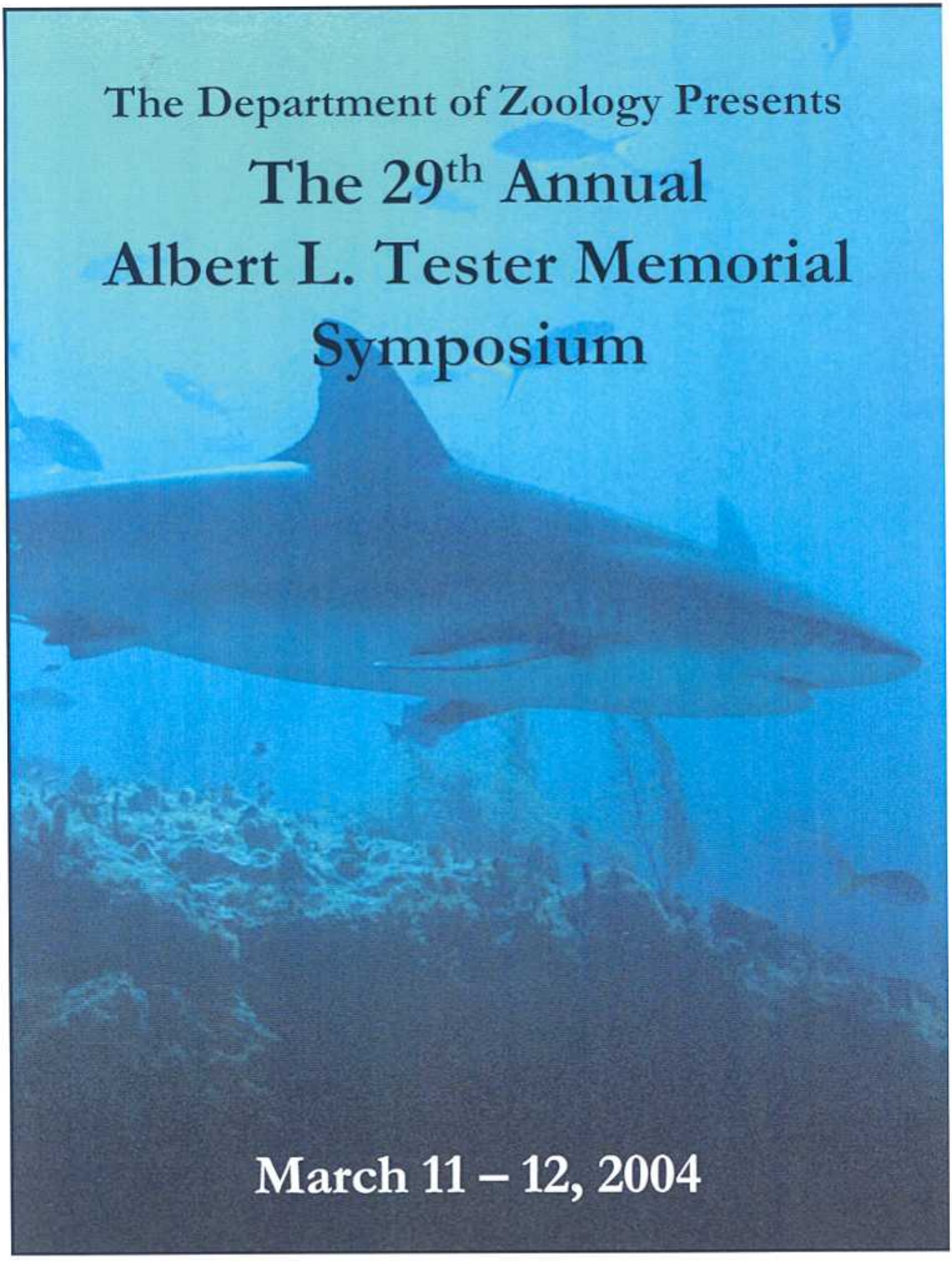
The Department of Zoology Presents
The 29th Annual
Albert L. Tester Memorial
Symposium
March 11 – 12, 2004

29th Annual
Albert L. Tester Memorial Symposium

Sponsors

The Department of Zoology gratefully acknowledges financial support provided by:

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Pacific Biomedical Research Center (Marylin F. Dunlap)
School of Ocean and Earth Sciences & Technology (Klaus Keil)
University of Hawaii Sea Grant College Program (Gordon Grau)

We also acknowledge the office staff of the Department of Zoology for logistical assistance.

Photos courtesy of Dr. Philip Motta.

Presented by Department of Zoology
University of Hawai'i at Manoa

29th Annual Albert L. Tester Memorial Symposium
March 11-12, 2004

Wednesday, March 10th, 4:00 PM: Tester Symposium Distinguished Visitor's Address

Marine Science Building, Room 114

Dr. Philip Motta

"Function and evolution of feeding mechanisms in sharks and rays"

Student Seminar Sessions

East West Center, Keoni Auditorium

Thursday, March 11th

8:30 AM **Introduction, Dr. Sheila Conant**

Session 1 Chaired by Dr. Elaine Seaver

8:45	**Michael J. Boyle**	Department of Zoology
	Isolation and Characterization of Acrosomal Proteins from the Polychaete *Eudistylia*	
9:00	**Kim Andrews**	Department of Zoology
	Genetic Structure of the Hawaiian Spinner Dolphin (*Stenella longirostris*)	
9:15	**Rachel Blaser**	Department of Psychology
	Backward Blocking in Honeybees	
9:30	**Christopher E. Bird**	Department of Botany
	A Priori Optimization of Point-Intercept Sampling	
9:45	**Jennifer Brum**	Department of Oceanography
	Concentration, Production, and Turnover of Viruses and Dissolved DNA at Station Aloha	

10:00 ***Coffee Break***

Session 2	Chaired by Dr. Tim Tricas	
10:30	**David R. Bybee** Spawning Periodicity and Gametogenesis of the Fan Worm *Sabellastarte spectabilis*	Department of Zoology
10:45	**Ken Hayes** Phylogeography and Evolution of the Florida Crown Conch (*Melongena corona*)	Department of Zoology
11:00	**Christine Byrum** Secrets of Amazing Gutless Sea Urchin Embryos!	Department of Zoology
11:15	**Tim Clark** Remote Tracking of the Manta Ray (*Manta birostris*) in Hawaii	Department of Zoology
11:30	**Claudia Farfán** Isolation, Characterization and Expression of the *Euprymna scolopes apterous* Gene	Department of Zoology
11:45	**Aaron Hebshi** Food Limitation in the Tropics: Starvation Events of Wedge-Tailed Shearwater Chicks Indicate the Ability of Food to Regulate Reproductive Rates in Seabirds	Department of Zoology
12:00	***Lunch Break***	
Session 3	Chaired by Dr. Ian Cooke	
1:30	**Jennifer Hoof** Comparison of two *Metrosideros polymorpha* (Gaud) Varieties at a High Altitude Site on Mauna Loa, Hawai'i	Department of Botany
1:45	**Anuschka Faucci** Phylogeography of Vermetids in Hawaii	Department of Zoology
2:00	**Chela J. Zabin** Between Hawaiian Tides: A Surprising Diversity in Oahu's Intertidal	Department of Zoology
2:15	**Kanesa Duncan** Population Biology of Scalloped Hammerhead Sharks (*Sphyrna lewini*) in their Nursery Grounds	Department of Zoology
2:30	**Tamar Saturen Cunha** Sea Urchin Diet and its Possible Role in Defense against Predation	Department of Zoology
2:45	***Coffee Break***	

Session 4	Chaired by Dr. Steve Robinow	
3:15	**Danielle Jayewardene** Larval Supply may not always be key to Recruitment	Department of Zoology
3:30	**Sam Kahng** The Ecology and Impact of an Alien, Invasive Octocoral in Hawaii	Department of Oceanography
3:45	**Kornelia M. Szauter** Mapping of a Novel Gene Mutation in *RC* Mice that Results in Cyclic Hair Loss and a Possible Keratinocyte Stem Cell Fate Switch	Cardiovascular Research Center, JABSOM
4:00	**Teresa Restom** Patterns of Water Uptake and Transpiration by Forest Plantations	Department of Botany
4:15	**Andrew McClung** Projected Effects of an Alien Plant Invasion on an Endangered Northwest Hawaiian Islands Passerine Bird, the Laysan Finch (*Telespiza cantans*)	Department of Zoology
4:30	**Pedro Afonso-Santos** Distribution, Reproduction and Movements of Parrotfish in the Azores	Department of Zoology

Friday, March 12th

East West Center, Keoni Auditorium

Session 5	Chaired by Dr. Petra Lenz	
8:30	**Ken Hayes** Systematics, Phylogeography and Evolution of Apple Snails (*Pomacea* spp.)	Department of Zoology
8:45	**Toby S. Daly-Engel** Population Ecology of the Sandbar Shark (*Carcharhinus plumbeus*) in Hawaii	Department of Zoology
9:00	**Orou G. Gaoué** Assessing the Impact of Non Timber Forest Products Harvest on African Dry Zone Mahogany	Department of Botany
9:15	**Han Lee** Temporal Changes in the Infaunal Community Surrounding a Hawaiian Mariculture Operation	Department of Zoology
9:30	**David Q. Matus** Metazoan Hox Gene Evolution and the Phylogenetic Position of the Chaetognaths	Department of Zoology
9:45	**Gayla Ivey** Movements and Habitat Utilization of *Octopus cyanea* in Kaneohe Bay, Hawaii	Department of Zoology
10:00	***Coffee Break***	

Session 6 Chaired by Dr. Rob Cowie

10:30 **Sarah McTee** — Department of Zoology
Algal Territories of Damselfish: are they a Threat to the Long-term Persistence of a Reef?

10:45 **Brett Schumacher** — Department of Zoology
Movement Patterns of the Introduced Snapper *Lutjanus kasmira* and Native Goatfishes in Hawai'i

11:00 **Lance Smith** — Department of Zoology
Identifying Determinants of Resistance to High Temperatures: Evidence from a Coral Transplant Experiment

11:15 **Heather Spalding** — Department of Botany
Deep Thoughts in Muddy Waters: Deep-Water Macroalgae as Water Clarity Bio-Indicators?

11:30 **Alison K. Stimpert** — Department of Zoology
Distributions of four Baleen Whale Species in the Northwest Atlantic Ocean Based on Large-scale Aerial Survey Data

11:45 **Nel C. Venzon, Jr.** — Dartmouth College SURF Program
Characterization of the Role of Swarming Motility in Pseudomonas aeruginosa Biofilm Development

12:00 ***Lunch Break***

Poster Session

1:00 – 3:00

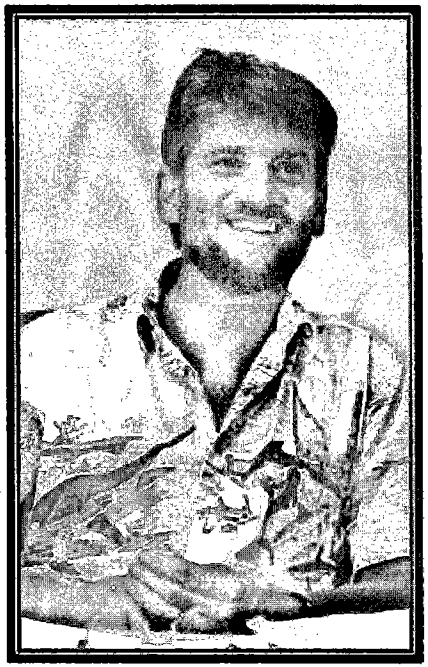
1. **Michael J. Boyle** — Department of Zoology
   Isolation and Characterization of Acrosomal Proteins from the Polychaete *Eudistylia*
2. **Jakob Eijzenga** — Department of Botany
   Identifying Key Predators of Hawaiian Stilt (*Himantopus mexicanus knudseni*) Chicks
3. **T. Aran Mooney** — Department of Zoology
   A Method to Reduce Marine Mammal Bycatch: Target Strength and Predicted Biosonar Detection Ranges of Experimental Gillnets

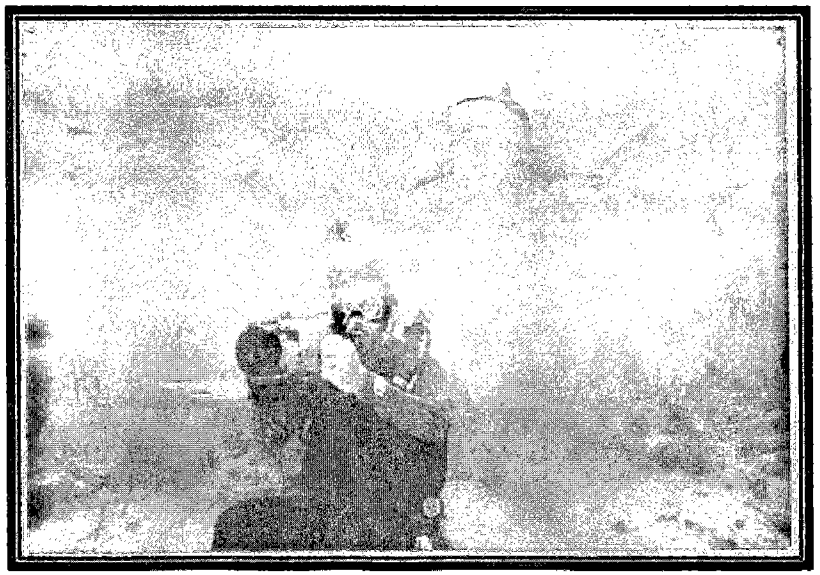
4:00 Tester Symposium Distinguished Visitor's Address

East West Center, Keoni Auditorium

Dr. Philip Motta

"Case studies in shark feeding: suckers and biters"





Introduction

The Albert L. Tester Memorial Symposium is held in honor of Professor Albert Tester who, at the time of his death in 1974, was Senior Professor of Zoology at the University of Hawaii. The faculty and students of the Department of Zoology proposed an annual symposium of student research papers as a means of honoring, in a continuing and active way, Dr. Tester's lively encouragement of student research in a broad range of fields within marine biology. Papers reporting original research on any aspect of science are solicited from students at the University and these papers are presented at the Symposium, which takes place during the spring semester. Income from contributions to the Albert L. Tester Memorial Fund of the University of Hawaii Foundation is used to provide prizes for the two best papers, judged on quality, originality, and importance of research reported, as well as the quality of the public presentation. Judges include Department of Zoology faculty members and the previous year's student award winners. In addition, a distinguished scholar from another university or research institution is invited to participate in the Symposium as a judge and to present the major Symposium address.

2004 Invited Speaker

This year's distinguished visitor and judge is Dr. Philip J. Motta, Professor of Biology at the University of South Florida in Tampa, Florida. Dr. Motta received his B.S. from Duke University in 1975 and his Ph.D. from the University of Hawaii in 1980. He has edited Ecological Morphology of Fishes (1995) with J. Luczkovich, S. Norton and K. Liem and The Biology of the Butterflyfishes: Success on the Coral Reef (1989), and has authored over 50 scientific papers. His research interests include the functional and ecological morphology and behavior of fishes. His current research centers on the comparative functional morphology of feeding mechanisms, the relationship of functional morphology to feeding behavior, and the evolution of feeding mechanisms in a variety of ancestral and derived shark species encompassing many feeding types. Together with his graduate students, he has studied feeding in at least 17 species of sharks, rays and bony fishes, investigating the anatomy and functional morphology of the feeding mechanism, kinematics during prey capture, the functions of jaw protrusion, the evolution and function of jaw suspension types in sharks and rays, the ability to change or modify feeding patterns with different prey types, the ontogeny of prey capture kinematics and morphology, and the evolution of jaws in fishes.

29th Annual Albert L. Tester Memorial Symposium

Albert L. Tester

Senior Professor of Zoology

This Symposium is dedicated to Dr. Albert Lewis Tester, scholar and teacher, who died in Honolulu, Hawaii, on November 27, 1974, his 66th birthday. He was a multi-talented man who developed an international reputation in not one, but several aspects of marine biology, as well as being an outstanding teacher of both university students and laymen. Dr. Tester was a delightful friend, a meticulous worker, and a valued colleague.

A native of Toronto, Canada, Dr. Tester received his doctorate from the University of Toronto in 1936. In 1931 he joined the Pacific Biological Station of the Biological (now Fisheries Research) Board of Canada where he conducted highly significant work on herring.

In 1948 Dr. Tester joined the Department of Zoology at the University of Hawaii where he remained, except for a short time away, until his death. From 1955 to 1958, he was director of the Pacific Oceanic Fisheries Investigations of the U.S. Fish and Wildlife Service in Honolulu. In 1957 he served as chief of the Service's Division of Biological Research in Washington, D.C., a job he found to be hectic and frustrating. Consequently, in 1958 Dr. Tester returned to the University of Hawaii as Senior Professor of Zoology.

At the University, Dr. Tester studied the life history of the baitfish used to catch tuna and the response of tuna to various stimuli as part of an overall program designed to improve tuna fishing in the Pacific. Long after Dr. Tester stopped active tuna research he continued his contributions in this area through his participation on the Governor's Task Force on Hawaii and the Sea, and on the Marine Resources Committee of the Pacific islands Development Commission.

Dr. Tester's most valuable and well known work were in the field of elasmobranch biology which he began in 1960 and continued until his death. He had, in fact, planned to do further work on sharks after his retirement. His interests in elasmobranch biology were broad and included studies on the ecology, behavior, and sensory biology of sharks as well as practical aspects of shark attack and control. From 1967 to 1969 Dr. Tester directed the Cooperative Shark Research and Control Program of the State of Hawaii, and in 1967 he was appointed to the Shark Research Panel of the American Institute of Biology Sciences.

Dr. Tester's major research interest was the shark sensory systems. He did significant morphological and behavioral studies of olfaction, vision, and the chemical senses. During the last 7 years of his life Dr. Tester intensively studied the acoustico-lateralis system, especially the innervation and morphology of neuromasts and the cupula structure in the lateral line, and broadened his interest to include the inner ear, especially that of the carcharinid sharks.

Al Tester was the author of more than 100 publications. In 1974, in acknowledgement of the excellence of his work, the University of Hawaii awarded him the University's Research Medal.

While Dr. Tester's scientific contributions are highly significant, many of us will remember him best as a dedicated teacher, who greatly enjoyed his work with students, and as an active and respected participant in the University community. Dr. Tester served a term as chairman of the Department of Zoology and then continued to be a major influence in many areas of college life. Warm and congenial, he had a winning sense of humor that surfaced at informal gatherings. Whether demonstrating the hula (which he led the Zoology faculty in learning in the '50s), or singing, or playing the organ, he was an affable host, the complete man.

This tribute to Al Tester was written by Arthur N. Popper, formerly of the Zoology Department, University of Hawaii, and now at the University of Maryland, Department of Zoology, and Claire and Perry W. Gilbert of the Mote Marine Laboratory, Sarasota Florida. It is modified from a tribute to Dr. Tester that appeared in American Zoologist, 1977, 17:289-291.

Selected Bibliography

Dr. Albert L. Tester

Tester, A. L. 1933. Populations of herring in the coastal waters of British Columbia. Trans. Amer. Fish. Soc. 63:286-289.

Tester, A. L. 1935. The herring fishery of British Columbia--past and present. Bull. Biol. Bd. Can. 47:1-37.

Tester, A. L., P. B. van Weel and J. J. Naughton. 1955. Reaction of tuna to stimuli--1952-1953 Part I. Response of tuna to chemical stimuli. U.S. Fish and Wildlife Service, Spec. Sci. Rept. Fisheries, No. 130:1-62.

Tester, A. L. and S. C. Hsiao. 1955. Reaction of tuna to stimuli--1952-1953 Part II. Response of tuna to visual and visual-chemical stimuli. U.S. Fish and Wildlife Service, Spec. Sci. Rept. Fisheries, No. 130:63-76.

Tester, A. L. 1960. Fatal shark attack, Oahu, Hawaii, December 13, 1958. Pac. Sci. 14(2):181-184.

Tester, A. L. 1963. The role of olfaction in shark predation. Pac. Sci. 17(2):145-170.

Tester, A. L., G. J. Nelson, and C. I. Daniels. 1968. Test of NUWC shark attack deterrent device. University of Hawaii, for Research and Engineering Department. 43pp.

Tester, A. L. and S. Kato. 1966. Visual target discrimination in blacktip sharks (*Carcharhinus melanopterus*) and grey sharks (*C. menisorrah*). Pac. Sci. 20(4):461-471.

Tester, A. L. and J. I. Kendall. 1967. Innervation of free and canal neuromasts in the sharks *Carcharhinus menisorrah* and *Sphyrna lewini*. In: (P. Cahn, ed.), Lateral Line Detectors, p. 53-69, Indiana University Press, Bloomington, Indiana.

Tester, A. L. and G. J. Nelson. 1967. Free neuromasts (pit organs) in sharks. In: (P.W. Gilbert, R.F. Mathewson, and D.P. Rall, eds.), Sharks, Skates, and Rays, p. 503-531, The Johns Hopkins Press, Baltimore, Maryland. 624 pp.

Tester, A. L. 1968. Olfaction, gestation, and the common chemical sense in sharks. In: (P.W. Gilbert, ed.) Sharks and Survival, p. 255-282, D.C. Heath, Boston. 578 pp.

Tester, A. L. and J. I. Kendall. 1968. Cupulae in shark neuromasts: Composition, origin, generation. Science 160:772-774.

Katsuki, Y., K. Yanagisawa, A. L. Tester and J. I. Kendall. 1969. Shark pit organs: Response to chemicals. Science 163:405-407.

Tester, A. L. and J. I. Kendall. 1969. Morphology of the lateralis canal system in the shark genus *Carcharhinus*. Pac. Sci. 23(1):1-16.

Tester, A. L. 1969. Factors affecting the behavior of sharks. Final Report. Office of Naval Research (Code 484), Contract Nonr 2756(00); Project NR 104503.

Fishman, S. S. and A. L. Tester. 1970. Response of sharks to cavitating ultrasound at 20Khz. Proc. Western Pharmacology Soc. 13:204-205.

Tester, A. L., J. I. Kendall and W. B. Milisen. 1972. Morphology of the ear of the shark genus *Carcharhinus*, with particular reference to the macula neglecta. Pac. Sci. 26(3):264-274.

Fay, R. R., J. I. Kendall, A. N. Popper and A. L. Tester. 1974. Vibration detection by the macula neglecta of sharks. Comp. Biochem. Physiol. 47A:1235-1240.

Albert L. Tester Memorial Symposium
Past Symposia Best Paper Awards

1976
Tina Weatherby
Dennis Gorlick & Paul Atkins

1977
Charles van Riper
Craig MacDonald & Bruce Thompson

1978
Jon Hayashi
James Wyban

1979
Gerald Heslinga
Frank Perron

1980
Stephen C. Kempf
Clyde S. Tamaru

1981
Carol N. Hopper
Michael Walker

1982
Ronaldo Ferraris
Evelyn Cox

1983
Thomas L. Smalley
Sharon Hendrix

1984
Janice Bell
Joan Canfield
Cynthia Hunter & Cedar Kehoe

1985
Karla McDermid
Hing-Chung Lee
Timothy Tricas

1986
James Howard
Charles Madenjian
Tom Hourigan

1987
Amy Ringwood
Joyce Rundhaug
Jeff Burgett

1988
Teresa Telecky
Randall Kosaki
Jay Jones

1989
Rachel Behnke
Catherine Hurlbut
Edward Metz

1990
Carol Reeb
Bailey Kessing
Kevin Hill

1991
Vanessa Gauger
Gary Jahn
Andrew Martin

1992
Greta Aeby
Robert Feldman
J. Koji Lum

1993
Kazue Asoh
Deborah J. Gochfeld
Andrea Fleig

1994
Kevin Beach
Susan Murphy-Walker
Richard L. Pyle

1995
Eric Vanderwerf
Christopher Lowe
Gwen Lowe
Kabi Raj Neupane

1996
Scott Larned
Patrick Hart
Patricia Lee

1997
Aaron Bush
Angel Yanagihara
Ilsa Kuffner

1998
Elizabeth Nemeth
Jessica Garb
Jamie Foster

1999
Wendy Kuntz
Lisa Privitera
James Leary

2000
Kelly Benoit Bird
Timothy D. Male
Jennifer Smith
Jill Zamzow

2001
Buffy Cushman
Timothy Fitzgerald
Carl Meyer

2002
Matthew Parry
David Phillips
Amy Baco-Taylor

2003
Brittany Graham
Karen Maruska
Donovan Studo

Past Symposia Invited Speakers

1976 A. A. Myrberg, Jr., University of Miami
1977 R. Glenn Northcutt, University of Michigan
1978 Karel F. Liem, Harvard University
1979 Edmund S. Hobson, Southwest Fisheries Center, Tiburon Laboratory
1980 Gareth Nelson, American Museum of Natural History
1981 Stephen Jay Gould, Museum of Comparative Zoology, Harvard University
1982 Howard A. Bern, University of California, Berkeley
1983 Robert T. Paine, University of Washington, Seattle
1984 Joseph Connell, University of California, Santa Barbara
1985 George W. Barlow, University of California, Berkeley
1986 Jared Diamond, University of California, Los Angeles
1987 Lynn Margulis, Boston University
1988 Eric Davidson, California Institute of Technology, Pasadena
1989 Jonathan Roughgarden, Stanford University, Palo Alto
1990 Corey S. Goodman, University of California, Berkeley
1991 John Maynard Smith, Univeristy of Sussex
1992 Robert Warner, University of California, Santa Barbara
1993 Stephen Hubbell, Princeton University
1994 Nancy Knowlton, Smithsonian Tropical Research Institute
1995 Mimi A.R. Koehl, University of California, Berkeley
1996 George L. Gabor Miklos, The Neurosciences Inst., La Jolla
1997 Stephen A. Wainwright, Duke University
1998 Kenneth B. Storey, Carleton University
1999 Robert E. Ricklefs, University of Missouri-St. Louis
2000 John A. Endler, University of California, Santa Barbara
2001 Steve Jones, University College, London
2002 Marc Mangel, University of California, Santa Cruz
2003 William G. Eberhard, Smithsonian Tropical Research Institute

2004 Symposium Invited Speaker

Dr. Philip J. Motta
University of South Florida

Judges

Philip Motta
Jonathan Stillman
Brittany Graham
Karen Maruska
Donovan Studo

Presented by the Department of Zoology, University of Hawaii at Manoa

April 16-17, 2003

Kim Andrews, Department of Zoology
(Advisor: Whitlow Au)

GENETIC STRUCTURE OF THE HAWAIIAN SPINNER DOLPHIN (*STENELLA LONGIROSTRIS*)
(Hawaii Institute of Marine Biology)

In many cetacean populations, reproductively isolated subgroups exist within populations even when these subgroups live in the same geographic range or are capable of traveling to other subgroups' ranges. The factors which lead to reproductive isolation of these subgroups are often complex and can include factors such as food type and distribution, feeding behavior, social structure, migration patterns, philopatry, and learned behaviors. In the Hawaiian spinner dolphin (*Stenella longirostris*) population, there is variability throughout the Hawaiian Archipelago in geographic distance between suitable habitat, prey distribution, habitat type, availability of habitat, and social structure. To investigate the hypotheses that these factors have led to reproductive isolation, and therefore genetic distinction, between subgroups, a comparison was made of genetic structure, movement patterns, and social structure of the Hawaiian spinner dolphin throughout the Hawaiian Archipelago using genetic analysis and available photographic identification data. Genetic samples were collected from 6 islands in the Hawaiian Archipelago: the Big Island, Maui, Oahu, Niihau, and Midway Atoll. Preliminary population genetic analysis of the mitochondrial D-loop region indicated the presence of statistically significant genetic structure within the Hawaiian Archipelago (Φ_{ST}=0.06, p<0.001). Dolphins at the Main Islands were genetically distinct from the Northwest Islands, likely due to the large geographic distance separating them. Genetic differentiation was also found between dolphins at different Main Hawaiian Islands, indicating the presence of restricted gene flow despite the relatively small geographic distance separating these islands. Genetic diversity was significantly lower at the Northwest Islands than at the Main Islands, likely due to smaller populations and more stable social groups at the Northwest Islands. These results suggest that geographic distance, habitat type, and social structure are factors which influence genetic structure and genetic diversity within the Hawaiian spinner dolphin population.

Christopher E. Bird, Department of Botany
(Advisor: Celia M. Smith)

A PRIORI OPTIMIZATION OF POINT-INTERCEPT SAMPLING

Point-intercept sampling is a popular and powerful tool for sampling the percent cover of benthic species. Many researchers have empirically tested the accuracy and precision of point-intercept sampling against that of other sampling methods. Unfortunately, the results of these studies have been varied, with "system specific" conclusions, indicating that the accuracy of point-intercept cover estimates must be empirically determined separately for each system. Using a computer model to generate "quadrats" with varying species richness, dispersion, and percent cover and to analyze the quadrats with varying numbers of randomly positioned point-intercepts, we find random point-intercept cover estimates to be unbiased, precise, and predictable with the binomial equation for standard deviation (r2=.999, P<.001). The absolute precision of a cover estimate is doubled by quadrupling the number of point intercepts, is the poorest at 50% cover and increases as 0% and 100% are approached When point-intercepts are positioned in a stratified-random fashion, the precision of cover estimates is, at least, equal to and often better than those obtained when point-intercepts are randomly positioned. The magnitude of improvement in the precision is determined by the percent of strata occupied, the size of a species patch relative to the size of a stratum, and the interaction of these factors (r2=.996, P< 0.001). These results hold for photoquadrats from actual coral reefs and volcanic shorelines. As a result, one can quantitiatively determine the number of points required to detect rare species or detect a difference in percent cover at a user-specified level of confidence with little or no exposure to system to be sampled.

Rachel Blaser, Department of Psychology
(Advisor: Dr. P.A. Couvillon)

BACKWARD BLOCKING IN HONEYBEES
(Pacific Biomedical Research Center)

A systematic study of learning in honeybees has yielded results surprisingly similar to the results of studies of vertebrate learning. Given the differences in brain development and structure, these similarities suggest relatively simple mechanisms underlying learning. An important phenomenon in vertebrate learning, also found in honeybees, is blocking: rewarded experience with stimulus A (+) followed by rewarded experience with a compound of A and B (AB+) appears to 'block' learning about stimulus B. Recently, studies with humans have uncovered 'backward blocking;' experience with A+ following experience with AB+ also appears to block learning about B. The current experiments were designed to investigate the possibility that backward blocking might be found in honeybees as well, suggesting a simple associative explanation of the effect. In two experiments, free-flying honeybees were trained to forage at a laboratory window for sucrose placed on targets labeled with odors. In the first experiment, responding to odor B after AB+ training was less in the groups that were also given A+ training than in the control groups, whether A preceded, followed, or was concurrent with the AB+ training. In the second experiment, responding to B was less when the AB+ training was followed by A+ training than when it was followed by A- training. These results provide evidence not only of forward blocking, but also of backward blocking in honeybees, a phenomenon that contradicts the results of parallel experiments on within-compound association in honeybees. The same contradiction is to be found in the literature of vertebrate learning.

(Co-authors: Dr. P.A. Couvillon and Dr. M.E. Bitterman)

Michael J. Boyle, Department of Zoology
(Advisor: Elaine Seaver)

ISOLATION AND CHARACTERIZATION OF ACROSOMAL PROTEINS FROM THE POLYCHAETE *EUDISTYLIA*
(Biological Sciences, Humboldt State University)

Marine invertebrates that reproduce by spawning rely upon gamete surface proteins to recognize conspecific gametes for fertilization. By mediating species-specific fertilization, these proteins define reproductive compatibility. Gamete recognition proteins (GRPs) and their genes have previously been studied in echinoderms (E. C. Metz, and S. R. Palumbi, *Mol. Biol.***13**, 397-406, 1996) and mollusks (V. D. Vacquier, *Science.* **281**, 1995-1998, 1998). We have begun characterization of GRPs from marine polychaete annelids, opening this diverse group (~10,000 species) for the first time to comparative studies on the molecular evolution of fertilization. Gametes were surgically removed and brief sonication physically separated sperm nuclei from acrosomes; enrichment for either was not achieved. Whole sperm proteins were separated by SDS-PAGE. *Eudistylia* sperm contain large acrosomal vesicles that distinctly labeled with Fluorescamine (free amino group label); sperm nuclei distinctly labeled with DAPI (nucleic acid label). Insoluble acrosomal "gum-like" material, collected and labeled with Fluorescamine, was only solubilized in 4-8M urea or 10% SDS. Hypoosmotic treatment produced acrosomal "ring" structures attached on whole sperm that labeled with Fluorescamine. We found that the major component of *Eudistylia* acrosomes is highly insoluble, basic protein. These proteins could not be resolved using SDS-PAGE, and we plan to isolate and characterize acrosomal "gum" using acid-urea gels. *Eudistylia* is an ideal model system for research on GRPs and a variety of techniques will be used to access the gene(s) and studies of its molecular evolution.

(Project was directed by Ed C. Metz and funded by the Howard Hughes Medical Institute).

Jennifer Brum, Department of Oceanography
(Advisor: Grieg Steward)

CONCENTRATION, PRODUCTION, AND TURNOVER OF VIRUSES AND DISSOLVED DNA AT STATION ALOHA

A newly developed centrifugal concentration method for quantification of dissolved DNA (D-DNA) was used to study the composition and production of the D-DNA pool, including viruses, in a depth profile at Station ALOHA in the subtropical North Pacific Gyre. D-DNA within viruses comprised 49-63% of the D-DNA pool and the remaining D-DNA was hydrolyzable by deoxyribonuclease (termed free D-DNA). The turnover time of free D-DNA in the upper water column ranged from 0.97 to 6.2 h, 3 to 10 times faster than the turnover of DNA within viruses. Based on virus production rates, viruses were estimated to lyse 3.2-16.5% of the standing stock of bacteria at Station ALOHA per hour, resulting in the release of free D-DNA which was estimated to be 11-35% of the total free D-DNA production. This research supports the hypothesis that individual components of the D-DNA pool are cycled at different rates and shows that viruses in open-ocean gyre systems may have large impacts on the microbial community there, including viral-induced mortality and subsequent release of cellular contents to the DOM pool.

David R. Bybee, Department of Zoology
(Advisor: Julie Bailey-Brock)

SPAWNING PERIODICITY AND GAMETOGENESIS OF THE FAN WORM *SABELLASTARTE SPECTABILIS*

The sabellid polychaete *Sabellastarte spectabilis* occurs in calm, protected waters throughout Hawai'i. There is very little published information on the biology of this fan worm, which is now in high demand for the marine ornamental trade. Understanding the reproductive biology of *S. spectabilis* will help to facilitate aquaculture of this polychaete. It will also benefit coral reef conservation by decreasing destructive collecting practices. Spawning periodicity and gametogenesis were investigated over a one-year period. Twenty-five worms were collected from Kaneohe bay each month. Seven-millimeter sections of preserved worms were mounted on glass slides and stained using histological techniques. Gametes appear to be limited to abdominal segments and absent in the thorax. Oogenesis is extraovarian. Primary oocytes are released into the coelom early in gametogenesis where they will under go vitellogenesis and a drastic increase in size before spawning occurs. Spermatogenesis also occurs in the coelom where spermatocytes are released and undergo development, which involves a decrease in size. Oocytes were arranged into maturation stages (previtellogenic and post vitellogenic). Changes in the mean number of mature oocytes, and presence or absence of sperm were compared with seasonal changes in water temperature and day length. Gamete development and observed spawning coincided broadly with changing water temperatures.

Christine Byrum, Department of Zoology
(Advisor: Athula Wikramanayake)

SECRETS OF AMAZING GUTLESS SEA URCHIN EMBRYOS!

Studies in frogs, zebrafish, and flies have shown that the cytoplasmic protein Dishevelled (Dsh) plays a key role in non-canonical Wnt signaling and that it is necessary for convergent extension during vertebrate gastrulation. Dsh has three important binding domains: DIX, PDZ, and DEP. Overexpression of Dsh-DEP is known to block gastrulation in vertebrates and, as expected, we found that it also prevented gastrulation in the sea urchins *Lytechinus variegatus, L. pictus, Strongylocentrotus purpuratus.* Dsh-DEP embryos are hollow and blastula-like, but also produce mesenchyme-like cells. The Dsh-DEP phenotype differs depending on the Dsh-DEP mRNA concentration. At highest concentrations, embryos are mostly hollow. At mid concentrations they remain hollow, but tend to contain more mesen chyme-like cells, and, at lower concentrations, they are radial. Not only do Dsh-DEP embryos fail to gastrulate, they also lack expression of Endo1 (an endodermal marker) and, many of the mesenchyme-like cells do not express 1d5 (a marker of differentiated 1° mesenchyme). Because protein expression differed in Dsh-DEP embryos, we used RT-PCR to test whether Dsh-DEP embryos transcribe different forms of mRNA and found that levels of Brachyury and Delta are reduced in Dsh-DEP embryos. Since transcription of these products is also reduced in Wnt8 MO embryos, we then tested whether Wnt8 acts upstream or downstream of the blocked non-canonical Wnt pathway. Our results indicate that the non-canonical Wnt pathway lies downstream of Wnt8.

Tim Clark, Department of Zoology
(Advisor: Kim Holland)

REMOTE TRACKING OF THE MANTA RAY (*MANTA BIROSTRIS*) IN HAWAII

The manta ray has come under increasing threats in the last four years due to a demand for dried manta ray gill filaments for a medicinal market in China. Given the long life, late maturity, and low fecundity of mantas, populations are highly susceptible to over-fishing unless the population being fished is very large. Acoustic tags were placed on twenty-eight mantas on the Big Island and Maui to investigate the home range of mantas in Hawaii. Tagged mantas were remotely tracked via an array of acoustic receivers along the Kona coast of the Big Island and on Maui. To date, no manta has been recorded migrating between the two islands. On the Big Island, tagged manta rays were detected along a 15 km stretch of coastline in over 80% of detections, with only occasional detections outside of this key area. Two locations where mantas showed exceptionally strong site fidelity are a known feeding area and a cleaning station. These data suggest that manta rays have a closed population in Hawaii, with little or no migration between neighboring islands.

Tamar Saturen Cunha, Department of Zoology
(Advisor: John Stimson)

SEA URCHIN DIET AND ITS POSSIBLE ROLE IN DEFENSE AGAINST PREDATION

(Hawaii Institute of Marine Biology)

After fish, sea urchins are the most visible herbivores on coral reefs. The collector urchin (*Tripneustes gratilla*) is a generalist, consuming an average of about 14 grams of algae per day. In laboratory tests, *T. gratilla* showed little difference in consumption rates for several macroscopic algae (non-native: *Acanthophora spicifera, Gracilaria salicornia, Kappaphycus* sp and native: *Dictyosphaeria cavernosa, Padina japonica*), though it ate the smallest amount of *Kappaphycus* sp (an average of 7.5 g. vs. 13-19 g. of other species). When given two-option preference tests, subjects unexpectedly showed preferences for all choices over *Dictyosphaeria cavernosa* ($p < 0.01$), including *Kappaphycus* sp. In a third test, urchins were found to prefer macroscopic algae over rocks with turf algae, though most of the differences were not significant. This is not surprising, since *T. gratilla* are browsers and do not scrape the hard substrate to get to finer, filamentous algae like grazing urchins.

From the studies outlined above, and other published data, we see that *T. gratilla* are generalist herbivores. Many algae produce chemical defenses and those compounds vary between and within species. One important question is: how do the urchins biochemically handle this variance? *T. gratilla* are often found out in the open on coral reefs and are active during the hay, yet they seem to have few predators. I hypothesize that they avoid predation because they are unpalatable due to chemicals absorbed from the algae they have eaten. An analysis of various urchin tissues will show whether the urchins are able to sequester any of the algal compounds to make them less palatable food for potential predators.

Toby S. Daly-Engel, Department of Zoology
(Advisor: Kim Holland)

POPULATION ECOLOGY OF THE SANDBAR SHARK (*CARCHARHINUS PLUMBEUS*) IN HAWAII

(Hawaii Institute of Marine Biology)

Fisheries have been established for the sandbar shark, *Carcharhinus plumbeus*, in almost every location in which they are found except Hawaii. Few of these regions place restrictions on their annual take, resulting in overfishing. In the Western Atlantic, sandbar sharks have endured a population crash and are still being overfished. Because of their k-selected life history, these sharks are highly vulnerable to population depletion through overfishing. The sandbar shark in Hawaii presents a unique opportunity to gather pre-exploitation data on a population that is highly vulnerable to bottleneck. In this study, data will be gathered on the movement patterns, relative abundance, and size class distributions of sandbar sharks around the main Hawaiian Islands using tracking and tag-and-release. Also, the Hawaiian sandbar's genetic relatedness to the population in the Western Atlantic will be examined using mitochondrial and microsatellite DNA analysis. Because they are coastal sharks that have not demonstrated mid-ocean or transoceanic movements, it is unlikely that migration and gene flow are occurring between the Hawaiian and Atlantic populations. In addition, preliminary evidence shows marked differences in the life-history strategies of these two groups, differences that will be examined and documented in the proposed study. I hypothesize that the two populations have diverged genetically as well as behaviorally, and that this genetic dissimilarity will be borne out through testing. If the Hawaiian sandbar sharks are genetically distinct from other populations, it will help make a case for their protection should they become a target for commercial fishing. It is the goal of this study to contribute to the preservation of the sandbar shark in Hawaii and elsewhere by expanding the body of knowledge on this species and thereby facilitating conservation efforts.

Gayla Ivey, Department of Zoology
(Advisor: Kim Holland)

MOVEMENTS AND HABITAT UTILIZATION OF *OCTOPUS CYANEA* IN KANEOHE BAY, HAWAII

(Hawaii Institute of Marine Biology)

Octopus cyanea is the basis of an important artisinal fishery in Hawaiian waters and is by far the largest harvest component taken in Kaneohe Bay. However, very little of the basic behavioral and ecological data are available to assess the impact and sustainability of this fishery or to formulate appropriate management methods. For example, very little data exists on the home ranges, site fidelity and habitat requirements of *O. cyanea.* This project aims to address this lack of data by developing and employing ultrasonic telemetry techniques to describe the movement patterns of *O. cyanea* individuals in Kaneohe Bay. Laboratory investigations have led to a novel method of transmitter attachment for octopuses that allows for reliable retention of the transmitter for between 6 and 14 days while having negligible effects on their movements. Two preliminary trials have demonstrated the practicality of these methods in the field. Future field investigations address the following questions: What are the daily movement patterns and home range sizes of *Octopus cyanea* in Kaneohe Bay? How are the observed movement patterns correlated to habitat or substrate type, and what benthic organisms are associated with those substrates? What are the den occupancy patterns of *O. cyanea* in Kaneohe Bay, and what degree of site fidelity is exhibited? The results of field investigations will be analyzed in the context of existing data on *O. cyanea* life history and bioenergetics and of the Kaneohe Bay fishery to form conclusions about the appropriateness and design of a marine reserve as a management tool for this fishery.

Danielle Jayewardene, Department of Zoology
(Advisor: Charles Birkeland)

LARVAL SUPPLY MAY NOT ALWAYS BE KEY TO RECRUITMENT

Newly settled coral spat of *Pocillopora damicornis* were experimentally set out using terracotta tiles on the subtidal reef at Hanauma Bay, a marine protected area. Although spat on vertically placed tiles survived better than on horizontal tiles, overall survival of newly settled spat was low. This is because of the deposition of fine sand by turbulent waters smothering the juveniles on the tiles. This prevents successful larval recruitment from being prevalent at Hanauma Bay. Only 1.5% of the coral colonies have originated from sexual reproduction, while the great majority of small corals are asexual remnants of larger colonies. However, in terms of "genets" (genetic units), the sexually reproduced colonies outnumbered the clones. When defining sexual recruits as colonies less than 5 cm in diameter, it matches our poor survival on tiles that only 0.1% out of the total calculated colonies were recruits. Much of the research these days is focused on the connectivity of reefs by the dispersion of larvae, but it may be the case that larval recruitment is sometimes a small component of reproduction, even in some of the best coral reefs.

Sam Kahng, Department of Oceanography
(Advisor: Richard W. Grigg)

THE ECOLOGY AND IMPACT OF AN ALIEN, INVASIVE OCTOCORAL IN HAWAII

In 2001, a deep water survey of the Maui Black Coral beds discovered a large percentage of black coral colonies overgrown and smothered by an alien soft coral, *Carijoa riisei*. Until this time, *C. riisei* was considered a relatively benign introduction colonizing underutilized habitat in shallow-waters. In fact, very few introduced marine invertebrates are known to proliferate on coral reef communities, and the process of invasion on coral reef communities is poorly understood. A 2003 follow-up investigation confirmed that *C. riisei* was readily killing black corals (*Antipathes dichotoma, A. grandis*), proliferating at depth, and overgrowing large beds of plate corals (*Leptoseris sp.*). Relative abundance and distribution of *C. riisei* was compiled from submersible and ROV video data to quantify the ecological impact at depth. The data and observations suggest that the probability of *C. riisei* settlement and overgrowth on black corals increases with time and may be facilitated by other epifauna. The result is that the reproductively mature colonies are differentially being killed. Despite it emerging notoriety, little is known about *C. riisei's* ecology including its reproductive characteristics. Preliminary results from time series analysis of gonad development of tagged colonies reveal that *C. riisei* is highly fecund and capable of continuously seeding the water column with larvae. While *C. riisei* exhibits common soft coral reproductive characteristics, it also exhibits a regular incidence of simultaneous hermaphroditism – extremely rare in octocorals. Together with analysis of *C. riisei's* other life history traits and regional ecology, an integrated picture is emerging of a successful invader in a susceptible ecosystem.

Han Lee, Department of Zoology
(Advisor: Julie H. Bailey-Brock)

TEMPORAL CHANGES IN THE INFAUNAL COMMUNITY SURROUNDING A HAWAIIAN MARICULTURE OPERATION

Repeated benthic biomonitoring efforts in the vicinity of a Pacific Threadfin, *Polydactylis sexfilis*, mariculture venture has allowed us to examine eutrophic effects on the infaunal community. Polychaete infaunal communities from two sites near the point source were compared to reference stations beyond the range of fish feed and wastes. Increasing abundances of two opportunistic polychaetes, *Capitella capitata* and *Ophryotrocha adherens* resulted in decreasing Shannon-Weiner diversity values at affected stations. High nematode abundances, low redox potentials, and low amphipod abundance concur with the presence of polychaete pollution indicators, low species richness and abundance in illustrating the mounting effects of fish mariculture on the south shore of O'ahu, Hawai'i.

David Q. Matus, Department of Zoology
(Advisor: Mark Q. Martindale)

METAZOAN HOX GENE EVOLUTION AND THE PHYLOGENETIC POSITION OF THE CHAETOGNATHS
(Kewalo Marine Laboratory / PBRC)

We are interested in the evolution of anterior/posterior axial patterning and body plan formation throughout the Metazoa. Using a degenerate PCR approach, we have isolated developmental regulatory genes involved in axial patterning from the pelagic chaetognath, *Flaccisagitta enflata*. These include 10 members of the Hox family and a ParaHox gene. Hox genes are developmental regulatory genes involved in body plan formation and are believed to have diversified before the last common bilaterian ancestor. Chaetognaths, or arrow worms, are marine animals that are ubiquitous and abundant members of oceanic zooplankton communities, yet their phylogenetic position within the Metazoa has remained enigmatic since Darwin's time. They possess a suite of morphological and developmental characters that have made resolving their phylogenetic affinity within the Metazoa difficult utilizing traditional methodologies. However, recent molecular evidence that I have generated from structural and developmental regulatory genes suggests that they may occupy a basal position within the protostomes. Yet the presence of many deuterostome-like characteristics (holoblastic radial cleavage, enterocoely, a tripartite coelomic arrangement, a post-anal tail, and a presumed posterior fate of the blastopore) suggests that their origins may lie even more basal to the protostome/deuterostome divergence. The study of developmental regulatory genes within this potential basal bilaterian will shed new light onto the evolution of animal body plans and axes formation at the base of the Bilateria.

Andrew McClung, Department of Zoology
(Advisor: Sheila Conant)

PROJECTED EFFECTS OF AN ALIEN PLANT INVASION ON AN ENDANGERED NORTHWEST HAWAIIAN ISLANDS PASSERINE BIRD, THE LAYSAN FINCH (*TELESPIZA CANTANS*)

Efforts to maintain diversity and minimize human contributions to extinction are challenged by propagation of alien species into new habitats. Absent typical regulating mechanisms, colonists can degrade habitat and increase extinction risk for native species. Population viability analysis (PVA) provides a way to assess extinction risk and the relative value of management actions. This study applied a count-based PVA method to a translocated population of the Laysan finch (*Telespiza cantans*), a federally listed endangered endemic passerine, at Southeast Island, Pearl and Hermes Reef. Density dependence form and magnitude were assessed by nonlinear regression of population size time series data, which also provided parameter value estimates. Demographic stochasticity and environmental autocorrelation in growth rates were not found to be significant, but a sampling error adjustment was used to reduce spurious inflation of growth rate variance. A stochastic version of the Ricker logistic model of popuation growth was simulated to obtain the extinction time cumulative distribution function for pre- and post-invasion periods. The simulation projects low extinction risk at PHR, and a surpising reduction in risk due to the increase in carrying capacity associated with the weed invasion. However, stochastic demographic matrix (SDM) models and VORTEX PVA suggest much higher extinction risk. All three modeling methods provide limited precision due to the amount and quality of time series and demographic data, and all populations remain vulnerable to biotic invasions and effects of climate change.

Sarah McTee, Department of Zoology
(Advisors: James Parrish and Charles Birkeland)

ALGAL TERRITORIES OF DAMSELFISH: ARE THEY A THREAT TO THE LONG-TERM PERSISTENCE OF A REEF?

Within the national park on Ofu, American Samoa, *Stegastes nigricans* and *Stegastes albifasciatus* have established, and effectively defend, algal "gardens" within various expanses of *Acropora donei.* The ongoing presence of algae in this area led to the concern that damselfish territories may negatively affect the long-term persistence of Ofu's reefs. Consequently, this study was designed to determine if damselfish territories, by facilitating the establishment of invertebrate bioeroders, significantly affect the structural integrity of the reef within the national park. *Acropora donei* within and outside of *Stegastes* territories was examined for relative amounts of bioerosion, as well as overall abundance and taxonomic composition of invertebrate bioeroders. Bioeroders were almost three times more abundant in *A. donei* located inside *Stegastes* territories than outside. Despite the greater abundance of bioeroders within territories, the amount of bioerosion was not significantly different than that outside of territories. Within *Stegastes* territories the number of bioeroding invertebrates was significantly greater in branches from the center than from the edge of territories. Suprisingly, the relative amount of bioerosion in branches collected from the center was not significantly different than those from the edges. Although *Stegastes* algal gardens significantly increase the number of invertebrate bioeroders in the coral substrate, at present, it does not appear that damselfish territories significantly alter the structure or stability of the reef system in American Samoa.

Teresa Restom, Department of Botany
(Advisor: Guillermo Goldstein)

PATTERNS OF WATER UPTAKE AND TRANSPIRATION BY FOREST PLANTATIONS.

Alien tree plantations were introduced to Hawaii in the first half of the 20th century to reduce the hydrological impacts that intensive sandalwood extraction and cattle ranching had caused on the watersheds in the 1800s. Since their introduction, the impact of tree plantations on the hydrological cycle of these ecosystems has not been evaluated. The overall goal of this project is to estimate the potential of these plantations to recharge groundwater in the mesic watershed of Honouliuli, Oahu. This study focuses on the transpiration patterns and rates, depth of water uptake, and leaf area and soil moisture dynamics of forests dominated by three different alien species: *Eucalyptus robusta*, *Fraxinus uhdei*, and *Casuarina glauca.* The objectives are to assess differences in water uptake and transpiration of different species and their effect on whole stand water use. Depth of water uptake, leaf area index (LAI), rainfall, soil moisture, and tree sap flow were measured in one stand dominated by each species between August 1998 and March 2002. A long period of drought was observed between January 2000 and October 2001. After rainfall levels increased, the *F. uhdei* stand exhibited higher soil moisture and faster recovery of LAI than the other two stands. The stand dominated by *E. robusta* had the slowest LAI recovery but the fastest recovery in sap flow. In the *C. glauca* stand, soil moisture and sap flow remained low four months after the end of the drought, indicating that *C. glauca* was less adapted to drought than the other species, probably due to its shallow water uptake and low soil infiltration rates. These characteristics resulted in highest transpiration rates in the stand dominated by *E. robusta* and lowest in the stand dominated by *C. glauca*, supporting the hypothesis that forest hydrology is influenced by species composition.

Pedro Afonso-Santos, Department of Zoology
(Advisor: Kim Holland)

DISTRIBUTION, REPRODUCTION AND MOVEMENTS OF PARROTFISH IN THE AZORES

(Department of Oceanography and Fisheries,
University of the Azores)

The parrotfish, *Sparisoma cretense,* sustains a growing gill-net fishery around the islands of the Azores, north-east Atlantic. However, little is known about its life history and population dynamics. We conducted underwater visual census, biology and acoustic telemetry studies in order to know their distribution, reproduction and space use. Parrotfish are abundant around the islands (7 +/- 12 fish per 250 m^2 transect) and occur in a wide variety of habitats, with a peak in abundance around 10 to 15 meter depth. Size composition varied along the archipelago, with larger individuals being more abundant in those islands with less fishing pressure. Reproduction takes place from July to September. During this period, individuals are either territorial, with males forming harems in hydrodynamic coastlines, or they school and spend most of their time in sheltered bays, but they both gather in the territorial areas during early morning when spawning takes place. Therefore, two different social and reproductive strategies seem to coexist in the population. Adult parrotfish display typically small home ranges and information obtained so far indicates high site fidelity and reduced dispersion. Our results indicate that the netting fishery, which operates in sheltered coasts, might be impacting considerably parrotfish populations and selectively removing larger and schooling fishes. We argue that adequately enforced marine reserves of small to medium size might effectively protect core populations of this species within boundaries if they include connected habitats.

(With Telmo Morato, Jorge Fontes, Kim Holland and Ricardo Serrao-Santos)

Brett Schumacher, Department of Zoology
(Advisor: James Parrish)

MOVEMENT PATTERNS OF THE INTRODUCED SNAPPER *LUTJANUS KASMIRA* AND NATIVE GOATFISHES IN HAWAI'I

Anecdotal reports from commercial and recreational fishers in Hawai'i indicate that catches and population sizes of some native reef fish may have declined since the blue-line snapper, *Lutjanus kasmira* (Family: Lutjanidae), was introduced in the mid-1950's. This correlation led to the popular, though *a priori*, assertion that *L. kasmira* was responsible for these declines through competitive or predatory interactions with native fishes. The present study focused on identifying evidence of potential competitive interactions functioning through spatial and temporal overlap between *L. kasmira* and three species of native goatfish (Family: Mullidae: *Mulloidichthys flavolineatus*, *M. vanicolensis* and *Parupeneus multifasciatus*) at well-established coral reefs sites off the south shore of O'ahu, Hawai'i. Acoustic transmitters were surgically implanted in specimens of each species, and their movements monitored either from a surface vessel or by remote receivers placed in selected habitat areas. Results indicate that *L. kasmira* overlaps spatially with all of the species in this study to some degree. Data from remote monitors also suggest that site fidelity to resting areas may be greater than to feeding areas. Further investigations into spatio-temporal relationships and dietary interactions will continue to clarify these potential competitive and predator-prey relationships, and help to interpret their ecological importance.

Lance Smith, Hawai'i Cooperative Fishery Research Unit,
Department of Zoology
(Advisor: Chuck Birkeland)

IDENTIFYING DETERMINANTS OF RESISTANCE TO HIGH TEMPERATURES: EVIDENCE FROM A CORAL TRANSPLANT EXPERIMENT

Coral reef marine protected areas should include coral colonies and habitats that are resistant to high temperatures so that these areas can provide a basis for coral recovery from bleaching events. Identification of determinants of resistance is a critical step in establishing networks of MPAs that are likely to be most robust in the face of continuing climate change. We conducted a coral transplant experiment in Ofu Lagoon, American Samoa, to test for resistance to high temperatures. The lagoon consists of a series of pools that vary in thermal conditions, with temperatures in some pools reaching 35 °C and fluctuating daily by >6 °C. Yet the pools support diverse coral communities, including many species thought to be sensitive to high temperatures such as *Acropora*, *Pocillopora*, and *Millepora* spp. Nubbins of *Pocillopora damicornis* and *Porites cylindrica* were obtained from the deepest pool, dyed with Alizarin red S for measuring growth, and transplanted to the shallowest pool and a pool intermediate in depth, as well as back into the pool of origin. Water temperatures were recorded hourly at the three sites during the one year period, and other water quality and physical characteristics were studied at the three sites. The shallowest site had the highest daily maximum temperatures, the greatest duration of high temperatures, and the greatest daily fluctuations of temperatures of the three study sites. However, transplants of both species had the highest growth rates at the shallowest site, and *P. damicornis* had the highest survival rate at this site. Water motion and dissolved oxygen levels were higher at the shallowest site than the other two transplant sites, suggesting that one or both of these extrinsic factors enhance the resistance of corals to high temperatures.

Heather Spalding, Department of Botany
(Advisor: Celia Smith)

DEEP THOUGHTS IN MUDDY WATERS: DEEP-WATER MACROALGAE AS WATER CLARITY BIO-INDICATORS? (Moss Landing Marine Laboratories)

Given suitable substrate, light is generally considered the controlling factor limiting macroalgal growth with increasing depth in temperate waters. Any long-term changes in light availability at the lower depth limits of deep-water (30 – 80 m) macroalgal assemblages (DWAAS) could affect their depth distribution, species composition, and/or abundance. Thus, it has been suggested that a temporal comparison of DWAAS could be used to monitor the biological impacts of long-term coastal marine perturbations causing decreased water clarity. To test this hypothesis, the Carmel River in central California was used as a natural turbidity gradient. The lower depth limits and abundance of deep-water macroalgae were surveyed with the ROV *Ventana* at varying distances from the river and compared with 14 other sites unaffected by river output. Diffuse attenuation coefficients were calculated from irradiance profiles at each site. It was hypothesized that sites close to the river mouth would have increased light attenuation and therefore shallower depth limits, compared to sites farther away with decreased light attenuation and lower depth limits. Deep-water macroalgae were less abundant and had shallower depth limits near the river mouth, but surprisingly, there were no significant differences in light attenuation between sites. Decreased macroalgal abundance appeared to be the result of burial from sedimentation, thus masking any possible effects from increased light attenuation. Similar changes were not apparent at ≤ 30 m depths, suggesting deep-water macroalgae may be affected by processes, such as sedimentation, not evident in shallower water.

Alison K. Stimpert, Department of Zoology
(Advisor: Whitlow Au)

DISTRIBUTIONS OF FOUR BALEEN WHALE SPECIES IN THE NORTHWEST ATLANTIC OCEAN BASED ON LARGE-SCALE AERIAL SURVEY DATA

(Northeast Fisheries Science Center, NOAA Fisheries)

Spatial and temporal distributions of baleen whales in the U.S. portion of the Gulf of Maine were derived from sighting data collected during complete, systematic aerial surveys during the spring and early summers of 2001 and 2002. Surveys were conducted according to a randomized systematic sampling scheme, with broadscale survey lines extending from the coast to the Hague line, and from Long Island to northern Maine. Sighting data were analyzed in ArcViewGIS 3.2a, and tests for differences among broadscale series, species, and their interaction were performed using MANOVA on pooled location data. A total of 1084 whale sightings were recorded, and average location among species differed overall (Wilk's lambda 0.894, $p<0.0001$). Using ArcviewGIS, sightings per unit effort (SPUE) values were also calculated for ten-minute cell units based on kilometers of trackline flown in each cell. These values are used to examine relative use of key habitat areas by each species on a seasonal basis. Right and sei whales showed eastward movement from April through July, congregating in early summer on the northern edge of Georges Bank. Humpbacks and fins remained more widely spread throughout the Gulf of Maine, and demonstrated heavier use of Stellwagen Bank than rights and seis. Overlap in preferred prey may be one explanation for sympatric distributions between these pairs of species. Implications of this method and of these data for management are discussed.

(Co-authors: Timothy V.N. Cole, Richard M. Pace III, and Phillip J. Clapham, Northeast Fisheries Science Center. Ackn.: NEFSC Right Whale Aerial Survey Team and Debi Palka.)

Kornelia M. Szauter, Cardiovascular Research Center, JABSOM
(Advisors: Tongyu Cao, Katalin Csiszar)

MAPPING OF A NOVEL GENE MUTATION IN RC MICE THAT RESULTS IN CYCLIC HAIR LOSS AND A POSSIBLE KERATINOCYTE STEM CELL FATE SWITCH

The hair follicles are an ideal model system for studying stem cell fate determination and differentiation. The multipotent keratinocyte stem cells (KSCs) residing in the hair follicles give rise to the sebaceous glands, are responsible for the cyclic growth of the hair follicles, and play a role in epidermal wound healing. KSC fate is determined by the coordinated functioning of several signaling pathways, and alterations in these pathways may result in defects in KSC differentiation. The rough coat mutant mice display phenotypes that suggest a switch in KSC fate. Rough coat (*rc*) is a recessive mutation that arose spontaneously in the C57BL/6 strain at the Jackson Laboratory. The *rc* mice have unkempt hair at weaning age and develop cyclic and progressive hair loss. Histologically, the *rc* phenotype is characterized by follicular atrophy and hypertrophic sebaceous glands. At later stages the mice develop defects in epidermal wound healing. The *rc* was previously mapped on chromosome 9; however, the mutation has not been identified. In this study, we aim to identify the mutation causing the *rc* phenotype. We carried out high resolution linkage analysis using backcross mice, defined and reduced the *rc* interval to 1.1 megabases. We are currently constructing a physical map of the *rc* interval and analyzing candidate genes for mutations. We expect to discover either a novel gene or a novel function of a known gene involved in KSC fate determination.

(Peter Racz, Qing-Ping He, Eszter Pankotai, Ben Fogelgren, Darlene Ramones, Gregory Young)

Nel C. Venzon, Jr., Dartmouth College SURF Program
(Sponsor: George A. O'Toole)

CHARACTERIZATION OF THE ROLE OF SWARMING MOTILITY IN *PSEUDOMONAS AERUGINOSA* BIOFILM DEVELOPMENT

(Dartmouth Medical School)

Pseudomonas aeruginosa, a ubiquitous opportunistic human pathogen, is capable of forming biofilm. Two types of motilities, swimming and twitching, are necessary for biofilm formation in *P. aeruginosa*. However, little is known about the role of swarming, another flagellum-mediated motility, in *P. aeruginosa* biofilm development. In the laboratory, a mutation in the second flagellar motor, mutant *sad*-210, which leads to a strong defect in biofilm formation and swarming motility, had been characterized. In order to find the suppressor mutants able to restore biofilm formation, we built a transposon library in the *sad*-210 genetic background and screened it for a biofilm-plus phenotype. We screened a library of about 6,900 mutants and isolated two candidates, P3F8 and P30H4, for further characterization. These *sad*-210 suppressor mutants, were able to swim, twitch, and form biofilm under static condition on an abiotic surface after 24h, but were deficient in swarming motility. The biofilm architecture status of bacterial cells in a flow-cell system was also further investigated at 4h and 27h post-inoculation using phase-contrast microscopy. Identification and genetic mapping of the two suppressor mutants via arbitrary PCR revealed that the transposons were localized in the genes PA5565 (encoding the glucose-inhibited division protein A) for P3F8, and PA4672 (encoding the peptidyl-tRNA hydrolase) for P30H4. Since P3F8 and P30H4 suppressor mutants were in the *sad*-210 genetic background, their motility phenotypes showed that the second mutation rescued biofilm formation, but not swarming, indicating that both phenotypes may be linked, but indirectly.

(Supported by NSF Grant #9984521)

Chela J. Zabin, Department of Zoology
(Advisor: Andrew Taylor)

BETWEEN HAWAIIAN TIDES: A SURPRISING DIVERSITY IN OAHU'S INTERTIDAL

Hawaii's tidal range is about 1/3 that of California's and in many places wave splash is higher than the highest tide. Perhaps because of this, the prevailing view among scientists seems to be that the intertidal in Hawaii is a species-poor, marginal habitat. As a result, the Hawaiian intertidal has received little scientific study compared to coral reef areas, and even less conservation attention. With no published field guides or species lists to guide us, we surveyed five intertidal sites around the island of Oahu with 54 9th grade students from a public school in Honolulu. Students collected, and with the assistance of graduate students and volunteers from the Bishop Museum, identified over 340 species of macroalgae, fish and invertebrates. Six additional sites were surveyed by one of the authors, bringing the total list of invertebrate species alone to 312. For invertebrates, this level of diversity parallels that from several mainland West Coast sites, and is undoubtedly an underestimate of the actual diversity. Endemism was in line with or higher than levels reported for subtidal species, and numbers of invasive species were also high compared with rocky intertidal systems elsewhere. Juveniles of several reef fish species were found in tide pools, illustrating a link between the intertidal zone and the reef. Student projects this year will include quantitative counts, surveys of new sites, and an attempt to quantify human impacts in the intertidal zone.

(Erin P. Baumgartner, Curriculum Research and Development Group, University of Hawaii, Manoa, and Dawn N. Adams, Botany Department, University of Hawaii)

Kanesa Duncan, Department of Zoology
(Advisor: Kim Holland)

POPULATION BIOLOGY OF SCALLOPED HAMMERHEAD SHARKS (*SPHYRNA LEWINI*) IN THEIR NURSERY GROUNDS
(Hawaii Institute of Marine Biology)

Nursery use is common to many species of sharks and represents a link between open ocean and coastal energy systems. Like other large sharks, scalloped hammerheads (*Sphyrna lewini*) use nurseries throughout their range. The annual influx of newborn pups provides a large amount of biomass to the nursery, but pups also act as apex predators, seasonally dominating vertebrate biomass and consuming large quantities of food. Their role in the nursery's trophic ecology was quantified by combining estimates of population size, survivorship, residence time, and movement patterns with previously published energetic and food consumption data. Shark pups were found in the bay throughout the year, with highest catch rates in the deeper mud-silt habitat and highest population densities in mid summer. While some sharks moved over 5km in a single day, most sharks were recaptured close to the initial point of release and within the expected activity range for this species, suggesting behavioral retention within the bay. Approximately 7698 + 2240 sharks are born into Kaneohe Bay each summer. Shark pups grow slowly in their first few months after birth and there is a significant trend toward lower fitness in late summer and fall, followed by increased growth rates during the winter. Mortality is as high as 90.6%, but sharks that survive tend to remain within the nursery for at least a year. Even with this long residency time there is a positive influx of energy into the nursery. Thus, Kaneohe may serve more as protection from predators than a place of easy foraging. Whether this is a common nursery theme or an artifact can be determined by examining other nursery sites and testing hypotheses of historic nursery use and related genetic lineages.

Claudia Farfán, Department of Zoology
(Advisor: H. G. de Couet)

ISOLATION, CHARACTERIZATION AND EXPRESSION OF THE *EUPRYMNA SCOLOPES APTEROUS* GENE.

The gene *apterous* (*ap*) is best known for its fundamental role as dorsal selector gene required for wing patterning and wing growth in *Drosophila melanogaster*, but *ap* also have other important functions for neuronal pathfinding and fasciculation, fertility and normal viability of the fruit fly. *ap* encodes a protein of the LIM-homoedomain subfamily. Many transcription factors of this class have been conserved during evolution, however in most cases it is not know whether structurally related genes play similar roles in different organisms.

In this work I report the isolation, characterization and expression of the *Euprymna scolopes apterous* homolog (*Esc-ap*). The isolation was carried out by RT-PCR and RACE techniques. Expression patterns were analyzed by whole mount *in situ* hybridization.

The *Esc- ap* is a composite full-length cDNA sequence 1728 bp long with a predicted ORF encoding a predicted protein with 424 amino acid residues. This is the first time a full-length cDNA for the *ap* gene is described for a mollusc or any other lophotrochozoan.

Esc-ap expression was detected in the earliest embryonic stage examined, stage 21, and it was found in the eye placodes. By stage 24-25 high levels were found in the eye retina and all major ganglia of the central and peripherial nervous systems (CNS and PNS). In arms and tentacles expression was confined to the interbrachial nerves and base of the suckers. In older stages *Esc-ap* was downregulated or lost. These results suggests that *Esc-ap* is not involved in the patterning and/or growth of the brachial crown, but has a major role in eye development, and in both CNS and PNS development during the phase of most intensive ganglionic growth and neuropil formation.

Anuschka Faucci, Department of Zoology
(Advisor: Michael G. Hadfield)

PHYLOGEOGRAPHY OF VERMETIDS IN HAWAII
(Kewalo Marine Laboratory)

High dispersal is a common feature of marine organisms. Population genetic data can be used as an indirect measure of dispersal, because the variation in the distance that larvae are transported, and subsequently gene flow, result in characteristic genetic patterns. Studies correlating genetic differentiation with life history traits like dispersal ability have shown that, in general, high dispersal potential is associated with lack of genetic differentiation among populations. However, there are exceptions to this simple rule due to case specific biological and physical reasons. Vermetids are sessile, suspension-feeding gastropods found in shallow marine waters. They show a wide range of developmental patterns from obligate, pelagic planktotrophic larvae, which reside in the plankton for several weeks, to species with directly developing benthic juveniles, which lack a planktonic phase. The Vermetidae in Hawaii comprise nine species in the four major vermetid genera. Most species are locally abundant and distributed throughout the coastal waters of the Hawaiian Islands. A 569-base pair region of the mitochondrial cytochrome oxidase I (COI) gene was sequenced for the nine species from most Hawaiian Islands, including the Northwestern Hawaiian Islands. Neighbor-joining, maximum-likelihood, and maximum-parsimony trees were produced. Preliminary data for three species with direct development (crawl-away juveniles), *Dendropoma gregaria, D. platypus, and D. rhyssoconcha,* show highly structured populations throughout the Hawaiian Archipelago, suggesting very limited to no dispersal among islands. Furthermore, the vermetids appear to have colonized the Hawaiian Islands via the hypothesized French Frigate Shoals-Johnston Atoll connection, with a subsequent rapid radiation into the remainder of the Archipelago.

Orou G. Gaoué, Department of Botany
(Advisor: Tamara Ticktin)

ASSESSING THE IMPACT OF NON TIMBER FOREST PRODUCTS HARVEST ON AFRICAN DRY ZONE MAHOGANY

Despite the importance of non timber forest products (NTFPs) for indigenous people as well as in international markets, the impact of their extraction has been overlooked by many scholars. Although NTFP extraction has been considered *a priori* sustainable, several lines of evidence suggest the contrary. The different uses of *Khaya senegalensis* (African dry zone mahogany) by indigenous people in Benin (West Africa) provide an interesting case study to investigate the ecological impacts of NTFP harvest in tropical Africa using demographic as well as molecular genetic approaches. *K. senegalensis* is one of the rare fodder sources used by *Fulani* tribe to feed their livestock during the dry season. Dry season pruning pressure is so high that many trees fail to produce flower and fruit. This severely affects the regeneration capacity of populations. The rare seedlings that emerge from this harsh system are subject to fire and indiscriminate grazing, which constitute challenging factors for survival. Debarking for medicinal purposes along with the uncontrolled and illegal logging of the best trees, are serious additional threats for the long-term survival of *Khaya* populations. To test for NTFP harvesting impacts on populations, they should be classified not only on the basis of present harvesting intensity but also on harvesting histories and techniques. In this study, to assess the impact of bark and foliage harvest on *K. senegalensis* populations dynamics, I will compare the values of the stochastic growth rate (λ_s), extinction probabilities and vital rates among three groups of six populations with different harvest intensities and histories. I will also compare the genetic heterozygosity and differentiation parameters among the same groups of populations to test the impact of harvest on the genetic diversity.

Ken Hayes, Department of Zoology
(Advisor: Rob Cowie)

PHYLOGEOGRAPHY AND EVOLUTION OF THE FLORIDA CROWN CONCH (*MELONGENA CORONA*).

(Department of Biology, University of South Florida)

Snails of the *Melongena corona* species group are predatory marine gastropods that inhabit sheltered, typically estuarine, embayments from Little Lagoon Alabama in the west to Matanzas Inlet on the east coast of Florida. Current taxonomic designations for the group are based predominantly on shell shape, color, spination, and geographic distribution. Shell morphology in gastropods may be phenotypically plastic and readily affected by changes in environmental conditions (e.g. temperature, salinity, wave action, predation, diet, etc.). Extraordinary phenotypic plasticity within this group makes it difficult to clarify the relationships within and among populations of *Melongena* using only shell morphology. Additionally, *Melongena* is a case where populations of a highly philopatric species lives in discrete habitats separated by uninhabitable areas. Under this scenario, it is possible for large numbers of genetically distinct but ecologically similar populations to develop, and conceivably become reproductively isolated over time. To better evaluate the phylogenetic relationships within this group, fragments of the 16s and COI mtDNA genes were sequenced and compared from all putative species within the genus. Furthermore, individuals from 19 populations have been genotyped at eight microsatellite loci. Phylogenetic analyses completed with these data provide no support for the putative species designations within this group and suggest that the corona complex is composed of a single polymorphic species. Furthermore, microsatellite data reveal population structure consistent with restricted gene flow between extant populations and phylogeography heavily influenced by historical sea-level fluctuations during the Late Pleistocene.

(Stephen A. Karl – Co-Author)

Ken Hayes, Department of Zoology
(Advisor: Rob Cowie)

SYSTEMATICS, PHYLOGEOGRAPHY AND EVOLUTION OF APPLE SNAILS (*POMACEA* SPP.)

The freshwater apple snail genus *Pomacea* (family Ampullariidae) has a native range covering most of South and Central America and the southeastern U.S. *Pomacea* spp. have been introduced widely in southern and eastern Asia, Hawaii and other Pacific islands, and elsewhere in the mainland U.S. In their introduced ranges they have become major pests of wetland crops, notably rice and to a lesser extent taro. The taxonomic identity and precise geographic origins of the pest species are, however, not well understood. Without this knowledge it is difficult to develop effective pest management programs (including searching for biocontrol agents). This lack of understanding also has implications for research involving many other aspects of apple snail biology. Ampullariids are a major component of native freshwater diversity throughout the tropics and subtropics. *Pomacea*, with 117 recognized species, is the largest genus. As such, *Pomacea* spp. are important from a number of perspectives, including ecosystem and human health (as vectors of human parasites), and they offer a valuable model for investigation of Neotropical biogeography. As part of a systematic revision of the genus *Pomacea* we are using DNA sequence data to develop a phylogenetic basis for hypotheses of the evolution of freshwater biodiversity in the Neotropics. To date, the mitochondrial COI gene has been sequenced from 34 snails including at least three species groups within the genus *Pomacea.* Also, four nuclear loci (ITS2, H3, ATPSα & β introns) and one mitochondrial gene (16S) have been sequenced for at least two individuals in several species. The preliminary results support the hypothesis that *Pomacea* (probably *P. canaliculata*) was introduced into SE Asia from Argentina, and that the introduced apple snail in Sri Lanka is *Pomacea bridgesii.*

Aaron Hebshi, Department of Zoology
(Advisor: David Duffy)

FOOD LIMITATION IN THE TROPICS: STARVATION EVENTS OF WEDGE-TAILED SHEARWATER CHICKS INDICATE THE ABILITY OF FOOD TO REGULATE REPRODUCTIVE RATES IN SEABIRDS

Previous studies have suggested that food availability, at least in non- El Niño years, does not regulate populations of open-ocean tropical seabirds. This supposition has been advanced by studies showing the wide variety of prey taken by topical seabirds, and by studies showing that adults can easily increase food delivery when their brood numbers are manipulated. This study documents food shortage in Hawaiian Wedge-tailed Shearwaters (*Puffinus pacificus*) in two of the three breeding seasons studied. Chick growth rates showed significant negative anomalies during a two-three week period in August 2000 ($F_{1,15} = 18.55$; $P < .0001$) and a two-week period in September 2003 ($F_{1,13} = 15.8$; $P < .0005$). In addition, weekly mortality rates during these periods ranged up to 14% against a background mortality rate of 1-2%. Wedge-tailed Shearwaters depend heavily upon skipjack tuna (*Katsuwonus pelamis*), which drive prey up to the ocean's surface. Food shortages likely correspond to temporary reductions of foraging skipjack tuna within the shearwaters' foraging range.

Jennifer Hoof, Department of Botany
(Advisor: David Webb)

COMPARISON OF TWO *METROSIDEROS POLYMORPHA* (GAUD.) VARIETIES AT A HIGH ALTITUDE SITE ON MAUNA LOA, HAWAI'I

Metrosideros polymorpha (Ohia lehua) is a major component of native Hawaiian forests. It can be found from sea level to the tree line, and it is capable of growing in very extreme environments like recent lava flows, mountain bogs, and high altitudes. It has a highly variable morphology in terms of leaf size, shape, coloration, and pubescence. While pubescent and glabrous leaved varieties can be found sympatrically, pubescent leaves typify leaf morphology of high altitude plants while glabrous plants are characteristically found at middle altitudes and moderate climates. Glabrous plants are rare at the tree line on Hawai'i. At one known site a population of approximately 11 glabrous *M. polymorpha* plants exists among numerous pubescent plants. In *M. polymorpha,* the presence of trichomes is hypothesized to have an adaptive significance.

Anatomical and physiological research is underway to elucidate how glabrous *M. polymoprha* plants have adapted to exist in such an extreme environment. Anatomical measurements such as leaf and cuticle thickness, vessel diameter, and stomatal frequency are being considered. Physiological factors including stomatal conductance and transpiration rate are also being measured.

Initial findings show that the glabrous variety of *M. polymorpha* being studied has a higher average stomatal conductance rate and more stomata per leaf area than the pubescent variety. Minimal differences have been recorded in internal leaf anatomy. Additional anatomical and physiological data are still being collected.

Abstracts: Poster Presentations
(in alphabetical order)

See Abstracts: Oral Presentations for the following poster:

Michael J. Boyle, Department of Zoology
(Advisor: Elaine Seaver)

ISOLATION AND CHARACTERIZATION OF ACROSOMAL PROTEINS FROM THE POLYCHAETE *EUDISTYLIA*
(Biological Sciences, Humboldt State University)

Jakob Eijzena, Department of Botany
(Advisor: Dr. David C. Duffy)

IDENTIFYING KEY PREDATORS OF HAWAIIAN STILT (*HIMANTOPUS MEXICANUS KNUDSENI*) CHICKS. (US Fish and Wildlife Service, Oahu National Wildlife Refuge Complex)

The Kii unit of James Campbell National Wildlife Refuge is a long-term stronghold for waterbirds, including the Hawaiian Stilt, or Ae'o (*Himantopus mexicanus knudseni*). However, despite control and exclusion of mammalian predators, stilt fledging success is very low. Stilt chicks are flightless for the first three weeks after hatching and disappear within the first two weeks after hatching. In 2003 hatching success was 88% with a fledging success of less than 9%. To determine hatchling survival and identify key-predators we banded 24, 7-10 day-old stilt chicks with unique color combinations of bands on the tibiotarsus, and outfitted them with small radio transmitters that were glued directly onto the back. We found evidence of predation by a cat (*Felis catus*), and Black-crowned Night Herons (*Nycticorax nycticorax hoactli*) and/or Cattle Egrets (*Bulbulbus ibis*), and identified Bullfrogs (*Rana catesbeiana*) as a major predator. Other causes of mortality were entanglement and emaciation. We will continue and expand this study in 2004 to gather additional data that can be used to implement effective predator control strategies, and ultimately to increase reproductive success of the Hawaiian Stilt.

T. Aran Mooney, Department of Zoology
(Advisor: Paul E. Nachtigall)

A METHOD TO REDUCE MARINE MAMMAL BYCATCH: TARGET STRENGTH AND PREDICTED BIOSONAR DETECTION RANGES OF EXPERIMENTAL GILLNETS

(Hawaii Institute of Marine Biology)

Small cetaceans are often caught as bycatch in gillnet fisheries. One potential method that has been shown to reduce harbor porpoise bycatch is the use of barium sulphate (hypothesized acoustically reflective) enhanced gillnets. To determine acoustic reflectivity, this study compared the target strength of two experimental gillnets; a barium sulphate and an iron oxide gillnet, with a comparable control monofilament gillnet at 0°, 10°, 20°, 30° and 40°. At normal incidence, all nets measured were not different in target strength and biosonar detection ranges are estimated to be relatively similar. As the angle of incidence increased, the experimental nets' echo strength remained the same while the control net echo strength decreased at a greater rate. Iron oxide nets maintained the highest target strength respective of incident angle. Biosonar detection ranges are estimated to be greatest for the iron oxide net and shortest for the control net at increased angles. Echolocating odontocetes may utilize acoustic reflections of experimental nets to a greater degree but due to the weak target strength of both nets, other mechanisms may also mitigate reduced odontocete bycatch.

Au, W.W.L. MMRP, HIMB, University of Hawaii
Nachtigall, P.E. MMRP, HIMB, University of Hawaii

Program Supplement

Please note the following changes to the program:

Thursday, March 11th
Session 3
1:45 PM

Anuschka Faucci replaced by Sheldon Plentovich
(abstract follows)

Session 6
11:30 AM

Alison K. Stimpert presentation title has changed to:

BALEEN WHALE DISTRIBUTIONS OVER THE NORTHWEST ATLANTIC OCEAN AS SEEN THROUGH A SMALL BUBBLE WINDOW

Friday, March 12th
Poster Session Addition

Anuschka Faucci, Department of Zoology
(Advisor: Michael G. Hadfield)

INFLUENCE OF LARVAL MODE ON DISPERSAL AND GENETIC POPULATION STRUCTURE OF HAWAIIAN VERMETIDS (VERMETIDAE: GASTROPODA)

(see abstract above)

Sheldon Plentovich, Department of Zoology
(Adivsor: Sheila Conant)

THE IMPACTS OF THE INVASIVE ANT, *SOLENOPSIS GEMINATA*, ON WEDGE-TAILED SHEARWATER CHICK CONDITION AND FLEDGING SUCCESS.

Invasive ants have been implicated in altering ecosystems by altering arthropod populations, directly and indirectly impacting plant communities, and directly harming vertebrate species. The impacts of ants may be especially noticeable on islands with no social insects in the native fauna, such as the Hawaiian Islands. The fire ant, *Solenopsis geminata*, is one of 43 species that has been introduced to Hawaii and is suspected of disrupting ecosystems. It is not known to harm vertebrates in its native range. Here, we used the experimental control of fire ant numbers as a tool to investigate the influence of fire ants on seabird condition, growth-rates and nesting success. Our study was conducted on a pair of small (<5 ha) offshore islets similar in topography, geology, vegetation composition, bird species and ant species. On the treated islet, we used AMDRO, a protein based ant bait, and were able to reduce fire ant numbers present at bait cards from 273 to 9. On the untreated islet, numbers decline much less dramatically. There were only about half as many injuries (37% vs. 70%) to seabirds on the treated islet vs. the untreated islet. Two chicks on the untreated islet lost more than 50% of their feet due to injuries from fire ants. The fire ant negatively impacts the condition of seabird chicks, but preliminarily does not affect fledging success. The use of ant baits, such as AMDRO reduce the number seabirds injured by fire ants. Additional data will clarify how the reduction of injury influences growth-rate and fledging success.