] Postgrado en Ecología Aplicada. Facultad de Ciencias. La Universidad del Zulia Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV)
[2] Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV)
[3] Facultad Experimental de Ciencias. Departamento de Biología. La Universidad del Zulia
[4] Facultad de Ciencias Veterinarias. La Universidad del Zulia

Sea turtles occupy an important place inside the magical-religious beliefs of the indigenous Wuayuú. They are considered a “gift of the gods” and symbols of fertility and longevity. The commercial exploitation of their products has increased in the past few decades; the sale of sea turtle meat in local, national and international markets (illegal commerce in the Colombo-Venezuelan border) and the sale of varnished hawksbill shells are very common. With the objective of bringing to the Wuayuú communities the meaning of terms such as: environmental education, extinction, conservation, and sustainable use, the Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV) carries out common activities of integration adapted to the conditions and beliefs of these communities. These activities include training workshops in the elaboration of figures in yeso, seminars on the importance of the conservation of sea turtles for children and adults, and workshops shops for the fishermen. During this year, this activity was carried out in the locality of Paraguiapoa, on December 12 and 13, with the participation of 12 volunteers from the GTTM-GV and the entire local community.

Implementation of the judicial tools in force in the Venezuelan legislature for the protection of sea turtles

Omar Barrios-Garrido[1], Zarina Leal [2], Héctor Barrios-Garrido [3], and Ma. Gabriela Montiel-Villalobos [4]

[1] Facultad de Ciencias Jurídicas y Políticas. La Universidad del Zulia
[2] Facultad de Ciencias Políticas, Administrativas y Sociales. Universidad Rafael Urdaneta
[3] Postgrado en Ecología Aplicada. Facultad de Ciencias. La Universidad del Zulia Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV)
[4] Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV)

Since the 1960s, Venezuela has developed a legislative branch that is very sympathetic to environmental matters on the Latin American level. This development has caused the creation of laws designed to regulate environmental protection as well as garner the approval of diverse international covenants. However, when analyzing the results of these laws when put in place, it is observed that deficiencies exist in the implementation of the laws as a result of the absence of governmental enforcement. There is a clear absence of legislation regulating the conservation of marine turtles, and it is recommended that laws protecting marine turtles and their habitat be enacted, implemented and enforced. Laws must also be put in place to create institutions that develop policies in areas of education, investigation and conservation of marine turtles.

A practice-based approach is used locally in Mazatlan to conserve marine turtles and their habitats

Raquel Briseño-Dueñas[1], Daniel Ríos-Olmeda[2], F. Alberto Abreu-Grobois[3], J. Wallace Nichols [4], Angeles Cruz-Morelos[5], and Martha Osuna-Madrigal [6]

[1] Banco de Información de Tortugas Marinas (BITMAR), Unidad Académica Mazatlán, Instituto de Ciencias del Mar y Limnología, UNAM, Apdo. Postal 811, Mazatlán, Sinaloa, Mexico 82000 Email: raquel@ola.icmyl.unam.mx
[2] Centro de Protección y Conservacion de Tortugas Marinas "El Verde", Mazatlán, Sin, DGVS, Delegación Sinaloa, Semarnat, Email: drios@mzt.megared.net.mx
[3] Laboratorio de Genética, Unidad Académica Mazatlán, Instituto de Ciencias del Mar y Limnología, UNAM, Apdo. Postal 811, Mazatlán, Sinaloa, Mexico 82000 Email: abreu@ola.icmyl.unam.mx
[4] WiLDCOAST, PO Box 324 Davenport, California 95017, USA, and Department of Herpetology, California Academy of Sciences, San Francisco, California, USA
[5] Departamento de Educación Ambiental, Acuario Mazatlán, Ave. de los Deportes 111 Fracc. Tellería, Mazatlan, Sin, Mexico. Email: educamb@latinmail.com
[6] Programa de Rescate de Nidos en la Zona Urbana de Mazatlan, Acuario Mazatlan, Ave. de los Deportes 111, Fracc. Tellería, Mazatlán, Sin, Mexico

That the availability of extensive scientific knowledge and the application of best practices is a pre-requisite for effective conservation of marine turtles and their habitats is undeniable. Nevertheless, in spite of the prolonged application of human and economic resources to generate information and recommendations in specialized publications, international and regional meetings and workshops, deficiencies persist when transferring to governmental programs of national scope and these are amplified at the local level with absent, erratic or baseless conservation policies. Consequently, recovery programs are exceeded by pressure factors like persistent directed and incidental capture of marine turtles, egg poaching and trade and the degradation

/destruction of critical habitats. Through the instrumentation of a practice-based model at a local level that included biological and social components, we organized best-practice training workshops, environmental education programs, a marine fauna contingencies committee, a strandings network, programs to promote valuation of the natural heritage within cultural and traditional festivals, and dissemination through the mass media. We present results for these programs and report on the successes at mitigating pressure factors impacting the local El Verde (Sinaloa, Mexico) marine turtle sanctuary, an index nesting beach for *Lepidochelys olivacea*, and foraging grounds for *Eretmochelys imbricata* and *Chelonia agassizii*, with a monitoring program since 1975.

Controlling the illegal trade of sea turtle products in Costa Rica: A focus on turtle shell souvenirs

Didiher Chacón[1], Wagner Quirós[2], and Isabel Naranjo[3]

[1] ANAI/WIDECAST, Costa Rica, tortugas@racsa.co.cr
[2] ANAI, Costa Rica, volunteers@racsa.co.cr
[3] PRETOMA, Costa Rica, inaranjo@tortugamarina.org

The project was carried out between 2000 and 2003. The objective was implemented using a series of steps to reduce the illegal trade of sea turtle products with focus on turtle shell handcrafts. During phase one, an assessment was developed to understand the characteristics of the trade in Costa Rica including types of vendors, origin, prices, quantities and movements. That included visiting 27 cities, town and villages. The following part was the design of activities to impact the illegal trade. This strategy relied on 7 main steps with local, national and international actions and the participation of governmental authorities. The last part of the project was developed to measure the impact of this strategy. This resulted mainly in a change of nationality of vendors (before Nicaraguan citizens, now Colombian citizens), reducing 42% of the items in the commercial places (905 pieces), reducing the number of locations with products, only one person had 59.2% of the total products reported in the second assessment, 53 commercial places took the certification stamp. During the project, 15 confiscation actions were developed with the participation of all stakeholders, two national workshops, 10 training activities and international exchange of expertise between our authorities and US government. The main result of this project was political in nature because it was the first time that all authorities with responsibility for sea turtles, control, custom, politics, health and academia have a dialogue.

Reducing fishery impacts in Vietnam: First steps

Steph Cox[1], Nguyen Truong Giang[2], and Nick Cox[3]

[1] Independent Consultant, Hanoi, Vietnam
[2] Con Dao National Park, Ba Ria Vung Tau province, Vietnam
[3] WWF Indochina, Hanoi, Vietnam

Marine turtle conservation in Vietnam has been successful in protecting nesting beaches of green turtles and releasing hatchlings, particularly in Con Dao in the south of Vietnam. Results of advocacy work with the government and the development of the Vietnam Marine Turtle National Action Plan 2003-2010, in partnership with the Vietnam Ministry of Fisheries, IUCN, WWF, and TRAFFIC, promote further conservation activities to widen the scope of marine turtle conservation in Vietnam. A large proportion of the population in Vietnam live on the coast and are engaged in inshore fishing activities, and estimates of fishing related mortality suggest up to

4,000 deaths per year. The areas of highest marine turtle abundance are also subject to the highest inshore fishing pressure. The unregulated nature of the fisheries industry, together with an impoverished coastal population fishing ever declining resources, leads to a number of conflicts and implications for designing conservation initiatives. A partnerships approach is necessary for designing effective, sustainable initiatives to reduce the impact of fisheries in Vietnam. Key next steps are to identify motivating factors for the wide range of stakeholders (from the Ministry level to local fishers). Once these are identified, participatory data collection on incidental catch, trials with TEDs using commercial and local vessels, evaluation of current marine zoning plans and strengthening existing fisheries management capacity should be the starting points for mitigation activities. This approach is intended to result in a broader understanding of fisheries impacts on sea turtles and help to develop positive relationships between stakeholders.

Preliminary assessment on the use and commerce of sea turtles in the Archipelago Los Roques National Park

Verónica de los Llanos [1], Pedro D. Vernet [2], Luis G. Morales [3], Hedelvy J. Guada [4], and José M. Martinez[2]

[1] Escuela de Biología, Universidad Central de Venezuela, Caracas, Venezuela
[2] Fundación Científica Los Roques. Apdo. N 1139-Caracas 1010-A, Venezuela
[3] Instituto de Zoología Tropical, Apdo 47058-Caracas 1041-A, Venezuela
[4] CICTMAR/ WIDECAST. Apdo. 50.789. Caracas 1050-A. Venezuela

The Archipelago Los Roques was given National Park status by law in 1972. Although the capture, extraction and commerce of sea turtles are illegal, the destruction of nests and the intentional capture of turtles in the water and on land continue. In order to assess the impact on this turtle population, an evaluation (of destruction of nests, intentional and incidental capture of turtles by local fishermen, side effects produced by the presence of permanent or temporary encampments and tourist use of protected areas) both hands on and through a survey, was undertaken, as well as the use and commerce of products derived from turtles. Also, the evaluation included the observation of natural factors that could have an effect on turtles (erosion, depredation and illness). 45 persons completed a survey, all men between 23 and 85 years old. The results showed that the poaching of nests occuring throughout the National Park reaches 27.46% of total nests. The incidental capture of these turtles continues to occur using fishing lines and does not occur with gillnets as was the case in the past. The intentional capture of juvenile and adult turtles is achieved by underwater diving. Regarding the use and commerce of products derived from turtles, 11% of those surveyed confirmed that turtle shells are reported as being mainly hawksbill shell sold specifically to Bonaire and Curacao and the strongest market being La Guaira, Venezuela.
A more thorough study is recommended on the use and commerce of products derived from sea turtles in this National Park.

Peyu Project sea turtles of Argentina Republic activities summary 2003-2004

Jose Di Paola, Marcela Iglesias, Cintia Echenique, Laura Prosdocimi, Tania Giuliani, Lucas D'Alessandro, Carolina Peralta, and Analia Garre

Proyecto Peyu - Tortugas Marinas de Argentina. La Plata, Buenos Aires, Argentina

Peyu Project – Research and Conservation of Argentine Sea Turtles has completed journeys to the coast of the Buenos Aires province between San Clemente del Tuyu and Bahia Blanca during 2003 and 2004. It has been organizing a consolidated, cooperational Program for Research and Conservation of Marine Turtles (PRICTMA) that includes aquariums, foundations and protected areas. The commitment of this program is to simplify the distribution and management of information throughout the Network of Sea Turtles from the South Western Atlantic. The Peyu Project has held seminars and training courses in specialty subjects at universities, academic meetings, high schools, and also organized the first course specializing in the biology and conservation of sea turtles in Argentina. The project has participated in publications such as "Geo Juvenil Argentina" and "Guía Argentina Sustentable," helping contribute to the knowledge of the existence and problems of sea turtles as well as the existence of our research team.

Use of marine turtles in West African pharmacopeia and voodoo

Jacques Fretey[1] and Gabriel Hoinsoudé Segniagbeto[2]

[1] UICN-France, FFSSN Muséum national d'Histoire naturelle, 57 rue Cuvier, Paris cedex 05, FR 75231
[2] Agbo-Zegue BP 6057, Lomé (Togo)

In Africa, one would have to invent a science called chelonian-pharmacology. Carapaces, bones, crushed skulls, fat, and other turtle parts are used for preparing medicines that traditional practitioners use to cure leprosy, asthma, malaria, headaches, convulsions, rickets and other illnesses. In Guinea, mothers bathe their children in a basin made from a green turtle carapace; in Togo, mothers put a sea turtle bone in the bath water when children are between 6-7 years of age so that they will have strong bones. The local belief is that the force developed by a turtle on land will be transmitted to the child through these practices. For these reasons, one may see a piece of bone around someone's neck as an amulet or around the hips of a child that has a delayed ability to walk. Besides these traditional practices, legends and animistic belief invoke the totemic and divine aspects of sea turtles. In some fishing communities in Ghana (Ahlons, Gans) and Benin, sea turtle hatchlings are used in voodoo ceremonies. The eggs of sea turtles are used in animistic practices especially among the followers of Mami-Wata, the goddess of the sea. According to her followers, this goddess uses a turtle as her transportation in the seas and to contact humans on land. The voodoo grand-priest in Ouidah (Benin) claims to join this fetish each year in his underwater clothes, thanks to a turtle that carries him standing on its back.

Declaration of a protected area to conserve leatherbacks (*Dermochelys coriacea*) in the municipality of Acandí, Colombian Caribbean Darién, from a social participation view

Walker Hoyos Giraldo[1] and Jorge Eliecer David Higuita[2]

[1] profesional de apoyo Area de Manejo Epecial del Darién adcrita al Unidad Administrativa Especial del Sistema de Parques Nacionales, Colombia
[2] coordinador Area de Manejo Epecial del Darién adcrita al Unidad Administrativa Especial del Sistema de Parques Nacionales, Colombia

The Colombian Darién includes the most important nesting beaches for Dermochelys coriacea in Colombia and one of most important in the Caribbean, with an average of 250 nesting females every year. For eleven years, we have been developing on these beaches the Protection of the Marine Turtles Days with emphasis on education, participation and investigation. The knowledge and experience acquired during this process on the reproductive cycle and threats to the species, classified in danger at national and global levels, has allowed us to have a solid base from which to propose measures of handling and protection. In 2003, a protected area was proposed in the Gulf of Arabá in an effort to preserve leatherback habitat and breeding grounds, jointly creating the Sanctuary of Flora and Fauna and the District of Integrated Handling, utilizing strict protection of nesting habitat and sustainable handling of the continental landscape bordering the area.

Sea life education for future conservation

Hector J. Horta Cruz

Senior Student Isidro Sanchez High School Luquillo PR, 00773 and Volunteer in Sea Turtle Projects of the Puerto Rico Department Of Natural

During the past 3 years, I have been working on the creation of an educational program in the northeastern coastal communities of Puerto Rico. The objective of the program is to integrate young students in the experience of training in different aspects regarding the conservation of marine life, with a large emphasis on sea turtle conservation.
Activities such as public educational exhibits, educational talks, TV specials and guiding student groups on nighttime turtle patrols are some examples of the efforts to educate young students in conservation activities. As a result of this effort, the present number of full time volunteers working on sea turtle nesting management activities under the Puerto Rico Department of Natural and Environmental Resources Sea Turtle Program has grown from 3 to 14. In addition, this has led to the increased awareness and interest in marine conservation in the coastal communities. In summer 2003, this project was presented for competition to The Earth Island Institute 2003 Youth Awards, receiving an honorable mention.

Ecosystem conservation approch in marine conservation in Sri Lanka

Thushan Kapurusinghe [1] and Lalith Ekanayeka[2]

[1] Project Leader - Turtle Conservation Project (TCP)
[2] Project Secretary - Turtle Conservation Project (TCP)

Five of the world's seven species of marine turtle come ashore to nest in Sri Lanka. They are the green turtle (*Chelonia mydas*), olive ridley turtle (*Lepidochelys olivacea*), loggerhead turtle (*Caretta caretta*), hawksbill turtle (*Eretmochelys imbricata*) and leatherback turtle (*Dermochelys coriacea*). Despite the protection of sea turtles under the government legislation since 1972, sea turtles are still being exploited by Sri Lankan fishermen for their meat and eggs. Coral mining, destruction of coastal vegetation such as mangroves and seagrass beds, coastal erosion, non-scientific hatchery practices, uncontrolled tourism, some coastal development activities and accidental bycatch can be listed as the other threats for sea turtles in Sri Lanka.

The Turtle Conservation Project (TCP) in Sri Lanka was established in 1993 to address the issue of marine turtle conservation through research, awareness, and community participation. TCP has initiated and conducted many community-based conservation activities along the coastal belt of Sri Lanka in order to address the marine turtle and their habitat issues. Major programs such as community environmental education programs, mangrove rehabilitation programs, model medicinal garden and free herbal drink programs, community library programs, free English teaching programs, nature trail program, turtle watch program, rural medical clinic program, primary school programs, school lecture programs, environmental film show programs have been successfully initiated between Kalpitiya (northwest) and Kirinda (southeast) of Sri Lanka with community participation. TCP continues its education and awareness programs and expands the coastal sites, which were not accessible due to LTTE separatist movements.

Present status of marine turtles and their conservation in Sri Lanka

Thushan Kapurusinghe [1] and Lalith Ekanayeka[2]

[1] Project Leader - Turtle Conservation Project (TCP)
[2] Project Secretary - Turtle Conservation Project (TCP)

Five species of sea turtles come ashore to nest and inhabit the coastal waters of Sri Lanka. Many turtle populations are declining to the point where they are no longer significant resources either materially or culturally. This is due mainly to the indiscriminate exploitation for their eggs and meat. In addition, turtle nesting beaches are being disturbed by tourism and development. Feeding habitats, such as coral reefs, sea grass beds and other coastal vegetation including mangrove habitats are being destroyed by pollution and unsustainable harvesting. Many turtles are also accidentally caught and drowned in fishing gear. Between November 1999 and November 2000, 5,241 turtles were reported as bycatch from 16 fish landing sites. The Turtle Conservation Project has rescued 278 entangled turtles in fishing nets during the 2000 and 2001 period. All 278 turtles were olive ridleys and were tagged before releasing them.

The south and southwest coasts of Sri Lanka have the largest marine turtle rookeries. The Turtle Conservation Project (TCP) has conducted an in-situ nest protection and research program in Rekawa between 1996 and 2000. 827 nesting turtles were tagged during this period and 3,328 nests were recorded. 305,128 hatchlings were released to the sea in the Rekawa rookery. One of the most widespread forms of marine turtle exploitations in Sri Lanka is the illegal poaching of turtle eggs for human consumption or for sale to unscientifically managed 'tourist attraction' turtle hatcheries. 16 turtle hatcheries were observed by TCP when conducting its marine turtle hatchery survey in 1995.

Marine turtle conservation effort through community participation at Narikel Jinjhira (St. Martin's Island) of Bangladesh

S. M. Munjurul Hannan Khan

IUCN-The World Conservation Union, Bangladesh Country Office

Narikel Jinjira is one of the important breeding habitats for marine turtles in Bangladesh. This offshore island is located on the southernmost tip of Bangladesh, roughly between 20'34"–20'39"N and 92'18"–92'21"E, separated from the mainland by a 9km-wide channel.

Five species of marine turtle, *Lepidochelys olivacea* (olive ridley), *Chelonia mydas* (green turtle), *Eretmochelys imbricata* (hawksbill turtle), *Caretta caretta* (loggerhead turtle) and *Dermochelys coriacea* (leatherback turtle), are reported in the territorial waters of Bangladesh.

At Narikel Jinjhira, a total of 535 families (i.e., households) are permanent residents. The traditional uses of marine turtle products by local communities are not significant. However, several causes have been identified in the decline of marine turtle populations, including degradation of nesting sites, high mortality of adults during fishing, predation of nesting females and stealing of eggs. Among these, stealing of eggs from in situ is the most detrimental (Islam et al. 1998). Every single nest is highly vulnerable due to anthropogenic threats.

Before implementation of two important conservation projects by the Ministry of the Environment and Forests of the Bangladesh government, there was no such conservation effort to protect marine turtles on the island. Under the project, the local community was mobilized towards turtle protection. Activities of these projects include group formation, volunteer selection, training, local level workshops and awareness material development. As a result of community mobilization, local communities are now taking care of the marine turtles of the island. This paper includes the steps of community mobilization for a conservation effort.

The history of marine turtle conservation in Trinidad and the active role of rural communities

Suzanne R. Livingstone and J R. Downie

University of Glasgow, Glasgow, Scotland, G12 8QQ

Five species of marine turtle have been observed nesting on Trinidad's beaches. Leatherbacks nest in large numbers. Hawksbills are also moderately common, although numbers appear to have decreased over the last few decades. Past literature reports that green, olive ridley and loggerhead turtles have also been known to nest on this coastline, although there has been little evidence of them in recent years.

Current reports from around the world indicate profound long term declines in numbers of sea turtles. This information concurs with the apparent diminution of four of Trinidad's turtle species. However, there is good evidence of a recent increase in the leatherback population. Trinidad is clearly a significant region for nesting leatherbacks, in the context of serious declines elsewhere.

The history of marine turtle conservation in Trinidad begins in the early 1960's. Much progress has been made since then, largely due to the community-based approach adopted by several local NGO's supported by the government. The east coast and accessible north coast beaches are well documented and have relatively successful ecotourism outfits. However, a large section of the northern coastline is inaccessible by road and little research has been carried out there. Recent investigation through the Darwin Initiative has now shown these beaches to be just as productive (if not more so) as other areas in Trinidad. We have been working closely with local NGO's with a view to enhancing community development, making turtle conservation an option for generating revenue in low-income rural villages through sustainable ecotourism.

The protection program of the "caná" sea turtle (*Dermochelys coriacea*), when the civil society takes the initiative, Darien Region - Colombia

Sergio Marquez Arias

Director, Fundacion Darien, Colombia

The protection program of the leatherback sea turtle, or "tortuga caná,", begun in 1993, has a peculiar and innovative way of working in order to preserve the sea turtle population at their nesting sites in the Urabá Gulf. A small group of people founded the Darien Foundation, taking the initiative and calling on various grassroots organizations and the regional and national authorities to join forces in a common effort to preserve the species and create better and more sustainable ways of development for the region.

The whole process has had a very important role regarding the participation of local inhabitants. Some important tasks included determining how to promote community participation, consolidating their organizational basis and finding alternative ways of management of the local ecosystems in order to minimize environmental impact on the natural resources and increase the communities' standard of living.

Various grassroots organizations have been created and strengthened during these years: Committee Pro Tortuga Caná, Local Tourism Committee Festicaná, Co-researcher Committee, various community action boards, local handcraft committees, and the Ungandi Regional Network of Natural Reserves, among others. All of them feel attached to the management rules and restrictions agreed upon in a consensus-based decision-making process in order to define the nesting sites as protected areas. At the same time, they realize the potential of their region to develop in a more manner without affecting local ecosystems and sea turtle populations.

Sea turtles and science in the classroom: Cultivating a conservation ethic through environmental education in Baja California, Mexico

Alexa McDermott[1], Jeffrey A. Seminoff[2], T. Todd Jones[3], and Antonio Resendiz[4]

[1] Florida Atlantic University, Boca Raton, FL, USA
[2] Southwest Fisheries Science Center, NOAA-National Marine Fisheries Service, La Jolla, CA, USA
[3] University of British Columbia, Vancouver, British Columbia, Canada
[4] Instituto Nacional de Ecología, Dirección General de Vida Silvestre, Secretaria

Bahia de los Angeles is a town teeming with marine life. Whales, whale sharks, and four species of sea turtles are a few of the many species that utilize the local waters. All of these animals are found in the backyard of the children that live in Bahia de los Angeles. However, environmental education and conservation education are lacking in local classrooms. Bahia de los Angeles is the former sea turtle fishery capital of northwestern Mexico. Many of the townspeople are descendents of turtle fishermen, and some still partake in turtle fishing. In Bahia de los Angeles, sea turtles have traditionally been looked upon as a source of food or income and not as something that should be conserved. To achieve our goals of bringing environmental education and conservation to the forefront of the local children's minds, we carried out Environmental Education classes in Bahia de los Angeles, Baja California, Mexico during the months of June and July from 2001-2003. Each week children from the town were invited to attend classes that were held at local offices or classrooms, at no cost. Classes were divided into two parts: lecture and activity. Lessons focused on marine animals that occur in Bahia de los Angeles. As Bahia de los Angeles is an important feeding site for the East Pacific green turtle many lessons were designed to make students aware of the problems faced by these sea turtles and how they could help in conservation efforts.

Community based organizational experiences along the leatherback sea turtle protection journeys in the Darien region, Colombia

Jaime Olivo, Alfonso Gutierez, David Naranjo, Feliciano Chaverra, and Viviana Gomez

Fundacion Darien, Colombia

The main goal to achieve since the protection journeys started in 1993 has been to find a balance between conservation and a better living standard for the local communities. The good management of resources and ecosystems by well-organized communities promotes innovative alternatives instead of restricting their actions and normal activities due to the preservation of an endangered species.

The protection journeys have been important as promoters of consciousness and social-cultural and economic processes. These activities for the preservation of the environment and the "caná" turtle (Dermochelys coriacea) need more active and organized participation of the local communities, different management of resources and alternative production together with the generation of income in order to become more sustainable in the long-term.

The change of attitude toward these species by the locals is easily seen over the past 11 years.

The communitarian co-research committee and the ecotourism committee are two of the initiatives that have been developed along the "caná" protection program. These can serve as good examples for new experiences with a larger perspective within the region.

The co-research committee plays an important role as facilitators within the community. Its challenges include having a main role in the community based organizational process, becoming strong enough to reinforce their position within environmental issues, establishing agreements for environmental management, and the management and administration of protected areas.

Successful field and conservation project with nesting leatherback females (*Dermochelys coriacea*) in Soropta Beach, Bocas del Toro, Panamá

Cristina Ordoñez Espinosa [1] and Natalia Decastro González. [2]

[1] Institute for Tropical Ecology and Conservation (ITEC), Gainsville, Florida, USA
[2] The Endangered Wildlife Trust (EWT), San Jose Costa Rica

Nesting activities of the leatherback turtle (*Dermochelys coriacea*) have been monitored for the last five years on Soropta Beach in Bocas del Toro Province, Panama. This beach on the Caribbean coast is part of the San San Pondsak Swamp lands. Until three years ago, a large proportion of the nesting females were killed and their eggs poached. During the last two years, nighttime patrols, tagging of nesting females, and nest protection have been increased with the participation of members of the bordering communities (Ngobe-Bugle indigenous people) and foreign volunteers. Support for the project has been provided by the National Environmental Authority (ANAM) and the National Police. Talks on environmental education have been given to local teachers and students with favorable results.

Peyu Project educational program as a university extension to the community

Carolina Peralta, Cintia Echenique , Analia Garre, José Luis Di Paola, Marcela Iglesias, Laura Prosdocimi, Tania Giuliani, and Lucas D. Alessandro

Proyecto Peyu- Tortugas Marinas de Argentina. La Plata, Buenos Aires, Argentina

Investigation is as important as communication and transmission of information to the general population. There should be a link between universities, lower academic levels, and the general community. This is what University Extension is dealing with, as with the case of La Plata National University (UNLP) from Argentina, and is one of the goals of Peyu Project-Marine Turtles, Argentina. The educational areas from Peyu Project carry out informational activities about sea turtles and their environmental crisis in Buenos Aires Province, Argentina, through workshops, seminars and training courses according to the academic levels of Argentina: preschool, general basic education (EGB), high school and university, and are available to the wider public as well. Through these activities, Peyu Project has completed the first course of Biology and Conservation of Argentine Sea Turtles, conducting talks and encouraging participation in a science workshop in Nuestra Señora del Carmen School, seminars with the herpetology professors of the Natural Science School of UNLP, community-based lectures for fishermen, and workshops for the children of Bahia Blanca. The project intends to expand their activities to all Buenos Aires Province coast territory with the objective of teaching about the existence of sea turtles and involve the population in active participation for the conservation of the three species that exist near Argentinean coasts.

System for the protection of marine turtles in the “tourist corridor” of MPIO. de los Cabos, B.C.S., Mexico

Tiburcio Pintos Graciela, Pedro Márquez Almansa, José M. Sandez Camilo, Ma. del Rayo Duarte, and Ma. Fernanda Calderon Campusano

H. VIII Ayuntamiento de Los Cabos, B.C.S. (Coordinación para la Protección de la Tortuga Marina)

The lack of community interest in the conservation of sea turtles is caused by a lack of diversification in awareness programs across different sectors and institutions. The solution is to allow the general population to actively participate in projects to help them understand different environmental problems, their magnitude and consequences, and special actions they can take to help mitigate them. The H. VIII Ayuntamiento de Los Cabos, B.C.S. (Municipal Government), created the “System for the Protection of Marine Turtles in the “Tourist Corridor” of MPIO. de los Cabos” with the objective of creating awareness that promotes the respect for life and a permanent friendly relationship between humans and the environment. The program is directed towards hotels in an impacted tourist area with the principle objectives of training the employees during workshops named “Management and Conservation of Sea Turtles in Baja California Sur,” in order to obtain and promote the information necessary to protecting beaches, turtles, nests and hatchlings during the nesting season. More than 18 hotels currently participate, protecting approximately 40 nests. In this presentation, we present the results of our efforts, helping new hotels to understand the importance and understand the added value of nesting sea turtles on their beaches as a tourist attraction.

Turtle conservation: Community education and involvement in tourism areas

Amber L. Pitt

University of Florida, Gainesville, Florida, USA

With the ever-growing human population, direct and indirect human/turtle interactions are increasingly damaging turtle populations and reproductive success. Turtle conservation is dependent on public education and cooperation. In general, few people understand the plight of the turtle or have an appreciation for these creatures, and without justification, they are unwilling to alter their habits for turtle conservation. My poster will explore grassroots conservation efforts utilizing education and local community participation in areas of high tourist traffic. Current programs and new ideas for educating and involving the public with conservation efforts will be addressed, including volunteer monitoring and public outreach.

Environmental education: The perfect complement to sea turtle conservation

Fabian Andres Sanchez[1] and Rachel Beth Silverman[2]

[1] Salvamento Internacional de la Tortuga del Mar (SITMAR), Puerto Jimenez, Osa Peninsula, Costa Rica
[2] National Save the Sea Turtle Foundation (NSTSTF), Ft. Lauderdale, Florida, USA and Salvamento Internacional de la Tortuga del Mar (SITMAR), Puerto Jimenez, Osa Peninsula, Costa Rica

On the Osa Peninsula, Costa Rica, Salvamento Internacional de la Tortuga del Mar (SITMAR) in the last two years has developed successful programs for conservation and environmental education. Students, the local community, governmental agencies and NGOs are actively involved in our conservation program. We teach the basic aspects of the lifecycle of sea turtles and the threats to their survival as well as other ecological issues by means of holding workshops, conferences, and field trips and by creating original education materials.

Now, more than 200 students per year participate with the conservation project and community members from all over Costa Rica (Osa, Golfito, Drake, Guanacaste, Gandoca, etc.) participated in four informational and planning workshops. We are also coordinating with MINAE, the Costa Rican Ministry of the Environment, giving workshops to increase awareness and interest about sea turtles ecology for other organizations.

For two years we have studied the local custom of taking eggs to sell for profit and have tried to teach a better, more conservationist attitude. We are trying to create an ecotourism conservation project that could completely eliminate the extraction of eggs on the beach by economically assisting the community. In conclusion, environmental education is the perfect complement to a conservation program; the community doesn't feel cut out of a resource that was theirs and, on the contrary, learn about self-sustainability.

Marine chelonian illustration Part two: Chelonia and the early studies

Chuck Schaffer

University of North Florida, 13811 Tortuga Pt. Dr., Jacksonville, FL US 32225

The historical illustration and early studies of Chelonia are vital in understanding the changing view of this chelonian. From earliest times, humans have attempted to better understand their world through pictures, with the oldest rock art images evolving to modern photographs. This metamorphosis progressed through media such as stone, pottery, and metalwork, but first gained wide popularity through 12th century manuscripts, and later, printed Bestiaries. The pre-140 BC, Alexandrian Physiologus, later translated from Greek into other languages (Latin before 431 AD), gave way to allegorical Bestiaries from the 5th century to the Middle Ages, before appearing as an English work of the same name. Only exceeded in numbers by Bibles, 12th and 13th century Bestiaries or Physiologi, were collections of short descriptions of animals, rooted in religion, intertwining symbolism with morality lessons. Like the fables that preceded them, such as Thesesus' turtle of Sciron, accounts were overlaid with allegory and highly stylized images. This led to a combination of highly precise information, based on practical contemporary faunal knowledge, but with unknown voids based on mythology and traveler's tales. Monsters from this era included the Kappa, a human with a turtles shell, and "Aspidochelone," a "turtle" island which drowned sailors who disembarked on its back. As Bestiaries were largely compilations of earlier sources, so did their successors, the "cabinets of curiosities" and encyclopedias of the 17th and 18th centuries contain previous images and descriptions, sometimes verbatim. These would ultimately spawn truly scientific endeavors beginning in the 18th century.

SEA TURTLES IN COSTA RICA: MINI SYMPOSIUM

Update in the arribada trends and behavior from Ostional Beach, Costa Rica

Gerardo Chaves[1], Rodrigo Morera[2], and Juan R. Avilés[2]

[1] Escuela de Biología-Universidad de Costa Rica, San Pedro de Montes de Oca, San José, Costa Rica
[2] Asociación de desarrollo integral de Ostional, Ostional, Guanacaste, Costa Rica

In 1970, the University of Costa Rica began the study of sea turtles in Ostional beach, Guanacaste, Costa Rica. There exist excellent records for arribadas over the last 25 years in relation to the date, size, time and area for each phenomenon. The arribadas in Ostional generally occur monthly, but in some years have occurred as frequently as every other week or as seldomly as every few months. The change in arribada size tends to increase throughout time, but is very irregular and seems to operate in a cyclical fashion. Here, we present other factors relating to arribadas such as their relationship to the moon, tides and changes across small and large time intervals.

Estacion Las Tortugas: A community based leatherback sea turtle protection project in Costa Rica

Cerys H. De Witt and Stanley Rodrigues Mendez

Estacion Las Tortugas, Playa Mondonguillo, Limon, Costa Rica

Estación Las Tortugas is a community-based conservation protection project for the leatherback sea turtle (*Dermochelys coriacea*) on the Caribbean coast of Costa Rica, which has been ongoing since the year 2000. The project has carried out an intensive patrol schedule over the 3 nesting seasons, working from early March to the end of July to protect the nests of the leatherback turtles from the local poachers along a 3-kilometer stretch of beach. Working in close support with EcoTeach, a US-based environmental education conservation organization, and through the dedicated and hard work of the local community, including ex-poachers, Costa Rican and international students, and volunteers, the poaching rate has successfully been reduced from 50% to 0.65% and 25,068 leatherback hatchlings have been released.

Sea turtle conservation techniques at the Pacuare Nature Reserve, Costa Rica

Belinda M. Dick and Matt Hammond

The Endangered Wildlife Trust, Costa Rica

Pacuare Nature Reserve is a private reserve with 6 km of nesting beach located along the Caribbean coast of Costa Rica, which was created in 1989 by a British charitable trust. The need to protect the nesting population of leatherback turtles (*Dermochelys coriacea*) from illegal poaching was evident; it was believed that over 99% of turtle eggs were taken annually from the nesting beach. In 1994, a continuous monitoring and tagging program, along with a small volunteer program, was created in order to protect nesting sea turtles and their nests from poachers. Over the past nine years, the program has experimented with different conservation techniques such as relocation of nests to hatcheries or different sectors of beach, nest camouflaging, employing both private and park guards and the introduction of educational programs for both local and international students. The reserve now receives over 400 international and local students per season, and has succeeded in lowering the poaching rate to less than 10%. Due to the critically endangered status of this species, it is a priority to critically evaluate the conservation techniques used in order to assure the success of this species. Conservation techniques used from the years 2000 to 2003 are compared in order to determine the effectiveness and success in achieving the goals of a long-term monitoring program.

Nesting of the leatherback sea turtle (*Dermochelys coriacea*) at Playa Negra, Puerto Viejo, southern Caribbean of Costa Rica

Joana Hancock, Carolina Arancibia, and Didiher Chacón

Asociación ANAI

Playa Negra, on the southern Caribbean coast of Costa Rica (82º49”W and 09º45”N), was monitored for the third season for the occurrence of nesting leatherback turtles (*Dermochelys coriacea*), with 8.1km being covered with night patrols between the 15th of March and the 30th of June 2003. The aim of the monitoring program was to extend the knowledge of the nesting colony of leatherback sea turtles of the region and their reproductive behavior, complementing

the data obtained for this beach previously, as well as for the major nesting beach of the region, Playa Gandoca.

A total of 328 nesting attempts were recorded, 198 of which resulted in nests, and the remaining false crawls. Of the recorded nests, 93.8% belonged to *D. coriacea*, while the rest belonged to other species (*Eretmochelys imbricata* and *Chelonia mydas*; 5.6% and 0.5% respectively). The number of females of *D. coriacea* recorded was 55, 26 of which were neophytes. A total of 30 females were tagged with MONEL tags and 17 with PIT tags. Renesting was observed for 19 females who nested four times (statistic mode), with 11-day intervals. The peak of activity occurred between April and May, with 38.46% and 32.30% of nesting, respectively. Of the nests found, 74 were relocated and 83 were camouflaged.

The results obtained show similar patterns of those at this and other monitoring projects for past seasons, and show a strong connection between Playa Negra and other adjacent nesting beaches such as Playa Gandoca.

'Las Siete Quillas' Education Center: Environmental education at Estación Las Tortugas: A community-based conservation project in Costa Rica

Sarah L. Jeffery

The EcoTeach Foundation, PO Box 737, Suquamish, Washington, USA

Estación Las Tortugas is a community based conservation project, owned and managed by local families and located on the central Caribbean coast of Costa Rica. This region is an important nesting site for leatherback turtles (Dermochelys coriacea), with smaller numbers of nesting green (Chelonia mydas) and hawksbill (Eretmochelys imbricata) turtles.

With support from EcoTeach, a U.S.-based environmental education organization, Estación Las Tortugas works to protect nesting leatherbacks and other sea turtles along three kilometers of beach. The poaching of eggs and killing of turtles for their meat and shells is still a problem in the area, meaning environmental education efforts are particularly important to support the conservation work carried out at this and other projects in the region.

To this end, the construction of a sea turtle education center at Estación Las Tortugas is currently underway. 'Las Siete Quillas' Education Center and medicinal plants garden will be a learning facility aimed at local schools, visitors and community groups as well as international students and volunteers. It is designed to serve as a hands-on educational resource and encourage more active participation in the conservation of sea turtles in the region as well as on a wider scale. The center is due to open its doors to visitors in February 2004.

Inter and intraseasonal nesting intervals of solitary nesting olive ridley sea turtles in Punta Banco, Caña Blanca/Rio Coco (Puntarenas) and San Miguel (Guanacaste) Costa Rica, from 1996 to 2003

Edna López and Randall Arauz

PRETOMA Programa Restauración de Tortugas Marinas

This report shows sea turtle nesting, renesting and remigration intervals for three different beaches on the Pacific coast of Costa Rica: Punta Banco (Puntarenas province), Caña Blanca/Río Coco (Puntarenas province) and San Miguel (Guanacaste province). Monitoring projects have

been carried out since 1996 in Punta Banco, and since 1998 at both Caña Blanca/Río Coco and San Miguel. These beaches are primarily solitary nesting beaches for olive ridley sea turtles (Lepidochelys olivacea). Black sea turtles (Chelonia mydas agassizii), hawksbill sea turtles (Eretmochelys imbricata) and leatherback sea turtles (Dermochelys coriacea) are also sporadically observed on these beaches. Monitoring takes place from July to December. As many turtles as possible are tagged using external monel flipper tags. In total, approximately 600 turtles have been tagged in Punta Banco, 250 in San Miguel, and 120 in Caña Blanca/Río Coco. The most frequent renesting interval recorded was 17-20 days in Punta Banco. The most frequent remigrant interval was 1 year in Punta Banco. Few monitoring projects exist at solitary olive ridley nesting. Punta Banco is exceptional as a site where solitary olive ridley nesting activity has been monitored using external flipper tags for 8 successive years.

The tropical fire ant, *Solenopsis geminata*, on an important sea turtle nesting beach in Carate, Osa Peninsula, Costa Rica

Paul McCurdy[1] and Jim Wetterer[2]

[1] Florida Atlantic University, Jupiter, Florida, USA
[2] National Save the Sea Turtle Foundation, Ft Lauderdale, Florida, USA

Several species of predatory ants are known to attack the hatchlings of ground-nesting reptiles. Hatching sea turtles are particularly vulnerable to attack by ants because hatchlings typically take from several hours to several days after pipping before they emerge from their nests. During this time, ants may invade the nests and attack trapped hatchlings. Ants also sting hatchlings as they exit the nest. Hatchlings may die as a direct result of the ant stings, or as an indirect result, due to impairment caused by stings, particularly stings to their eyes.

Fire ants (*Solenopsis spp.*), in particular, pose an important threat to sea turtles. On Sanibel Island, Florida, LeBuff (1990) concluded that "fire ants were the most dangerous predators upon hatchlings." In Wassaw National Wildlife Refuge, Georgia, Moulis (1997) found a significant decrease in emergence success in loggerhead sea turtle, *Caretta caretta*, nests infested with fire ants compared with uninfested nests (40.6% vs. 54.0%). In Key West Wildlife Refuge, Florida, Wilmers et al. (1996) found that 328 of 912 (36.0%) marked sea turtle nests had *Solenopsis invicta* present and two nests (<0.1%) had the tropical fire ant, *Solenopsis geminata*, present.

I conducted a preliminary survey of ants on an important olive ridley, *Lepidochelys olivacea*, nesting beach in Carate, Osa Peninsula, Costa Rica. In my survey, I wished to determine if the *Solenopsis* species of ants are present along the beaches of Carate. If present, they could potentially threaten hatching sea turtles.

Nesting of the leatherback sea turtle (*Dermochelys coriacea*), at Playa Langosta, from 1999-2000 to 2002-2003, Parque Nacional Marino Las Baulas, Guanacaste, Costa Rica

Rotney Piedra[1], Elizabeth Vélez[2], Clara Padilla[3], Peter Dutton[4], and Earl Possardt[5]

[1] Parque Nacional Marino las Baulas, Ministerio del Ambiente y Energía. Costa Rica
[2] Leatherback Sea Turtle Conservation Project at Playa Langosta, Parque Nacional Marino las Baulas, Guanacaste, Costa Rica
[3] Wildlife Conservation Society - Costa Rica
[4] U.S National Marine Fisheries Service, Southwest Fisheries Science Center.
[5] U.S Fish and Wildlife Service

Playa Langosta is 1.3 km long, and is one of three beaches (Playa Grande and Ventanas) that comprise Las Baulas National Marine Park, the most important nesting site in the eastern Pacific for the leatherback sea turtle, *Dermochelys coriacea*. The use of Passive Integrated Transponder (PIT) tags has allowed identification of each nesting female leatherback on Playa Langosta since the 1996-1997 nesting season. From 1999-2000 to 2002-2003, a total of 208 individual leatherbacks have been registered in Playa Langosta, and 134 of them were neophytes: 60 PIT tagged in Playa Langosta, and 74 originally tagged in Playa Grande. During the 1999-2000 nesting season, 58 females were identified; 20.7% (n=12) were remigrants, and 7 of them nested for the first time on Playa Langosta. During the 2000-2001 nesting season, the number of leatherbacks nesting increased to 106, of which 38.7% (n=41) were remigrant turtles, and 23 of them nested on Playa Langosta for the first time. The number of individual leatherbacks that nested during the last two seasons in Playa Langosta declined drastically to 22 females each season, with a percentage of new individuals of 59.1% and 45.4%, and a remigration percentage of 40.9% and 54.5%, respectively. A high percentage of leatherbacks share Playa Langosta and Playa Grande as nesting sites. Conservation efforts in Langosta have mitigated nest loss due to poaching. To ensure reproductive success, nesting areas must be protected against uncontrolled development and fishing activity must be reduced in and around migration areas and nesting sites.

The nesting activity of marine turtles on Playa Caletas, Costa Rica; from November 1, 2002 to February 2004

Andrew L. Pyle[1], Randall Arauz[1], and Jairo Serna[2]

[1] Pretoma, Costa Rica
[2] ASVO, Costa Rica

From November 1, 2002 to March 28, 2003 and July 15, 2003 to February 2004, all marine turtle activity was recorded on Playa Caletas, Costa Rica. Two species of marine turtles were found to nest here. Lepidochelys olivacea (297 records, 2002-2003) and Dermochelys coriacea (23 records, 2002-2003) nest on this 5-kilometer beach. For the 2002-2003 season, 18 D. coriacea nests were recorded. As of November 15, 2003, 10 nests were recorded for D. coriacea. The peak months for L. olivacea nesting are September and October, while the peak months for D. coriacea nesting are December and January. During the 2002-2003 season, all nests were left in-situ to assess the natural conditions of the beach. From 2003-2004, a hatchery was built to place nests in for protection. Information concerning abundance and size of nesting females, distribution of nesting, clutch size, emergence period, and hatchling success rates was recorded from observed marine turtles.

From 0 to 26,000: Two years of conservation in Carate and Rio Oro, Costa Rica

Rachel Beth Silverman[1] and Fabian Andres Sanchez[2]

[1] National Save the Sea Turtle Foundation(NSTSTF), Ft. Lauderdale, Florida, USA and Salvamento Internacional de la Tortuga del Mar(SITMAR), Puerto Jimenez, Puntarenas, Costa Rica
[2] Salvamento Internacional de la Totuga del Mar(SITMAR), Puerto Jimenez, Puntarenas, Costa Rica

The wild and rugged west coast of the southern Osa Peninsula, Costa Rica is an important nesting ground to four species of sea turtles: *Lepidochelys olivacea*, *Chelonia agassizii*, *Dermochelys coriacea*, and *Eretmochelys imbricata*. The turtles, their nests and hatchlings are vulnerable to threats both natural and exotic. A few community projects have attempted to protect the nesting habitat from exotic threats, mainly loose dogs and human poachers. In 1999, Rio Oro, six kilometers of the most active nesting beach in the area, was declared a National Wildlife Refuge. Due to lack of funding and organization, the beach was literally left to the dogs.

In 2002, The National Save the Sea Turtle Foundation (NSTSTF) launched a conservation project emphasizing protection of sea turtle nesting habitat in Rio Oro and Carate. Two focuses of the project are physically protecting the beach and environmental education of the local community. A small international staff of researchers and volunteers conduct beach patrols, maintain a hatchery and educate the public.

After two years we have protected over 40,000 eggs from three species (*L. olivacea*, *C. mydas agassizii*, *D. coriacea*), producing approximately 26,000 hatchlings for release. We started the first tagging program on the Osa and tagged more than 200 adult turtles. We initiated a national information campaign to help increase environmental awareness. Over 400 students actively participated in conservation with our environmental education program. Finally, Salvamento Internacional de la Tortuga del Mar, a Costa Rican foundation, was created along with a biological field station in Carate.

Survivorship and behavior of sea turtles off the coast of Costa Rica following interactions with longline fishing gear

Yonat Swimmer[1], Randall Arauz[2], Michael Musyl[3], Jorge Ballestero[2], Lianne McNaughton[3], Anders Nielsen[4], and Richard Brill[5]

[1] National Marine Fisheries Service, Pacific Islands Fisheries Science Center
[2] Sea Turtle Restoration Project & PRETOMA, Costa Rica
[3] Joint Institute for Marine and Atmospheric Research, University of Hawaii
[4] The Royal Veterinary and Agricultural University, Denmark
[5] National Marine Fisheries Service, NEFSC & Virginia Institute of Marine Science

The Costa Rican longline fishery targets mahi mahi (*Coryphaena hippurus*) using a shallow-set (<100m) daytime fishing operation. The incidence of sea turtle-longline fisheries interactions is relatively high, approximately 6 turtles per 1,000 hooks. To quantify the survivorship and movements (horizontal and vertical) of sea turtles caught and released from longline fishing gear, we attached pop-up satellite archival tags (PSATs) on incidentally caught hard-shelled sea turtles. PSATs' primary advantage is that they return data even in the event of a mortality.

Between November 2001 and June 2003, we deployed PSATs on 9 olive ridleys (*Lepidochelys olivacea*) and 1 green (*Chelonia mydas*) sea turtle incidentally caught on longline fishing gear. Hooks were embedded through the jaw or in the throat and were removed in all cases but one. We also attached PSATs to 5 olive ridley turtles captured while they rested at the surface. Data from one turtle indicate that a mortality occurred. Average length of tag duration was 62 days for both turtle groups.

During the day, control turtles spent 92% and longline-caught turtles spent 78% of recorded time within the top 60 m. Both groups spent 94% of nighttime within the top 60 m. The one green turtle spent 97% of time within the top 50 m, and remained shallower at night than during the day.
Our data suggest that limiting shallow-set fisheries in areas of high sea turtle density, such as areas immediately offshore major sea turtles rookeries, would reduce rates of sea turtle interactions with fishing gear.

Analysis of nest abortions of leatherback turtles in Playa Grande, Costa Rica

Megan Thynge[1], Annette Sieg[1], Jim Spotila[1], and Frank Paladino[2]

[1] Drexel University
[2] Indiana-Purdue University, Ft. Wayne

Inherent to the conservation efforts for the leatherback sea turtle (*Dermochelys coriacea*) at Parque Nacional Las Baulas is the concept that reproductive output is of primary importance due to the high adult mortality of the species and the accessibility of this aspect of the highly pelagic leatherback's life. Researchers at Parque Nacional Las Baulas, on the Pacific coast of Costa Rica, have amassed a longitudinal dataset of nesting biology that spans twelve years. Failed attempts at nesting emergence from the ocean and failure to oviposit have also been recorded in the dataset and yet have not been carefully characterized. Identification of causal factors for failed nestings, especially if anthropogenic in nature, could have important implications for current conservation efforts. We investigated the effects of environmental and anthropogenic factors including seasonality, nest location, tide level, weather, number of tourists present, and invasive scientific research procedures on the occurrence of failed nestings. We also studied the existence of trends in nesting failure between individuals. These results will lead to a more comprehensive understanding of nesting failure both in terms of distinct factors and combinations of factors that may subsequently dictate improvements in the conservation practices on leatherback nesting beaches.

Leatherback sea turtle (*Dermochelys coriacea*) conservation project at Playa Langosta, Parque Nacional Marino Las Baulas, Guanacaste, Costa Rica

Elizabeth Vélez[1], Rotney Piedra[2], Clara Padilla[3], Peter Dutton[4], and Earl Possardt[5]

[1] Parque Nacional Marino las Baulas, Ministerio del Ambiente y Energía. Costa Rica
[2] Leatherback Sea Turtle Conservation Project at Playa Langosta, Parque Nacional Marino las Baulas, Guanacaste, Costa Rica
[3] Wildlife Conservation Society - Costa Rica
[4] U.S National Marine Fisheries Service, Southwest Fisheries Science Center.
[5] U.S Fish and Wildlife Service

Las Baulas National Marine Park, comprised of Playa Grande, Ventanas, and Playa Langosta, is the most important nesting site in the eastern Pacific for the leatherback sea turtle, Dermochelys coriacea. Playa Langosta is 1.3 km long. The Sea Turtle Conservation Project in Playa Langosta was initiated in 1994, with the continuing support of the Wildlife Conservation Society. Since 1996, the project has received economic and logistic support from the U.S. National Marine Fisheries Service and the U.S. Fish and Wildlife Service. Langosta is a nesting site for the

following turtles: the olive ridley (Lepidochelys olivacea), the black (Chelonia mydas a.), and the leatherback (Dermochelys coriacea), which is in critical danger of extinction. The project focuses on generating pertinent scientific information and developing protection, control, and environmental education programs, all with the goal of making good management decisions and promoting the survival of the marine turtles nesting in the park. From 1994 to 1996, the project was dedicated to the development of protection efforts for the females and their nests. In 1996-1997, the project began a research and tracking program, and in 2002 in conjunction with the Ministerio Ambiente y Energía, and The Leatherback Trust, environmental education activities were initiated, to provide workshops in which the students of Playa Grande School explore environmental issues. The conservation project involves researchers, research assistants, national and foreign volunteers, and park rangers who every year help to meet the goal of protecting, researching, and conserving marine turtles and their nests in this national park.

Pathological discoveries in olive ridley turtles (*Lepidochelys olivacea*) in the Pacific north from Costa Rica

Thierry Work[1] and Carlos Mario Orrego Vasquez[2]

[1] U.S. Geological Survey: National Wildlife Health Center, Honolulu, Hawaii. P.O. Box 50167
[2] Refugio Nacional de Vida Silvestre Ostional (RNVSO), Area de Conservación Tempisque (ACT), Ministerio del Ambiente y Energia (MINAE). P.O. Box 13699

Between the months of July and December 2002, at Nancite Beach (10º48'17"N and 85º41'58"W), Parque Nacional Santa Rosa, Guanacaste, Costa Rica, samples for histopathology were collected from 21 deadolive ridley turtles (Average LCC 68.16cm) found on the beach. The samples were put in formaline 10% for transport to Dr. Thierry Work at the U.S. Geological Survey National Wildlife Health Center, Honolulu, Hawaii. Samples revealed several common discoveries, including inflammation and trematode eggs in different organs, severe focal chronic fibropapillomatosis, skin, mononuclear infiltrates, etcetera.

TECHNOLOGY AND SEA TURTLES

Environmental enrichment for sea turtles

Corie L. Baird, Lauren Gaster, and Connie Murk

Mote Marine Laboratory, Sarasota, Florida, USA

For years, environmental enrichment programs have been in place at many terrestrial and marine mammal facilities, however, enrichment for reptiles has generally been overlooked. At Mote Marine Laboratory and Aquarium, a program of behavioral and environmental enrichment was implemented over two years ago with both the exhibit sea turtles and those undergoing rehabilitation. The turtles have shown a positive response to this program, demonstrating natural behaviors and staying active for large parts of the day. Environmental enrichment devices such as water cooler jugs, plastic dog bowls, large plastic balls, ice toys, PVC pipes, water falls and sprinklers are used on a regular basis with continuing positive results. The turtles are often

encouraged to forage by placing their food under piles of rocks or hiding it around the exhibit and live prey are used when available, allowing the turtles to practice hunting skills. This program has also been used to encourage animals with flipper constrictions or a propensity to stay at the surface, to dive to the bottom and investigate objects or food, thereby facilitating their release. It has served to enrich the turtles and their environment, enrich the staff and volunteers that work with them, and allowed for a more entertaining and educational experience for the public that comes to the facility.

Physical therapy with sea turtle hatchlings

Corie L. Baird, Lauren Gaster, and Lynne A. Byrd

Mote Marine Laboratory, Sarasota, Florida, USA

Physical therapy has been a regular practice within human medical care for years, and has recently been added to the repertoire of animal medicine as well. For over two years, sea turtle hatchlings that have come to Mote Marine Laboratory's Sea Turtle Hatchling Hospital with flipper constrictions, missing flippers, or other physical problems have been treated using similar methods. Physical therapy techniques such as therapeutic exercise, manual therapy, strengthening, stretching, and range of motion exercises are used to strengthen front and rear flippers, relieve bone or muscle constrictions, and enable hatchlings to swim and dive on their own. Staff and volunteers of the Sea Turtle Exhibit utilize these techniques with the hatchlings several times a day, depending on the severity of the problems. Improvement is generally seen after several days of therapy and we have had great success in releasing these animals. During the 2002 and 2003 sea turtle hatching seasons, 62 hatchlings were brought in with varying degrees of flipper constrictions and all but 11 of these were released within a few months of hatching.

Trawl guard: A probable substitute of TED for Indian waters

Chitta Ranjan Behera

Project Swarajya, Bakharabad, Cuttaack-753002, Orissa, India

Efforts for implementing TEDs in Indian marine fisheries, in response to the US trade embargo have passed through several phases. The coast of Orissa which is credited with the large nesting grounds of olive ridley turtles, but which in recent years earned the notoriety of being the killing field of these innocent animals, has witnessed a series of hot and cold battles between the trawling industry and the turtle conservationists over the issue of implementation of the TED. Several efforts at indigenizing the TED technology with a view to reduce the fish escape, have so far not contented the trawling community of Orissa, as was evident in the last Workshop-cum-Demonstration on TEDs held at Paradip in February 2002. With time passing, more and more issues of contention are unfolding between the trawling industry and the government. The present paper, while discussing the arguments of the trawling industry, seeks to suggest a few alternative options including the need for trial of a new device called Trawl Guard, with a view to end the much-tangled controversy over the TED.

Accumulation of hydrocarbons in green turtles (*Chelonia mydas*) from the Sultanate of Oman

Rita Carina Bicho [1], Vanda Maria Mendonca [2], and Ali Amer Al Kyiumi [2]

[1] University of Algarve, Faculty of Marine & Environmental Sciences, Campus of Gambelas, 8000 Faro, Algarve, Portugal
[2] Ministry of Regional Municipalities, Environment & Water Resources, P. O. Box 323, Muscat 113, Sultanate of Oman

The waters off the Sultanate of Oman are the gateway to the oil-rich region of the Arabian Gulf. Therefore, traffic of petroleum tankers is intense, and oil spills occur from time to time. In addition to that, the products of the oil exploitation sometimes are also released into the marine environment, despite tough legislation and law enforcement to protect living resources, as this region hosts many populations of endemic and/or endangered species. Specifically, the Sultanate of Oman has sea turtle populations of worldwide importance. For instance, the green turtle (*Chelonia mydas*) nesting population of Ras Al Hadd (Arabian Sea) is the largest of the Indian Ocean for this species. In the present study, livers of six fresh carcasses of greens, washed ashore at Ras Al Hadd Nature Reserve, were analyzed for petroleum hydrocarbons (HCs). Total HCs in livers was 12.

Cybertracker, GIS and regional database: New technology to help with the monitoring of sea turtles

Alexis Billes

Programme Kudu, Cellule de coordination ECOFAC, BP 15115, Libreville, Gabon

Computer science ensures better data collection and data transfer. In particular, Louis Liebenberg, a South African scientist very interested in the tracking capacity of Bushmen in Kalahari, invented the Cybertracker, a palmtop computer associated with a GPS receiver. Liebenberg developed an efficient software program to enable even non-literate users to gather large quantities of geo-referenced data for field observations. Today, in collaboration with the UE Cybertracker Program, the Kudu program is adapting the computer program to the monitoring of sea turtles. In this poster, we present the use of the Cybertracker, the program specially developed for sea turtles, the advantages of the system and its great interest to the GIS and to the regional database of the Kudu program.

The use of AVHRR imagery and the management of sea turtle interactions in the Mid-Atlantic bight - The second half of the story

Joanne Braun-McNeill[1], Christopher R. Sasso[2], Sheryan P. Epperly[2], and Carlos Rivero[2]

[1] National Marine Fisheries Service, Beaufort, NC, USA
[2] National Marine Fisheries Service, Miami, FL, USA

Large-mesh gill nets used in the fishery for goosefish (monkfish), *Lophius sp*., have been documented to capture and drown sea turtles along the Mid-Atlantic coast of the U.S. (NEFSC, unpublished data). Significant stranding events have been associated with the operation of this fishery in its southern range (SEFSC, unpublished data). The National Marine Fisheries Service,

one of two federal agencies with responsibility for protecting and recovering listed sea turtles, evaluated the risk of sea turtles interacting with this and other fisheries by analyzing sea surface temperature (SST) imagery from Cape Hatteras, North Carolina to Cape Cod, Massachusetts, during the months of January - December from 1993-2002. Weekly SST imagery acquired by the Advanced Very High Resolution Radiometer (AVHRR) sensor onboard NOAA polar orbiting satellites were divided into 18 zones with north/south boundaries spaced at 30 minute intervals; western and eastern boundaries were the coastline and the 20m and 200m depth contour, respectively. SST data from each zone were extracted and analyzed to determine the percentage of SST's greater than or equal to 11°C, and thus the likelihood for sea turtles to be present.

Tethered GPS/VHF transmitters: A high-tech, low-cost tool for fine scale, in-water tracks

Louise B. Brooks[1], James T. Harvey[1], and Wallace J. Nichols[2]

[1] Moss Landing Marine Laboratories, 8272 Moss Landing Road, Moss Landing, CA 95039
[2] Wildcoast, P.O. Box 324, Davenport, CA 95017 and California Academy of Sciences, Golden Gate Park, San Francisco, CA

We used tethered VHF/GPS transmitters to track sub-adult East Pacific green turtle (*Chelonia mydas*) in Bahía Magdalena, Baja California Sur, Mexico. This method utilized GPS technology to acquire fine-scale position data and VHF telemetry to locate and monitor the animal. GPS and VHF units were housed in a buoy that floated at the end of a 10 m tether. Tethers were attached to the turtle with a fail-safe release design that broke in the event of entanglement or resistance. Preliminary assessment determined that habitat characteristics and sea turtle behavior were suited to accommodate the unit. Turtles were tracked at depths of 1 to 8 m and for distances of up to 40 km per day. Use of the tethered transmitter units yielded consistently high quality data without compromising safety of the animal. Cost remained low in comparison to other tracking techniques. These data will be used to describe foraging ecology and to aid reserve design as part of an integrated sea turtle conservation program for the Bahía Magdalena region.

Satellite tracking of adult loggerheads (*Caretta caretta*) around waters of Cape Verde Archipelago (western Africa)

Daniel Cejudo[1], Nuria Varo[2], Óscar López[1], and Luis F. López-Jurado[1]

[1] Universidad de Ciencias del Mar, Las Palmas de Gran Canaria, Spain
[2] Instituto Canario de Ciencias Marinas, Las Palmas de Gran Canaria, Spain

During the 1999 nesting season (from June to October), four satellite transmitters were attached to two males and two females of *Caretta caretta* from Boavista Island (Cape Verde Archipelago, western Africa), where density of nesting females is the highest in the whole archipelago. Transmitters did not work as well as expected, resulting in a low number of locations, possibly due to the neritic behavior of adult loggerheads at reproductive habitat, with the antennae exposed to continuous rubbing. Therefore, we establish a conservative hypothesis about movements of *C. caretta* in Cape Verde. The two males monitored remained close to Boavista, one of them until mid-November, and both females exhibited a different pattern, remaining close to the island until the end of the season, subsequently traveling eastwards a long distance, possibly towards the African coast. On the other hand, out of the nesting season, some males (including a young one) have been observed in the nearby coast, but not between December and March; a few females

have been observed nesting in March. Taking these results into account, we believe males stay in Boavista throughout the whole nesting season, departing to feeding habitat later than females, and then arriving in Boavista earlier for reproduction. Close proximity of feeding habitat could explain why some females nest out of the typical season.

Tagging information on seaturtle.org

Michael S. Coyne[1], Matthew H. Godfrey[2], and Brendan J. Godley[3]

[1] seaturtle.org
[2] NC Wildlife Resources Commission, USA
[3] Marine Turtle Research Group, UK

The application of unique identifiers to sea turtles is an integral part of nearly all conservation and management projects of these species. Over the past few decades, technological advances and creative thinking have produced a wide variety of methods to tag sea turtles. We have pooled together the experiences and expertise of many different people across the world to create a centralized on-line resource that provides up-to-date information and advice on nearly all aspects of sea turtle tagging: http://www.seaturtle.org/tagging/

This website offers information, advice, and ideas, in addition to step-by-step instructions and photos, to anyone interested in applying tags to sea turtles. There is also a searchable database of tag records, called TagFinder, to facilitate the recovery of information from tags that are unfamiliar to the observer: http://www.seaturtle.org/tagfinder/

This website is constantly being updated with new information. We urge you to participate by sending us your comments or ideas and by submitting your tagging data to the growing TagFinder database. The greater the participation, the more powerful and informative the site will be.

A historical review of dredging impacts on sea turtles in the southeastern USA

Dena D. Dickerson

USACE Engineering Research and Development Center, Vicksburg, Mississippi, USA

Approximately 500 incidental takes of loggerhead, green, and Kemp's ridley sea turtles have occurred during hopper dredging projects since 1980 in 34 coastal channels from the Texas-Mexico border through Virginia. Over the past 23 years, the U.S. Army Corps of Engineers and dredging industry have worked to develop protocols, operational methods, and modified dredging equipment to reduce dredging impacts to sea turtles. The success of these protection efforts is illustrated in the reductions in incidental takes compared to the increasing number of dredged channels monitored. During 1980, 71 sea turtle incidental takes were recorded for Canaveral Harbor alone, whereas, 21 takes were collectively recorded from all coastal hopper-dredging projects along the southeastern USA during 2003.

Engineering and biological studies were done to develop the suite of protective tools currently available. These investigations have included sea turtle relative-abundance, behavioral, acoustic-detection and dispersal, and dredging equipment development. In addition to gaining valuable biological data for sea turtles in coastal channels, these studies helped to establish environmental windows, draghead modifications, draghead turtle deflectors, and protection protocols such as trawling to relocate sea turtles. The Corps of Engineers is presently establishing an internet-based database to centralize and archive historical and future data regarding sea turtle impacts from dredging activities. Although the overall impacts to sea turtles from dredging activities is relatively small, the Corps and dredging industry is committed to the continued pursuit of efforts to further reduce dredging impacts to sea turtles.

Commitments of the Corps of Engineers: Navigation, dredging, and sea turtles

Dena Dickerson[1], Monica Wolters[2], and Craig Theriot[2]

[1] USACE Engineering Research and Development Center, 3909 Halls Ferry Rd, Vicksburg, MS, USA 39180

[2] Computer Science Corporation, 3909 Halls Ferry Rd, Vicksburg, MS, USA 39180

Maintenance of inland and intracoastal waterways for navigation is essential for national and international trade, job creation, and national security. These waterways also provide hydropower, flood protection, municipal water supply, agricultural irrigation, recreation, and regional development. The US Army Corps of Engineers' role in maintaining and improving these waterways began in 1824 and, today, the Corps maintains over 12,000 miles (19,200 km) of waterways throughout the United States.

Several types of dredges are typically used for excavating sediments to construct new waterways or maintain navigation depths in channels. Cutterhead pipeline, hopper, and mechanical dredges are the three primary types used throughout U.S. waterways. The type used depends on factors such as sediment type, location, environmental considerations, and wave conditions.

Corps and contractor owned dredges annually remove over 270 million cubic yards (mcy) of sediment from over 150 projects in the U.S. This work is distributed as follows: cutterhead pipeline, 54% of projects, 60% material removed; hopper, 19% of projects, 27.6% material; mechanical, 21% of projects, 5.4% material; other dredge types, 6% of projects, 7% material. Incidental takes of approximately 500 sea turtles have been documented during hopper dredging projects since 1980 in 34 coastal channels from the Texas-Mexico border through Virginia. Operational differences between dredge types contribute to the differences in potential impacts to sea turtles. Engineering modifications to dredging equipment and changes to dredging procedures have led to dramatic reductions in sea turtle mortalities.

Sea turtle rescue center: A place where surgery, research and sensibilization's activity help marine turtle conservation

Daniela Freggi[1], Marco Biletta[2], and Marina Zucchini[2]

[1] WWF Italia

[2] Sea Turtle Rescue Center Lampedusa

In the last four years (2000-2003), the team working in Lampedusa Island (South Mediterranean Sea) has involved mentality and attention of fishermen engaged in that area on sea turtles problems. The activity of the rescue center shows how involving the contribution of fishermen is. We could save and release more than 1,500 turtles, but the center has not only a vet and surgery importance, but it increases also collaboration and sensibilization. We analyze the three main activities: urgency surgery, sensibilization, and data recollection. We also put attention on the necessity to enact protection across borders because vessels and turtles swim everywhere.

A preliminary investigation into the efficacy of different tissue vouchers for trace element analysis to locate foraging grounds of Mediterranean marine turtles

Wayne J. Fuller[1], Annette C. Broderick[2], Glyn C. Connelly[3], Fiona Glen[4], John C. Goold[3], Graeme C. Hays[1], and Brendan J. Godley[2]

[1] University of Wales, Swansea, Swansea, UK.
[2] University of Exeter, Exeter, Devon, UK
[3] University of Wales, Bangor, Bangor, UK
[4] University of Toronto, Toronto, Canada

Based on limited flipper tag returns and satellite tracking, the Mediterranean nesting populations of loggerhead (*Caretta caretta*) and green (*Chelonia mydas*) turtles are thought to have over-wintering grounds limited to the semi-enclosed sea. These inferences are by necessity either through reliance on high capital expenditure or serendipitous flipper tag returns, based on limited data. There is a need to develop a cheap and effective tool that can allow location of the foraging areas of large numbers of turtles for management purposes. We collected a range of different tissue samples from the individual nesting females to explore which non-invasive sampling regimes might be possible for large-scale analyses of trace element composition. From nesting females we collected: 1) Turtle carapace (keratin); 2) Skin biopsy 3) External plates of barnacle (*Chelonibia testudinaria*), 4) viscera of (3). In addition, 5) we sampled a section of the flipper of hatchlings that died in the nest of known females. We then determined the concentration of each of ten elements (Al, As, B, Cu, Hg, Mn, Pb, Si, Sn & Sr) using Inductively Coupled Plasma Optical Emission Spectrometer. In conjunction, we fitted twelve turtles with satellite transmitters, in order to ascertain the foraging grounds of each individual and to generate a possible elemental base map for comparison with the chemical signatures of other sampled individuals. We describe the results of our analyses of cross-comparability of different tissue vouchers and give inferences as to the likely distribution.

The effects of sea turtle relocation trawling during selected coastal dredging projects

John D. Glass, Trish D. Bargo, Tara Fitzpatrick, William R. Parks

REMSA, Inc., Newport News, Virginia, USA

Relocation trawling has been successful at temporarily displacing sea turtles from channels and nearshore mining areas in both the Atlantic and Gulf of Mexico during periods when hopper dredging was imminent or ongoing (NMFS NE Biological Opinion F/NER/2003/00302).

Net design, protocols, and trawling techniques were developed by the Army Corps of Engineers after considerable research and development efforts. Trawling projects are normally accomplished by contractors.

Towing two specially-designed, 60-foot trawl nets, the trawlers operate in the same vicinity as the dredge. Captured turtles are identified, measured, photographed, and thoroughly scanned for PIT tags and overall health. The turtles are then tagged and released unharmed 3-5 miles away from the channel. Collected data on each turtle is reported to the NMFS and to the ACOE.

Since September 2001, REMSA, Inc. personnel have completed eleven trawling projects capturing and safely relocating 219 threatened or endangered sea turtles. During the same period, a total of 10 turtles were taken by dredges involved in these projects. Results indicate that effectiveness of the trawling project itself varies widely with the level of trawling effort applied.

Importance of the integration of the computer science tools to the Integrated Program of Conservation and Development (PICD) in Nueva Esparta State, Isla de Margarita, Venezuela - Data base and web pages

Angel J. Gómez B.[1] and Pedro D. Vernet P.[2]

[1] Grupo de Trabajo en Tortugas Marinas del Estado Nueva Esparta, Isla de Margarita, Venezuela
[2] PROVITA, WILDLIFE TRUST

Due to the advance of diverse worldwide information tools and to the increasingly important need to be included in the context of global communication, it becomes increasingly necessary to adapt instruments of classification and communication of information to conservation programs, such as the case of the Integrated Program of Conservation and Development (PICD), developed by GTTM-NE.

Since 1999, the GTTM-NE has been developing software based on an orientated objects language (Borland Delphi) named Base of Information of sea turtles of the Nueva Esparta State (BDTM). The BDTM is a friendly and easy-to-manage program, in which nesting events are registered. The program allows for the printing and storage of reports and graphs on the nest activity classified by seasons, species, beaches and the comparison of these articles. Likewise, the BDTM allows for the viewing of a nesting distribution map around the insular territory and the export of images and information to Microsoft Power Point.

As an information strategy, the GTTM-NE has developed the web page GTTM-NE WEBSITE, which allows us to inform people worldwide about the activities that the institution takes part in, the conservation programs they manage, general information about Margarita Island and allows for online registration for volunteer programs. On the GTTM-NE WEBSITE, visitors can find sections for news, ecological tips and links to other pages of interest related to the topic of sea turtle conservation.

Migratory distribution of loggerhead turtles around Japan estimated satellite tracking

Naoki Kamezaki[1], Yoshimasa Matsuzawa[1], Tatsuya Ohshika[1], Yoshitaka Miyagata[1], Koujiro Mizuno[1], Hiroshi Takeshita[2], Masato Kobayashi[1], Takaaki Nishi[3], and Taichiro Toji[1]

[1] Sea Turtle Association of Japan, Hirakata, Osaka, Japan
[2] Miyazaki Wild Animal Research Group, Miyazaki, Japan
[3] University of Kagoshima, Kagoshima, Japan

From 1999 through 2002, 15 loggerhead turtles (2 males from the Yaeyama Islands (Ryukyu), 4 males and a female from the Amami Island, 2 nested females from Miyazaki, 4 females and 2 males from Kochi) were released with PTT tags in Japan. These turtles were examined to determine maturity by straight carapace length range (743-920 mm). Except for 2 turtles from Miyazaki, 13 turtles were caught by pond net.Twelve of 15 released turtles provided sufficient data of locations to track each migration route. Most of obtained location data showed the Japanese loggerheads distributed mostly in the water west of 170 degrees east, and from 25 to 40 degrees north. A female migrated from the Amami Island through the water off Vietnam, 6 turtles migrated to the East China Sea and Japan Sea, and settled around each probable foraging area. Three turtles migrated along the Kuroshio current to the eastern sea of Japan, and 2 turtles crossed the Kuroshio current and moved west. Six turtles of 8 released from Miyazaki, Amami Island and Yaeyama Islands, migrated to the East China Sea and settled in the foraging area. On the contrast, 4 turtles migrated to the open water. Loggerhead turtles living around Japan have two foraging styles; benthic feeder on the shelf and nekton feeder on the pelagic water.

Satellites – They're not just for tracking turtles anymore (Broad communication efforts to promote sea turtle conservation)

Dottie Klugel[1], Marydele Donnelly[2], and Llewellyn Ehrhart[3]

[1] Smithsonian Environmental Research Center, Edgewater, Maryland, USA
[2] The Ocean Conservancy, Washington, DC, USA
[3] University of Central Florida, Orlando, Florida, USA

For more than a decade, scientists have used satellite transmitters to gain valuable information about sea turtle migration patterns. The Smithsonian Institution (SI) and Ball State University (BSU) use satellite technology that allows audiences to follow turtles over time, teaching them about sea turtle biology, research, and conservation through "Electronic Field Trips (EFTs)." These live interactive broadcasts give participants access to experts and places they would not otherwise have.

In 2000, the SI and BSU produced the "Mystery Migration: Tracking Sea Turtles" from Melbourne, Florida, about sea turtles in the Archie Carr National Wildlife Refuge and the scientists and managers based there – Dr. Llewellyn "Doc" Ehrhart, Paul Tritaik, and David Godfrey. Two million students participated in this EFT.

In 2003, the SI and BSU again partnered to produce "Where the Land and Sea Intertwine: the Sea Turtles of Belize." This EFT, from Calabash Cay, focused on sea turtle conservation, especially in Belize, and new theories of sea turtle migration. Hosted by Dottie Klugel and Marydele Donnelly, this broadcast featured members of the community-based conservation program of Gales Point Manatee (GPM), the largest hawksbill nesting site in Belize. Approximately 15 million students in North and Central America participated in this EFT

Each EFT includes an accompanying website with information and curriculum to enhance the experience. Audience's phone or email questions during the EFTs to be answered on air. EFTs give valuable exposure to community-based conservation groups, enhance the goals of environmental education, and connect audiences directly with sea turtle experts.

Using the modern analog *Caretta caretta* (Testudinata: Cheloniidae) to study taphonomic processes of fossil sea turtles from the Cretaceous Pierre Shale (Campanian-Maastrichtian) of South Dakota, USA

Michael J. Knell, Margaret M. Hart, and Gale A. Bishop

South Dakota School of Mines & Technology, Rapid City, South Dakota, USA

During the Cretaceous Period, approximately 100 million years ago, a vast seaway covered much of the central North American continent. The state of South Dakota was centrally located within this epicontinental seaway. A diverse assemblage of marine reptiles, including two families of fossil sea turtles, Protostegidae and Cheloniidae, can be found in the Cretaceous Pierre Shale. Taphonomic studies of fossils derived from the Pierre Shale have not included sea turtles until now. The St. Catherines Island Sea Turtle Project provides us with a modern analog for sea turtle nesting and posthumous processes. The extant sea turtle *Caretta caretta* annually uses the beaches of Georgia, including St. Catherines Island, as a nesting ground. Deceased turtles commonly wash ashore, exhibiting either partial or no decomposition. The stranded turtles are then documented through measurements and photography to record the disintegration process. Using this data in conjunction with preservation details acquired from fossil sea turtles, it is possible to correlate death processes between the two.

Incidental capture of sea turtles by the artisanal fishery in Uruguay

Cecilia Lezama, Philip Miller, and Alejandro Fallabrino

CID/Karumbé, Tortugas Marinas del Uruguay, J. Paullier 1198/1001, Montevideo, Uruguay, email: karumbe@adinet.com.uy

Sea turtle incidental captures constitute an important mortality factor all over the world. In Uruguay, sea turtles frequently interact with the artisanal fishery communities that live along the coast. The aim of this study was to assess the sea turtle mortality due to incidental captures by the artisanal fishery. We used two different ways for the recovery of information; one based on the reports made by collaborators of the project as well as the same artisanal fishermen and the other based on monitoring made on-board artisanal fishing boats between October 2002 and May 2003. During these trips, a total of 41 fishing events were performed, in which the following information was recorded: number of sea turtles captured, gear characteristics and soak time, and the geographical position of the fishing area. During the study period, 73 incidental captures were reported, 94.5 % of them corresponding to juveniles of the species *Chelonia mydas*. 50.7 % of the sea turtles captured were found alive and released afterwards whereas the remaining 49.3 % were found drowned in gillnets. The localities of San Luis (29 %), Cerro Verde (29 %) and Piriapolis (27.6 %) have the highest percentage of green turtles captured. We suggest that these three localities represent developmental and foraging areas for the green turtle in Uruguay. Taking this into account, they should be considered as priority areas for future efforts for the recovery of this species.

Failure of female loggerhead sea turtles to ovulate in captivity: Are they induced ovulators?

Charles A. Manire, Howard L. Rhinehart, Lynne Byrd, Tonya Clauss, and Corie Baird

Mote Marine Laboratory and Aquarium, Sarasota, Florida, USA

All that is known regarding reproduction in sea turtles has been derived from wild populations or groups maintained in turtle farms. Two mature female *Caretta caretta* that had been in captivity since hatching and that were kept separated from male turtles for the past seven years, were observed using ultrasound techniques to follow ovulatory cycles for two years (two complete cycles per turtle). During winter, follicles in both ovaries were observed to increase in size until reaching a maximum diameter of 25-30 mm by early spring. The follicles remained that size until mid-summer, during which time changes in follicles were observed on ultrasound. Following that time, follicles began to decrease in size until they were all of a resting size by early autumn. At no time were eggs observed in the uterus nor did the turtles undergo oviposition. This would suggest that the follicles that were mature were not ovulated, but were eventually reabsorbed. Whether this is a function of not being with a male for mating (induced ovulation) or a function of being in captivity without reproducing for a number of years is yet to be determined.

Biochemistry values of *Chelonia mydas*: 16 parameters studied on 50 captive green turtles in Réunion Island

Pascal Melot[1], IDEXX Laboratory[2], and Center for Study and Discovery of Marine Turtles [3]

[1] Cabinet Vétérinaire de l' hermitage 40 rue antoine de Bertin 97434 Saint Gilles
[2] IDEXX Laboratoires France .BP 232, 95614 CERGY PONTOISE CEDEX
[3] Saint Leu La Réunion

50 marine turtles (*Chelonia mydas*) are blood sampled, and 16 parameters are analyzed with a VET TEST from IDEXX laboratory.

Sea turtles and trawl fishery in the Rio de la Plata Estuary: What is going on here?

Philip Miller[1], Martín Laporta [2], and Alejandro Fallabrino[3]

[1] CID/Karumbé, Tortugas Marinas del Uruguay, J. Paullier 1198/1001, Montevideo, Uruguay, email: kanariotortuga@adinet.com.uy
[2] CID/Karumbé, Tortugas Marinas del Uruguay, J. Paullier 1198/1001, Montevideo, Uruguay, email: martinl@adinet.com.uy
[3] CID/Karumbé, Tortugas Marinas del Uruguay, J. Paullier 1198/1001, Montevideo, Uruguay, email: afalla@adinet.com.uy

The Río de la Plata Estuary is located on the eastern coast of South America, between 34°00'-36°10' S and 55°00' - 58°10' W. This estuary shows rough changes in salinity and temperature, and also has notorious seasonal variations. This zone is an important feeding habitat for diverse marine fauna. Sea turtles are present in the estuary and interact with the fisheries that operate in this zone. Juveniles of the green turtle (*Chelonia mydas*), juveniles and adults of the loggerhead turtle (*Caretta caretta*), and adults of the leatherback turtle (*Dermochelys coriacea*) occur in this area. Biological aspects such as species and length frequencies, spatial and temporal distribution and mortality, were analyzed from the sea turtles incidentally caught by three trawling vessels. The data were gathered during the first year (2002-2003) of the "Onboard Tagging and Data Collection Program." Of the 27 analyzed turtles, 70.4% (n=19) were loggerhead; 18.5% (n=5) green, and 11.1% (n=3) leatherback. Mean CCLn-t was 74.6 cm for loggerhead, 43.2 cm for green, and 147.2 cm for leatherback. More than 50% of the captures occurred during fall; during winter no captures were registered. Mortality reached 25.7%. All the living turtles were released, and 95% (n=19) were tagged. One of the dead turtles was an adult female loggerhead previously tagged in Brazil. The data presented here, plus the characteristics of the megabenthic invertebrates and jellyfishes also caught as bycatch in this fishery, suggests the Río de la Plata Estuary as a sea turtle feeding area, thus requiring further research and conservation measures.

Distribution of sea turtle bycatch in sea scallop (*Placopecten magellanicus*) dredge gear in two areas of the northwestern Atlantic Ocean, 2001-2002

Kimberly T. Murray

National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA, USA

In May 2001, the National Marine Fisheries Service (NMFS) opened two areas in the northwestern Atlantic Ocean that had been previously closed to the U.S. sea scallop (*Placopecten magellanicus*) dredge fishery. Upon reopening these areas, termed the 'Hudson Canyon

Controlled Access Area' and the 'Virginia Beach Controlled Access Area,' NMFS observers determined that marine turtles were being caught incidentally in scallop dredges. This study utilizes a General Linear Model to examine environmental factors and gear characteristics that influenced the bycatch rates of turtles in these two areas during May-December in 2001 and 2002. Significant factors affecting sea turtle bycatch were season, sea surface temperature, and depth zone fished. Highest bycatch rates occurred during the summer season, in temperatures greater than 19°C, and at water depths between 49 and 57m. The high probability of bycatch occurring under these conditions is consistent with observed habitat regimes of loggerhead turtles in Mid-Atlantic offshore waters. Results from this analysis will be used to evaluate potential turtle bycatch reduction scenarios.

Honey as a wound dressing material in sea turtles

Ana Cecilia Negrete Philippe

Veterinary Staff, Acuario Xcaret, Carretera Chetumal- Pto. Juárez km 282, Playa del Carmen Quintana Roo

Because of the increasing interest in the use of alternative therapies, especially with the development of antibiotic resistance in bacteria becoming a major problem, the use of honey as a wound dressing material, an ancient remedy recently rediscovered, is becoming of increasing interest.

For more than a century, honey has been known for its anti-bacterial properties. Honey is active against a wide range of bacterial and fungal species.

Shell fractures result from trauma when the sea turtles are hit by watercraft (propellers), or bitten by predators such as sharks and crocodiles. Although the healing ability of the shell is remarkable, in captivity, treatment is necessary. When conventional treatment shows slow progress, some alternatives could be applied.

At Xcaret Park, we started using honey as a dressing recently for a wide diversity of clinical cases with good results. The main cases consisted in treating shell wounds, lacerations and conjunctivitis in hatchlings. On August 2003 we started treating a one-year-old turtle injured by a watercraft propeller. In a period of 45 days, the animal showed a remarkable recovery and it is expecting to be released in a short period of time. The rest of the patients are still in recovery.

Evaluation of incubation temperatures in hawksbill nests on islands in the Republic of the Seychelles

Amber Park[1], Jeanne A. Mortimer[2], Anne-Claire Rulie[2], Serge Roberts[2], and Thane Wibbels[1]

[1] University of Alabama at Birmingham, AL, USA
[2] Ministry of the Environment, Victoria, Mahe, Republic of the Seychelles

Sea turtles, like many reptiles, possess temperature-dependent sex determination (TSD). Hatchling sex ratios resulting from TSD are of interest because they affect the reproductive ecology of a species. Further, sex ratios are of interest to conservationists, because they affect the recovery of endangered species. The current study addresses hatching sex ratios in hawksbill turtles from islands in the Republic of the Seychelles. To evaluate sex ratios, nesting beach temperatures and nest incubation temperatures were monitored on several nesting beaches for the hawksbill in the Seychelles from 1999-2003. Data loggers were inserted into nests or buried at mid-nest depth to monitor temperatures. Each year, approximately 5 to 19 nests were monitored. Nest incubation temperature during the middle third of incubation was used to predict hatching sex ratios. The average incubation temperature during the middle third of incubation varied significantly between nests. The results suggest that a variety of hatchling sex ratios can be produced by these hawksbills depending on factors such as the location and timing of nesting.

Rations and the feeding frequencies in sub juveniles of the hawksbill turtle (*Eretmochelys imbricata*)

Elda Pelegrín, José Galindo, Iliana Fraga, and Susana Álvarez

Centro de Investigaciones Pesqueras, 5ta Ave. y 246 Barlovento, Santa Fe, Playa

A totally randomized experimental design was developed in the hatchery of quelonios of Isla de la Juventud during 84 days, with the objective of identifying the effect of different rations and the feeding frequencies in sub juveniles' growth of the hawksbill turtle (*Eretmochelys imbricata*) (average initial weight of 31.3 ± 0.27 g and 57.8 ± 0.15 mm of initial average length of the carapace). An artificial diet of 49.8 % protein was used to evaluate rations of 3, 4, and 5% of the biomass, with each given either once or twice a day. Each treatment had 21 trials. The factoral analysis demonstrated that there exists no interaction between the factors (rations and feeding frequencies) evaluated. There were not significant differences ($P>0.05$) among the different rations. The growth was significantly higher ($P<0.05$) with the highest feeding frequency. The survival varied between 78.3 and 81.7% and the food conversion ratio between 1.80 and 2.26. The protein efficiency ratio varied between 0.98 and 1.23. The daily index of growth in weight varied between 1.6 and 1.9 g/day. When feeding the sub-juvenile phase (under 1 year of age) of *E. imbricata*, we recommend using a ration of 3% of the biomass twice daily.

Regional scale studies of loggerhead nesting preference for high geomagnetic field intensity

Jessica E. Pilarczyk, W.J. Rink, and Joseph Boyce

McMaster University, Hamilton, Ontario, Canada

We have found that high nesting densities among loggerhead sea turtles generally correlate with high geomagnetic field intensities along approximately 100km of barrier island coastline in northwest Florida. Young loggerhead sea turtles (Caretta caretta) were previously shown in laboratory experiments to respond to changes in the declination, inclination and intensity of the earth's magnetic field (Lohmann et al., 1999, 2001). This ability has been inferred as a possible mechanism in natal homing scenarios among adult females, but thus far no demonstrated magnetic preferences have been shown among adults. We acquired from the Florida Marine Research Institute (St. Petersburg, Florida) nesting data from 9 barrier island beaches in the Gulf of Mexico near Apalachicola, Florida. These data comprise only total nest counts in each year (1979-2002) for given beaches ranging from 5 to 16km in length, in contrast to higher resolution nest location data obtained using GPS or detailed mapping (Rink et al., this volume). We compared this nesting data to aeromagnetic field intensity maps of the shoreline, and constructed a geomagnetic field intensity profile along the shoreline. The lowest field intensity was about 50,900 nanotesla (nT) which corresponded with the two lowest nesting densities per kilometer of shoreline (1.5 and 2.5/km-year), while the highest nesting density (13/km-year) was found in a zone of considerably higher field intensity ranging from 51,000 to 51,100 nT.

The adventures of three green turtles crossing the Gulf of Mexico (post-nesting migrations of green sea turtles in Lechuguillas, Veracurz-Mexico)

Tiburcio Pintos Graciela[1], George Balazs[2], Denise Parker[2], and Rafael Bravo Gamboa[3]

[1] Universidad Autónoma de Baja California Sur
[2] National Marine Fisheries Service (Southwest Fisheries Science Center Honolulu Laboratory
[3] Delegación SEMARNAT- Veracruz. Campamento Tortuguero Lechuguiallas

Significant populations of green turtles (*Chelonia mydas*) nest in the state of Veracruz, Mexico. Since 1994, more than 950 nesting green turtles have been tagged at Lechuguillas, Veracruz. Since, no tags or data from nesting green turtles have been reported or recovered within or outside of Mexico. We employed satellite telemetry in an effort to identify the resident foraging grounds and to track the routes taken to reach them. Satellite transmitters were attached to three nesting green turtles at Campamento Tortuguero in Lechuguillas, Veracruz, Mexico. Tagging was done during August and September 2000 and 2002. The turtles' movements were monitored by collecting longitude and latitude data using Satellite System service. All data points were interpreted and plotted using ArcView 3.2 GIS mapping software. Two turtles traveled from their nesting ground in Mexico to feeding grounds in the Marquesas Key area off the coast of Florida. Zyanya covered the 985-kilometer route in a southeastern curve, at an average rate of 0.631 km/hr, while Roberta traveled in the opposite direction at 0.362 km/hr for a total of 1,430 kilometers in a northeasterly direction. The last turtle named Manuelita traveled a 664-kilometer route in a southeastern curve, mean speed during movement 1.2 km/hr and stopped at feeding grounds off the coast of Campeche, Mexico. Different routes and different feeding ground areas were used for three turtles nesting in the same place.

Hatchling disorientations associated with beach nourishment projects on the east coast of Florida, USA

Kelly A. Roberts[1], Karen G. Holloway-Adkins[2], and Llewellyn M. Ehrhart[1]

[1] Department of Biology, University of Central Florida, Orlando, Florida, USA
[2] Dynamac Corporation, NASA Dyn-2, Kennedy Space Center, Florida, USA

Beach nourishment projects mitigate the effects of erosion in Florida and are coordinated with multiple engineering and environmental agencies to ensure the provision and enhancement of endangered species habitat (i.e. beach mice, sea turtle nesting, Wilson's plover). State and Federal agencies require that special permit conditions regarding the design and implementation of beach nourishment projects be met to minimize the potential negative effects to nesting marine turtles, while engineers must design projects that elevate and expand the beach profile to prevent further erosion. Five kilometers of shoreline along the east coast of central Florida were nourished before the 2002 marine turtle nesting season. This shoreline restoration project involved elevating the beach profile as much as 8 feet in some areas. As a result of the elevation and a lack of sufficient dune vegetation, light sources that had not previously illuminated the beach became visible.
Hatchling marine turtles rely almost exclusively on vision to orient to the sea and often become disoriented by artificial beachfront lighting. In the kilometers of beach nourished during 2002, hatchling disorientations are now being observed where previously none had been recorded. In some half kilometers, levels increased to as high as 20% of the total nests recorded for that area. The impacts of beach nourishment on sea turtle hatchling disorientation behavior are not well documented. While beaches are gaining shoreline restoration that inadvertently may benefit nesting sea turtles, the potential to negatively impact hatchling sea turtle's survival still needs to be addressed.

What can sea surface temperatures and bathymetry tell us about the travel patterns of three green turtles migrating from Baja California to Michoacan, Mexico?

Abigail Uribe M.[1], Raúl Aguirre G.[2], Wallace J. Nichols[3], Jeffrey A. Seminoff[4], and Alberto Abreu-Grobois[5]

[1] Instituto de Ciencias del Mar y Limnología, UNAM, México D.F. México
[2] Instituto de Geografía, UNAM, México D.F. México
[3] Wildcoast International Conservation Team, Davenport, California USA and Department of Herpetology, California Academy of Sciences, San Francisco, California, USA
[4] NOAA-National Marine Fisheries Service, Southwest Fisheries Science Center, La Jolla, California USA
[5] Laboratorio de Genética, Unidad Mazatlan, Instituto de Ciencias del Mar y Limnologia UNAM, Mazatlan, Sin., Mexico

The advent of satellite tracking of sea turtles coupled with parallel information on oceanographic conditions has facilitated the testing of hypotheses on how environmental conditions affect their migration patterns. Two deterministic factors that are often proposed are Sea Surface Temperature (SST) and bathymetry. Satellite tracks obtained for three eastern Pacific green turtles (*Chelonia mydas*) migrating from their foraging grounds in Baja California to their nesting beaches in Michoacan, Mexico were compared against SST maps derived from AVHRR daytime imagery and bathymetric charts of the Gulf of California and Mexican Pacific regions. Signal transmission of turtles' position started on January, August 1997 and November 1998, respectively. Migrations lasted between 51 and 90 days. The information gathered so far shows they follow very similar routes, travel through different patterns and ranges in ambient temperature, and take different paths while crossing deep waters. The observed paths taken after reaching the vicinity of continental Mexico, because they are consistent for all turtles, remain close to the shore and mostly on the continental platform, which is relatively narrow on that coast, indicate that these habits render the species particularly vulnerable to incidental and direct take as they pass through areas of intense fishing activities in frontal and upwelling zones.

Responses of juvenile loggerheads to light sticks used in longline fisheries

John H. Wang [1], Larry C. Boles[1], Ben Higgins[2], and Kenneth J. Lohmann[1]

[1] Department of Biology, University of North Carolina, Chapel Hill, NC, USA
[2] National Marine Fisheries Service, Galveston Laboratory, Galveston, TX, USA

The pelagic tuna and swordfish longline fisheries are a significant cause of injury and mortality to sea turtles. When turtles interact with longline fishing gear, they often become entangled in the fishing lines, ingest baited hooks, and drown. Thus, efforts to understand what stimuli induce turtles to approach longline sets may be useful in developing mitigation measures to limit the effects of such fisheries on sea turtle populations.

In several fisheries, light sticks (e.g. chemical light sticks or battery powered LEDs) are attached to lines to attract fish. We investigated whether such light sources also attract juvenile loggerheads. Experiments were conducted with captive reared juvenile loggerheads at the NMFS Galveston Sea Turtle Facility. When placed into a large tank under darkened conditions, tethered juvenile loggerhead turtles consistently swam towards activated chemical light sticks and battery powered electrolumes (LEDs). In contrast, turtles oriented randomly when tested in control trials in which there was no light source present. These results provide evidence that light sources used by longline fisheries attract juvenile turtles and may be one stimulus that induces sea turtles to approach and interact with longline-fishing gear.

Multi-year evaluation of the abundance and movements of juvenile sea turtles in the estuarine waters of Alabama

Thane Wibbels[1], Ken Marion[1], Alyssa Geis[1], David Nelson[2], Jenny Estes[1], Chris Murdock[1], Alex Schesny[3], and James Askew[4]

[1] University of Alabama at Birmingham, AL, USA
[2] University of South Alabama, Mobile, AL, USA
[3] J.L. Scott Marine Education Center, Biloxi, MS, USA
[4] Sacier Veterinary Hospital, Saucier, MS, USA

Since 1999, we have been evaluating the abundance, location, and movements of juvenile sea turtles in the estuarine systems of Alabama. During that period, we have not been able to identify any location in Alabama bays with a high abundance of sea turtles. However, we have documented that juvenile loggerhead and Kemp's ridley turtles do move through these waters. We have been utilizing a three-pronged approach. This includes the use of 1) a 220 m tangle net; 2) use of visual survey methods from boats to increase the area surveyed; and 3) collaborations with the Sea Turtle Stranding and Salvage Network in the study area in order to obtain turtles for tracking studies. Collectively, this three-pronged approach has resulted in the observation, capture, tagging, and/or tracking of as many as four juvenile sea turtles per year during 2000 and 2001, including both loggerhead and Kemp's ridley sea turtles. We have obtained recapture data on some of those turtles, which is providing long-term movement data. Additionally we have used sonic and satellite tracking to record the movements of juvenile turtles in the Alabama bay systems. Overall, our data as well as historical stranding data indicate that juvenile loggerhead and Kemp's ridley sea turtles inhabit the estuarine waters of Alabama, however, we have not found any area which tend to concentrate these turtles to the extent that they can be captured in relatively large numbers in a predicable fashion.

Post–nesting movements of green turtles in the Galapagos Islands

Patricia M. Zárate[1], Peter H. Dutton[2], Jeffrey A. Seminoff [2], and Denise M. Parker[2]

[1] Charles Darwin Research Station, Santa Cruz Island, Galapagos Islands, Ecuador
[2] National Marine Fisheries Service, Southwest Fisheries Science Center, La Jolla, California, USA

The Galapagos Islands green turtle rookery was first described in the 1970s by Green, who undertook an exhaustive flipper tagging program. Based on tag returns from throughout Central and South America, it was apparent that at least some green turtles departed this archipelago after nesting, although the proportion of turtles doing so remained unknown. In recent years, however, no further tag returns have been recorded. In this poster we assess post-nesting movements of four adult female green turtles that were equipped with satellite transmitters. Turtle movements were recorded from February to June 2003 as turtles departed the nesting beaches of Bahía Barahona (Isabela Island) and Las Salinas (Seymour Island). Of the four deployments, only one female remained in the Galapagos Marine Reserve (GMR), while three traveled substantially greater distances into oceanic waters, thereby leaving the protection of the GMR. These movements confirm the migratory nature of Galapagos green turtles and underscore their vulnerability to incidental capture by high seas fisheries.

The use of landmarks data, a geometric morphometrics analysis, in the carapace morphology differentiation

Tania Zúñiga Marroquín[1] and Efraín de Luna García[2]

[1] Departamento de Sistemática Vegetal, Instituto de Ecología, A.C., Xalapa, Veracruz, México
[2] Departamento de Ecología y Comportamiento Animal, Instituto de Ecología, A.C., Xalapa, Veracruz, México

In the sea turtle group, the carapace structure has been ambiguously used in species identification. Quantitative comparison of carapace morphology may be conducted by traditional morphometrics, outline analysis, or geometric morphometrics. In this study, we employ the landmarks data protocol to test its utility in the carapace form differentiation in two marine turtle species, *Lepidochelys olivacea* and *Eretmochelys imbricata*. The results provide evidence of the methodology efficacy in describing the carapace form and its potential to be used in the analysis of other structures for studies in ecology, comparative biology, phylogenetic systematic, characters evolution and others.

PART 3. VIDEO/FILM PRESENTATIONS

POTPOURI

Interactive DVD on marine turtles - An educational and research tool

Katy Garland, Bill Pendergraft, Ida Phillips Lynch, and Jere Snyder

Environmental Media, Port Royal, SC, USA

The plight of all species of sea turtles is a global problem that impacts the environment, international conservation efforts, the health of many ecosystems, and quality of life for everyone. Many people are not familiar with the threats to marine turtles and other species. Despite the numerous conservation efforts currently in place, sea turtle populations are declining. Through the design and production of interactive media on marine turtles, Environmental Media hopes to educate and inform conservation organizations, research professionals, teachers, and general audiences of this critical situation.

The content of the DVD currently includes life cycles, threats, innovative research, conservation efforts, rehabilitation facilities and practices, volunteer programs, long distance migrations, and international efforts. Project media includes worldwide terrestrial and underwater footage, interviews with scientists and researchers including: Llew Ehrhart, Sally Murphy, Karen Eckert, Wallace J. Nichols, Jeanette Wyneken, Larry Crowder, Archie Carr III, Jerris Foote, Ken Lohman, David Godfrey, Jean Beasley, Matthew Godfrey and others, and research projects in action from lab to open ocean.

The interactive DVD is a vital education and information tool and includes footage, still photos, links to websites, print materials, literature, GIS data, simulated life cycles with varying choices and outcomes, bibliographies, charts and graphs, teacher's guides, and more. The program will help disseminate information regarding current research to other turtle conservationists, biologists, and the general public. During our DVD presentation we will introduce the project to symposium attendees, explain and display its capabilities, and let them view samples of our exceptional variety of footage.

The last journey for the leatherback?

Todd Steiner

Turtle Island Restoration Network, Forest Knolls, California, USA

The “Last Journey for the Leatherback?” documents the incredible life of the leatherback, the largest species of sea turtle, which can dive as deep as the whales and migrate across entire ocean basins. Much of the story is told through interviews with leading marine scientists. The “Last Journey for the Leatherback?” also details the threat industrial fishing poses to their survival.

SEA TURTLES AND SOCIO-ECONOMICS

Caguamas del Pacifico: ¿En las manos de quién?- Loggerhead turtles of the Pacific: In whose hands?

S. Hoyt Peckham[1], Alejandro A. Aguilar[2], Edgar Caballero-Aspe[3], Wallace J. Nichols[4], and Christobal I. Figler[4]

[1] University of California at Santa Cruz, Santa Cruz, CA USA
[2] Cooperativa Pesqueria de Puerto Chale, San Juanico, BCS, Mexico
[3] Proyecto Caguama, La Paz, BCS, Mexico
[4] WiLDCOAST, Davenport, CA, USA

Because fisheries bycatch off of the Baja California peninsula is a leading threat to the critically endangered North Pacific loggerhead turtle, its future is partly in the hands of Mexican fishers. Ironically, it is difficult for many of Baja California’s halibut fishers to understand that loggerhead turtles are endangered because they can catch up to forty turtles in a single day.

In Caguamas del Pacifico: ¿en las manos de quién? Baja California fishers present the incredible transpacific migration of the loggerhead turtle featuring hands-on deployment of satellite tags, rare underwater turtle footage, stunning Baja California scenery, and galvanizing “turtle rodeo” action sequences. Fishers share the staggering turtle mortality they encounter on a daily basis, and for the first time, envision alternative fishing strategies.

Caguamas del Pacifico: ¿en las manos de quién? documents a landmark: Baja California fishers “owning” the fisheries bycatch problem and imagining solutions to protect the loggerhead turtle, pan-Pacific symbol of wisdom and endurance.

SEA TURTLES IN COSTA RICA: MINI SYMPOSIUM

Evaluation of the impact of the longline artisanal fishery on the sea turtle population of the Ostional Wildlife Refuge (Costa Rica) and surrounding waters

Jorge Ballestero, Daniel Loría, Randall Arauz, and Allan Bolaños

Programa Restauración de Tortugas Marinas (PRETOMA), Costa Rica

Bycatch is currently considered one of the main causes of mortality for leatherback, green and olive ridley sea turtles. It is widely thought that the majority of sea turtles captured incidentally are captured by industrial longliners. However, bycatch during artisanal fishing operations has not yet been evaluated in the Ostional Wildlife Refuge (Costa Rica) and surrounding waters.

This project was designed to evaluate the longline artisanal fishing operations that target demersal fishes (especially snappers) within and around the Ostional Wildlife Refuge, off the North Pacific coast of Costa Rica. This work represents the first evaluation of the effects this local fishery has on sea turtles.

The present project was carried out with the cooperation of the Playa Punta Guiones and Playa Pelada Fishermen Associations and took place from January to June 2003 at the behest of the Ostional Wildlife Refuge authorities (Ministry of the Environment).

Lessons from Pacuare: A high plains films documentary

Layne McIntosh[1], Scott Pankratz[2], Julie Osborn[2], and Sophia Bickford[2]

[1] High Plains films and Momentum Productions (joint affiliation), 5010 Greenwood Ave., Seattle, Washington 98103, USA

[2] Ecology Project International, P.O. Box 9192, Missoula, Montana 59807, USA

For the past four years, Ecology Project International has facilitated a research- and education-based partnership between more than 500 local Costa Rican high school students and sea turtle biologists at the Pacuare Nature Reserve. The Pacuare Nature Reserve (located 30 km north of Puerto Limon) is a high density leatherback nesting beach on the Caribbean coast of Costa Rica, the fourth most important nesting beach for leatherbacks in the world (Troeng et al, 2002). This video profiles the pilot year of the Sea Turtle Ecology Program, when Costa Rican public and private high school students took part in a unique experiential field ecology program. They attended science classes at the reserve during the day, and assisted biologists collecting field data at night. This collaboration targeted conservation, education, and cultural goals that benefited students and scientists. Students collected quality nesting data that met the biologists' monitoring needs, learned and applied the scientific method by developing their own biological research project, and prepared and delivered a presentation of their results. This project was the first involvement of local residents in sea turtle monitoring at the reserve, and marked the beginning of a conservation dialog between the Pacuare Nature Reserve and the adjacent community of Matina. The film incorporates unique night photography of the nesting leatherbacks, showcases the beauty and biodiversity of the area, and documents the students' work and the collaborative spirit that made the program a success.

TECHNOLOGY AND SEA TURTLES

Leatherbacks aboard

James Budi[1], Sheryan P. Epperly[2], Christopher R. Sasso[2], Malcolm O. MacLean[1], John Caldwell[1], Nick Hopkins[3], Dominy Hataway[3], and Nelson R. Beideman[4]

[1] Eagle Eye II Corp., Lawrence, NY, USA
[2] NOAA Fisheries, Miami, FL, USA
[3] NOAA Fisheries, Pascagoula, MS, USA
[4] Fisheries Research Institute & Blue Waters Fishermen's Association, Barnegat Light, NJ, USA

NOAA Fisheries, in cooperation with the U.S. pelagic longline fishery, implemented a three-year research program in 2001 in the western Atlantic Ocean to develop and evaluate sea turtle mitigation measures. The need to boat leatherbacks to collect biological data and to remove the fishing gear was identified. We designed, developed, and tested a leatherback hoist that can be used on commercial longline vessels to safely bring hooked and entangled leatherback turtles aboard. In August 2003, all 4 leatherbacks encountered by the F/V Eagle Eye II were successfully boated using this device and all gear was removed. This video shows the deployment of the lift, the boating of a 140.0 cm CCL turtle, the removal of the hook and subsequent treatment of the wound, and the collection of biological information on the turtle. After measurements were taken and the turtle was examined for existing tags (none found), a 125 kHz PIT tag and inconel tags were applied and a biopsy sample was taken. We plan to deploy conventional satellite tags and pop-up archival transmitting tags on such boated leatherbacks in the future.

Tools for removing pelagic longline fishing gear from captured sea turtles

Dominy Hataway [1] and Sheryan P. Epperly [2]

[1] NOAA Fisheries, Pascagoula, MS USA
[2] NOAA Fisheries, Miami, FL USA

Pelagic longline fishing is a common fisheries method practiced throughout the world. The primary target species are tuna and swordfish. Unintended bycatch of this fishery include threatened and endangered sea turtle species such as the loggerhead and leatherback turtles. Safely removing fishing gear from these turtles after capture greatly improves their chances of survival after release. Tools and techniques have been developed by scientists, fishing gear specialists, commercial fishermen, and industry representatives for removing hooks and monofilament line from these turtles to greatly improve the chances of survival of these captured sea turtles. This video demonstrates these tools and their proper use.

Aladdin's recovery: Enterotomy of a young hawksbill turtle

Pascal Melot[1] and Center for Study and Discovery of Marine Turtles [2]

[1] Cabinet Vétérinaire de l' Hermitage .97434 Saint Gilles les bains .La Reunion
[2] Saint Leu La Réunion

A young hawksbill turtle is found during a night dive. He is thin and weak. An X-ray shows a hook in the body. The hook is removed by enterotomy, with success.