The Proceedings of the International Workshop on CITES Implementation for Seahorse Conservation and Trade

February 3-5, 2004
Mazatlan, Sinaloa
MEXICO

Edited by
Andrew W. Bruckner
John D. Field
Nancy Daves

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

NOAA Technical Memorandum NMFS-OPR-35
April 2005

This publication should be cited as:
Bruckner, A.W. , J. D. Field and N. Daves (editors). 2005. The Proceedings of the International Workshop on CITES Implementation for Seahorse Conservation and Trade. NOAA Technical Memorandum NMFS-OPR-36 , Silver Spring, MD 171 pp.

Significant support for the development and printing of this document was provided by NOAA Fisheries, Office of Protected Resources, NOAA's Coral Conservation Program and U.S. Department of State. The views expressed in this document are those of the author and the participants of the workshop, and do not necessarily reflect the official views or policies of the U.S. Government, NOAA, USFWS or DOS.

Additional copies of this publication may be requested from:

Dr. Andrew W. Bruckner
National Oceanic and Atmospheric Administration
NOAA Fisheries
Office of Habitat Conservation
1315 East West Highway
Silver Spring, MD 20910

The Proceedings of the International Workshop on CITES Implementation for Seahorse Conservation and Trade

Edited by Andrew Bruckner, John Field and Nancy Daves
Office of Habitat Conservation, Rm 15829
NOAA National Marine Fisheries Service
1315 East-West Highway
Silver Spring, MD 20910-3282

NOAA Technical Memorandum NMFS-OHC-
February 2005

U.S. Department of Commerce
Carlos Gutierrez, Secretary

National Oceanic and Atmospheric Administration
Vice Admiral Conrad C. Lautenbacher, Jr., USN (Ret.)
Under Secretary for Oceans and Atmosphere

National Marine Fisheries Service
William T. Hogarth, Assistant Administrator for Fisheries

The Proceedings of the International Workshop on CITES Implementation for Seahorse Conservation and Trade

Organizing Committee

John Field, U.S. Fish and Wildlife Service
Nancy Daves, NOAA's National Marine Fisheries Service
Andy Bruckner, NOAA's National Marine Fisheries Service
Colin McIff , U.S. Department of State
Paola Mosig, Conabio, Mexico
Jorge Alvarez, Conabio, Mexico
Hesiquio Benitez, Conabio, Mexico
Erendira García, Dirección General de Vida Silvestre, Semarnat, Mexico

Working Group Leaders

Ernie Cooper
John Field
Oscar Ramirez Flores
Andy Bruckner

Logistical Support

Liliana Urbina, Beatriz Bugeda and Marcela Romero
The International Fund for Animal Welfare (IFAW)

Sponsors

Office of Marine Conservation
Department of State
Washington D.C., USA

NOAA Fisheries
Office of Protected Resources
Silver Spring, MD, USA

NOAA'S Coral Reef Conservation Program
NOAA Fisheries
Office of Habitat Conservation
Silver Spring, MD, USA

ACKNOWLEDGMENTS

The *Proceedings of the International Workshop on CITES Implementation for Seahorse Conservation and Trade* summarizes the outcome of a meeting held in Mazatlan, Mexico funded by the National Marine Fisheries Service (NOAA's Coral Reef Conservation Program and the Office of Protected Resources) and the U.S. State Department. The workshop was developed primarily to assist countries in identifying possible national management and monitoring strategies that could be implemented in their countries to promote sustainable harvest of seahorses and properly implement the CITES Appendix-II listing for these species.

The workshop would not have been possible without the dedicated efforts of the steering committee, John Field, Nancy Daves, Andy Bruckner, and Colin McIff (United States), Paola Mosig, Jorge Alvarez, and Hesiquio Benitez (Conabio, Mexico), and Erendira García (Dirección General de Vida Silvestre, Semarnat, Mexico), who were responsible for developing the agenda, objectives, work plan and working group tasks, identifying a venue, selecting participants, and pulling together background documents and the workshop proceedings. We are grateful to Beatriz Bugeda, Liliana Urbina and Marcela Romero from the International Fund for Animal Welfare (IFAW) , who helped with all logistical aspects of the workshop including planning and travel arrangements, conference support, and post-conference follow-up efforts. We are also grateful for the assistance provided by Sharanya Krishna-Prasad in the design, layout and formating of the Proceedings.

We would like to recognize the dedicated efforts of Ernie Cooper, John Field, Oscar Ramirez Flores, and Andy Bruckner as chairs of the working group sessions and for compiling the working group recommendations. Project Seahorse contributed numerous background materials and data on seahorse population status, trade, and management mechanisms used by participants in formulating final recommendations. All of the workshop participants also need to be recognized for their contributions to the workshop, including the development and presentation of country reports and background information, and their cooperative efforts in addressing the terms of reference and developing recommendations within their respective working groups that could assist countries in sustainably managing and conserving their seahorse populations. We are grateful for the participation by the CITES Secretariat, in particular for discussions and presentations that assisted participants in understanding the role of CITES in conservation of seahorses, and in identifying the requirements of exporting and importing countries in proper implementation of the Appendix-II listing for seahorses.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The *International Workshop on CITES Implementation for Seahorse Conservation and Trade* brought together over 40 participants from 9 countries, with representatives from CITES Parties, the CITES Secretariat, fisheries agencies, non-governmental organizations, industry, academia and public aquariums. The goal of the workshop was to assist countries in identifying sustainable management options for seahorse fisheries and addressing the Convention on International Trade in Endangered Species (CITES) permitting requirements for trade under the new CITES Appendix II listing of all seahorse species that goes into effect in May 15, 2004. The workshop was organized by Mexico and the United States, with logistical support provided by the International Fund for Animal Welfare.

The workshop opened with welcoming speeches from the director of the Secretaria de Medio Ambiente y Recursos Naturales (SEMARNAT) and the U.S. Fish and Wildlife Service. Participants were asked to consider and assess practical means to:

(i) enhance collection and sharing of fisheries and population data;
(ii) identify short and long-term approaches to sustainably manage fisheries and bycatch;
(iii) evaluate detrimental and non-detrimental trade for wild-harvested and aquacultured seahorses;
(iv) develop pragmatic ways to inspect and validate shipments of live and dried seahorses.

Experts then gave presentations on the biology, taxonomy and distribution of seahorses; seahorse fisheries and bycatch; international trade; CITES requirements for Appendix-II trade; approaches to determine if and ensure that trade is non-detrimental; and identification tools to assist law enforcement in monitoring seahorse shipments. This was followed by national reports on seahorse fisheries and trade in 10 countries.

Three concurrent working groups met for one and a half days to discuss the following topics:

1) elements of a functional national seahorse management program;
2) enforcement and implementation of a CITES listing; and
3) non-detriment findings.

Recommendations were presented on the third day, which were refined with input from all participants.

Working group 1 and 3 recommended interim short-term voluntary measures to ensure non-detrimental trade for wild harvest that included a universal minimum standard length **f**or export (i.e., 10 cm), with application of limits on the total volume of trade to current levels, and a cap on new licenses whenever there is clear evidence that seahorse populations are being overexploited and/or are diminishing. Other needs include efforts to map, characterize and assess seahorse habitats, and implementation of fishery dependent and fishery independent monitoring programs. An assessment of the percentage of existing protected seahorse habitat, and identification of additional protected areas based on seahorse life history and ontogeny, was thought to be a primary tool that could be used to make a non-detriment finding for non-selective (seahorse bycatch) fisheries. Other management options were assessed, with suggestions to test and evaluate different measures through an adaptive management process depending on the characteristics of each fishery.

Working group 2 suggested that certification or registration of captive breeding facilities, along with experimentation in methodology to tag captive bred seahorses is necessary to improve the capability of law enforcement at differentiating wild from aquacultured species. Until marking methods are developed, WG2 agreed that a paper document would suffice to distinguish wild and aquacultured seahorses. They concluded that the only practical way to monitor large shipments of dried seahorses is to report in weight, with conversion factors provided to assess numbers, with a recommendation that exporting countries require that traders separate shipments by species for permits to be valid. Separating seahorses from other tropical fish shipments would also assist law enforcement. Additional taxonomic work is needed to resolve the identification of similar species and to develop tools to assist in identification of live specimens.

Working group 3 also identified general criteria for acceptable and "non-detrimental" aquaculture operations, with emphasis on rearing capacity, prevention of release of aquaculture product into the wild, reliance on wild broodstock, and controls to minimize disease and mortality. The working group noted that CITES requires non-detriment findings for aquaculture operations producing F1 specimens from wild-origin broodstock, but agreed that there is no need for a standard minimum size to control exports of cultured seahorses at this time.

During the final session, workshop participants discussed and formulated 8 key recommendations to manage wild harvest and captive breeding operations, ensure non-detrimental trade, and facilitate implementation of the CITES Appendix II listing:

SUMMARY RECOMMENDATIONS

Recommendation 1: Minimum export size is a voluntary interim measure that could be used for making non-detriment findings. Complementary auxiliary and voluntary measures include a quota on the export levels at or below current levels, and a cap on the issuance of new licenses.

Recommendation 2: Countries with export fisheries should strive to obtain and make available certain minimum data sets to assist in validating adaptive management measures and making non-detriment findings. This includes improved documentation of catch and effort data along with basic information on population status and trends obtained via fishery-independent programs, or by sub-sampling commercial landings.

Recommendation 3: Countries should evaluate the extent of seahorse habitat that is currently closed to non-selective harvest and identify new areas as appropriate to protect vulnerable life stages. Comparing the extent of protected versus non-protected habitat will also enable CITES Scientific Authorities to gauge relative amount of seahorse refugia and the potential impact of exporting a given amount of seahorses taken as bycatch.

Recommendation 4: The long-term sustainability of seahorse fisheries and trade requires a systematic process to develop, implement and adapt management measures to meet resource and community needs. Countries should initiate efforts to improve communication, participation and cooperation among industry, resource management agencies, local communities, scientists and other stakeholders. Specific "sentinel" or indicator fisheries could be targeted to test and evaluate various management measures through an adaptive management process. Enforcement of existing laws (e.g., trawling bans in specific areas) is needed to improve the conservation of seahorses.

Recommendation 5: Exporting countries should adopt standards for seahorse exports, including uniform reporting volumes, separation of shipments of seahorses and other tropical fishes, and transparent packaging materials for live animals. Attempts should be made to resolve taxonomic discrepancies and develop tools and training materials for live seahorses.

Recommendation 6: Seahorse aquaculture operations should be inventoried and assessed to determine their production capabilities, degree of reliance on wild populations, and environmental concerns. Operations should be encouraged to develop marking systems to distinguish aquacultured seahorses from wild-caught specimens. Until marking systems are refined for aquacultured seahorses, national CITES authorities should rely on thorough paper documentation to distinguish between wild and aquacultured specimens. There is no need to impose a standard minimum export size for aquacultured seahorses produced in non-detrimental facilities.

Recommendation 7: Support is needed for publication of an updated Project Seahorse trade report, along with detailed individual country reports, as these documents could provide the baseline data needed by individual countries to identify fisheries of concern, determine the appropriate initial management options for their particular situation, and identify gaps in information and management needs.

Recommendation 8: Communication about seahorse management and the results of the present workshop should be addressed in a number of ways, including: 1) a CITES Notification to the Parties regarding the workshop proceedings; 2) communication about national seahorse management measures to the CITES Secretariat for dissemination and reference; 3) communication with the United Nations Food and Agriculture Organization (FAO), other UN Environmental Programme offices, regional fisheries management organizations (RMFOs) asking for capacity building and information sharing on seahorses and other bycatch management issues; 4) domestic coordination between non-governmental organizations (NGO's), museums, academia and CITES Authorities to gather relevant data on seahorse conservation status in national waters.

INTRODUCTION

The United States and Australia submitted a discussion document to the Eleventh Meeting of the Conference of the Parties to CITES (COP11; Nairoibi, Kenya; April, 2000) on trade in seahorses and other members of the family Syngnathidae. With this document, the United States and Australia intended to accomplish the following for Syngnathid conservation: 1) establish dialogue between Parties, concerned scientists, interested industry members, and affected communities; 2) further encourage continued research to clarify taxonomic discrepancies and compile species distribution and demographic data; and 3) further encourage the collection of data on international trade, catches by species, and species conservation status; and (4) promote actions to ensure the long-term viability of syngnathid populations..

As a result of this COP11 discussion paper, the Parties adopted decisions directed to the CITES Animals Committee and to the Secretariat to *inter alia* convene a workshop on syngnathid trade, biology, and conservation and subsequently report their findings at COP12.:

With funding from a number of countries, nongovernmental organizations, and industry groups, the CITES Workshop on International Trade in Seahorses (May 2002; Cebu, Philippines) workshop was convened in May 2002 in Cebu, Philippines as per Decision 11.153. After reviewing the workshop proceedings, the CITES Animals Committee determined that some species of seahorse met the biological criteria for a CITES Appendix-II listing and that others qualified for listing by similarity of appearance to the threatened species. The Committee determined that such a listing would be useful for seahorse conservation and management, while syngnathid bycatch should be addressed through expanded management programmes and continued capacity building in source countries[1] .

Based on the Animals Committee's findings, the United States submitted a successful proposal to list all species of seahorses in Appendix II of CITES at COP 12 (3-15 November 2002; Santiago, Chile). This listing, which uses systems to monitor and regulate the international trade in all *Hippocampus* species, had an 18-month delayed implementation that became effective on May 15, 2004. The delay was intended to allow countries sufficient time to consider management approaches, monitoring programs, identification materials, and size limits to ensure a legal and sustainable seahorse trade under CITES. Since seahorses are extremely vulnerable to overfishing, and may now be the most widely and voluminously traded CITES animal species, the listing requires significant work in source countries, the CITES Animals and Nomenclature Committees, academia, and the conservation community. Since most of the current seahorse exports are from developing countries, it was imperative to strengthen collaboration and cooperation between developed countries and these nations to establish management approaches that will help ensure this trade is not detrimental to wildseahorse populations.

In addition to the listing of seahorses in Appendix II, four decisions were adopted at COP12 to further the species' management and conservation:

Decision 12.53[2] :

a) Parties are encouraged, where domestic legislation bans fishing of and trade in species listed in the Appendices, as a matter of priority, to allow sustainable trade in specimens of *Hippocampus* species under the provisions of the Convention;

b) Parties are encouraged to explore the benefits of trade certification options offered by independent organizations; and

c) CITES Management Authorities are requested to strengthen their collaboration and cooperation regarding management of *Hippocampus* species with appropriate fisheries agencies.

Decision 12.54[3] :

The Animals Committee shall identify a minimum size limit for specimens of all *Hippocampus* species in trade as one component of an adaptive management plan, and as a simple precautionary means of making initial non-detriment findings in accordance with Article IV of the Convention.

Decision 12.55[4] :

The Nomenclature Committee shall propose a standard taxonomy for species in the genus *Hippocampus*.

Decision 12.56:

The World Customs Organization is invited to develop harmonized codes for live seahorses, dried seahorses, live pipefishes (and pipehorses), and dried pipefishes (and pipehorses).

As one step to assist countries in implementing the Appendix-II listing, Mexico and the United States convened the *International Workshop on CITES Implementation for Seahorse Conservation andTrade* on February 3-5, 2004 in Mazatlan, Sinaloa (Mexico). This international forum, coordinated bythe International Fund for Animal Welfare, brought together over 40 participants from nine countries, withrepresentatives from CITES Parties, the CITES Secretariat, fisheries agencies, non-governmental organizations, industry, academia and public aquariums. The goal of the workshop was to assist countriesin identifying sustainable management options for seahorse fisheries and addressing the CITES permitting and law enforcement requirements for trade under the Appendix-II listing.

[1] CITES, 2002. Conservation of seahorses and other members of the family Syngnathidae. COP12 Doc. 12.43. Twelfth meeting of the Conference of the Parties to CITES. Santiago (Chile), 3-15 November 2002.

[2] See Working Group 3 report for discussion of these subjects.

[3] See Working Group 3 report for discussion of the minimum size limit issue.

[4] See CITES COP13 Doc. 9.3.1 for a discussion of standard seahorse taxonomy (http://www.cites.org/eng/cop/13/doc/E13-09-3-1.pdf)

TERMS OF REFERENCE FOR WORKING GROUPS

Working Group 1: *Elements of a functional national management program and ensuring adequate information for non-detriment findings*

1. Identify and list practical means for quantifying seahorse landings, accounting for harvest variation in time, space and gear types.

2. List elements of a workable licensing or reporting mechanism for fishermen, dealers, and exporters.

3. List elements of accurate fishery-independent population surveys for wild seahorses (design, gear, execution), considering habitat types and fishery location.

4. Evaluate the pros and cons of the proposed fishery management tools in Paragraphs 1 and 2 from a biological, economic and enforceability standpoint.

5. Identify pragmatic ways to change fishing effort or landings under an "adaptive management" approach for seahorses.

Working Group 2: *Enforcement of a CITES listing*

1. Discuss and list pragmatic ways to distinguish captive-bred and wild-caught seahorses.

2. List pragmatic ways to inspect shipments when handling and sampling large volumes of *Hippocampus.*

3. List and address the hurdles faced by national authorities when issuing CITES permits in the seahorse industry.

4. Evaluate the Draft CITES identification manual as a tool for law enforcement.

Working Group 3: *Non-detriment findings*

1. Discuss and define non-detrimental aquaculture for *Hippocampus* spp.

2. Discuss how monitoring data and size limits for wild seahorse fisheries can be interpreted to separate "detrimental" and "non-detrimental" trade.

3. Develop potential methods to monitor, interpret, and control the effects of non-selective fishing gear on *Hippocampus* spp. populations caught in non-selective fishing gear.

Report from Working Group 1:

Elements of a functional national management program and ensuring adequate information for non-detriment findings

The group identified seven general recommendations that could enahnce monitoring efforts, improve management and facilitate implementation of the CITES Appendix II listing:

1. Efforts to develop maps of marine environment, illustrating spatial extent of different habitat types, seahorse distribution and fishing areas and use these as a tool to implement management approaches (e.g., demarcate fishing and no-fishing zones) should be promoted. As a first step, existing maps at the available resolution (e.g., WCMC World Atlas of Seagrasses, Mangroves and Coral Reef maps at a 4 km scale) should be refined to the highest level of detail possible once more information becomes available.

2. Parties should use the best available data on seahorse fisheries and trade as guidance to identify key locations where seahorses are targeted or taken as bycatch to identify areas for initial management and monitoring initiatives. One source of existing information is the country reports developed by Project Seahorse.

3. An email contact group should be created with the goal of establishing pilot seahorse management and monitoring programs/projects and for information- sharing (e.g. observer programs in place). Another goal of this group would be to improve communication among CITES authorities, FAO officials, fishery agencies and scientists.

4. The working group recognizes that the direct take or harvest of seahorses as bycatch may only represent a few animals per fishers or vessel per day. This amount of take could still impact populations over time because of the patchy, low abundance and vulnerable life history traits of these species. Total harvest over multiple trips may be substantial, especially when the entire fleet is large. Destruction or alteration of habitat might be as important or even more than direct take or bycatch.

5. Parties should continue to collect, analyze and apply fishery dependent and fishery independent data towards improved seahorse management. Observer programs could determine this.

6. As an initial management measure, Parties should consider adoption of a voluntary minimum size of 10 cm height for exports from wild populations This recommendation may be refined over time as more is learned about various species of seahorses.

7. The management of seahorse fisheries should be considered in the larger context of habitat conservation and mitigation of threats such as land-based pollution, inappropriate coastal development, and destructive fisheries practices (trawling, cyanide and blast fishing).

1. Identify and list practical means for quantifying seahorse catch and landings, accounting for harvest variation in time, space and gear types.

Target Fisheries

1. Parties should set mandatory reporting requirements. One approach could include logbooks that detail fishing area, season, and catch and effort in target fisheries.
2. Parties should interview fishers to expand historical data sets and obtain information on current practices.
3. Parties should encourage the formation of local or community-based fishing cooperatives to improve coordination, data collection and information- sharing with resource managers.
4. Parties should explore the possibility of including seahorse fishers, and seahorse collection sites under existing certification programs for ornamental fisheries (e.g., MAC) to assist in making non-detriment findings (NDFs).
5. Parties should work closely with fishers in the field to obtain fisheries data. Where taking of seahorses is legal conservation needs and the value of reliable, accurate fisheries dependent data should be emphasized, thereby improving the likelihood that fishers will accurately report data.

Bycatch

1. Observer programs are the most important tool to better understand the distribution of effort, species diversity and level of bycatch:

    a. Observers could be placed on board vessels or at ports (e.g. shrimp trawl fleet). Port samplers may be able to maximize number of vessels that are monitored with limited effort; placing observers on boats would allow data collection from a maximum of one boat per observer. Disadvantage of port inspection is that data is available on retained bycatch and not discards. Also, on vessels with multiple crew, individual fishers each may keep a portion of the seahorses landed and thus accurate sampling is not possible without direct observation.
    b. Observers should monitor more than just seahorses. All bycatch might be monitored or specific species of interest might be counted (e.g., rare species, species of concern due to overexploitation, key habitat forming invertebrates, and juveniles of commercially important species). Usually, programs are biased toward the more abundant and conspicuous species. Technical advice to collect data on species of low abundance as seahorses is needed.
    c. Where seahorse bycatch is retained, observers should identify and enumerate the entire seahorse catch, including sex, size and percentage of pregnant males, if feasible.

d. Where seahorse bycatch is discarded, observers will be unable to analyze everything. Observers should take representative samples of discards, enumerate all fish and invertebrate bycatch, including seahorses, and relate sample size to total amount of bycatch. Sub-sampling may be suitable for seahorses, because of their low abundance and low level of catch; therefore, statistical analysis and methodologies for sampling need to be developed.
e. It would be advantageous to spread observer effort over as wide a geographical area as possible. Once some information on focal areas of interest (main catch areas or areas with high incidence of seahorses or suitable habitat) is obtained, observer effort could be redefined as appropriate.
f. Observers need training in how to effectively work with fishers to gain their trust, and also in species identification, data sampling and collection. One possible way to implement observer programs is by involving university scientists/students, who may be more able to establish a good working relationship with fishers than government representatives.
g. It is critical that managers share information with neighboring countries and work to establish standardized recording procedures so data from neighboring areas is comparable.
h. Australia, the U.S. and other countries with observer programs should provide capacity building / training/aid programs to develop fisheries observer programs in other countries and to provide training in methodologies to analyze and interpret data. One example would involve a simplified regional identification guide that includes only local species for use by observers in collection areas.
i. The possibility of monitoring the movement (fishing areas) of vessels was considered, maybe by using a GPS system. Although this can be very useful and desirable, it might not be economically feasible in some cases.

2. Parties could require that captains of vessels involved in the take of seahorse bycatch maintain logbooks on bycatch. Most trawl fisher fleets have logbooks for commercial and bycatch species. It might be useful to have an additional logbook for protected species (including seahorses).
   a) This may be a cost-effective approach, but there is no assurance of data quality, especially if logbooks are not completed during fishing.

3. Bycatch in artisanal fishery - Evaluate its impact and levels: Which kind of artisanal fishing gear can have a more direct impact on seahorse populations? Also there could be some sampling, observers, interviews, and collaboration with fishers to keep track of data gathering. Cross data with salesmen, fishers and observers as well. This activity can have an important impact on key seahorse habitat areas (e.g. breeding or spawning areas).

2. List elements of a workable licensing or reporting mechanism for fishermen, dealers, and exporters.

Target Fisheries

1. Parties should require at a minimum a license for ornamental fisheries in general, or at least a specific license for seahorse fishers. This provides a tool to determine the total number of fishers and probably as a first effort control, by restricting the number of licenses.
   a. Data/logbooks should be submitted once per year at a minimum for renewal of a license. (Difficulties with this approach are that fishers may not record data until just before they renew license, decreasing accuracy of data.)
   b. Detailed information of catches (species level) should be reported for each trip; Monthly reporting may be a substitute for reporting for each trip in order to obtain seasonal data.
   These reports might be mandatory for re-issuing of the licenses.
2. Parties should encourage formation of fishing cooperatives and "management councils" that include resource agencies at a local and national level as well as stakeholders and user groups to facilitate cooperation. These cooperatives could be responsible for ensuring that fishers know how to fill out logbooks in order to ensure their accuracy. Cooperatives could also teach conservation approaches, recommend ways to enhance sustainability and product quality, and set standards to maximize product quality and value. Dealers might also be invited to participate in cooperatives. The Philippines is already implementing this approach.
3. It may not be necessary to specially license exporters since they may already need licenses to obtain export permits from the CITES Management Authority or because there are other types of specific regulations for the country, but might be useful if the system is not in place yet.
4. Licensing or permitting of dealers could provide information on total number of dealers, track movement of products within country, determine concentration centers of products, and facilitate inspection and enforcement. This also provides a cross check for data provided by fishers and exporters. If it is impractical to license or permit dealers, at the minimum resource, management agencies should have a list of all dealers. Each Party should develop a specific mechanism adapted to their needs.
5. A certification program such as that provided by the Marine Aquarium Council (MAC) provides one tool to track seahorses and other ornamentals from the reef to the retailer, providing data on collection area, size, sex and stage, and total level of take and effort.

Examples:

1. Mexico requires fishers that target ornamental species or species under special protection (e.g., seahorses) to hire a research center/university/biologist to assess the resource and determine whether the potential level of offtake is non-detrimental. Researchers have recommended that take be restricted to 10% of a population per year (0.81% per month) within specific collecting area.

2. Philippines now requires licenses for fishers, but do not restrict license holders to particular species; exporters also licensed. Philippines has a banned species list, but will give fishers specific licenses for these species for research purposes for one year to collect information on those species. All catch needs to be shown to enumerators, but can be sold after verification. This limits illegal harvest. Licensing is handled by local governments and fishing cooperatives are recommended, with national government providing assistance. Fisheries and aquatic resources management councils are composed of local, national governments, fishing cooperatives and fishers.
3. In Florida, fishers are licensed for particular species or groups and must provide trip tickets There are specific marine life licenses for ornamentals. Dealers are also licensed.

3. List elements of accurate fishery-independent population surveys for wild seahorses (design, gear, execution), considering habitat types and fishery location.

1. The approach used will vary depending on the habitat (e.g., a trawl would not be effective in a coral reef while visual (dive) surveys may not be practical in shallow grassbeds).
2. Parties should identify existing monitoring programs and approaches. If a commercial fishery has a stock assessment protocol, it should be evaluated to see whether seahorse monitoring could be added. Another gear type or additional species could be added to an existing program.
3. Any program should include standardization whenever possible of gear types, methodologies, statistical analysis and previous training, with specific gear types for certain habitats, species or depths
4. Fishers should be involved in field monitoring programs if possible; this can be particularly useful to determine tendencies within an adaptive management approach.
5. Monitoring should be conducted in fished and non-fished areas, within similar habitat types, to provide a means to separate fishery impacts from other stressors/disturbances. Some risk factors that might be taken into account are habitat destruction and pollution.
6. Selection of survey areas should consider previous mapping and areas with a higher probability to find seahorses.
7. Monitoring programs should be for seahorses and other associated species. Ideally, as many species as possible should be recorded in surveys with detailed information on species, abundance, size and sex whenever possible. This can help the surveys to be more useful, practical and economically viable, and also to have the needed support.
8. The WG debated on the convenience and likelihood of developing standardized format sheets to collect all the relevant data.
9. Some specific tools could include a drop net for seagrasses and fine mesh trawls for deeper non-coral areas. In coral reefs, typical belt transect surveys and stationary surveys (Bohnsack approach) used for larger mobile reef fishes will probably not work for more cryptic seahorses. However roving diver surveys (timed swims) may be useful in identifying rare species, although it is difficult to quantify numbers per area.

10. Although seahorses are occasionally targeted at night, it is not practical to survey at night on a large scale due to decreased efficiency and increased cost. However, general surveys can be complemented by night samplings, which have been proven to be useful in some areas. Even if daytime surveys underestimate actual abundance, they can still estimate changes in populations over time.
11. The MACTRAQ monitoring program is a visual survey approach developed in partnership with ReefCheck and MAC for the ornamental fishery. It should be evaluated to see if it could provide useful data on seahorses.
12. Research institutions should be encouraged to share their information and identify main areas for seahorses surveys and map habitats. Also, communication with them should be increased to contribute in their surveys design so that information to answer key questions for management and making NDFs can be generated.

4. Evaluate the pros and cons of the proposed fishery management tools from a biological, economic and enforceability standpoint.

General recommendations

1. Parties should evaluate and consider FAO's "Code of Conduct for Responsible Fishing" which identifies numerous approaches to conserve marine resources, with emphasis on an ecosystem approach.
2. The World Summit on Sustainable Development (2003) passed a recommendation that all countries set aside 10% of marine environments as no-take by 2012. This approach will help to conserve seahorses by protecting their habitat.
3. One approach to address concerns over sustainability of seahorses taken as bycatch is through area closures (spatial closures or rotating harvests with long closures between fishing periods to allow habitat recovery). More research is necessary to determine survival rates of species caught through bycatch. Possible measures to enhance survival also should be tested (e.g., duration of individual tows). Potential socioeconomic implications should be considered.

A. Size restriction for export

1. Minimum size can only be realistically applied to target fisheries, until research is conducted to determine optimal strategies to maximize survival of bycatch under different trawling conditions (e.g., depth, duration of gear deployment). Currently, application of this measure to bycatch fisheries may result in wastage due to discards of smaller animals that die. Some species may be caught both through target and non-target fisheries. Not including a minimum size for species taken as bycatch may create a loophole for target fisheries if a minimum size for target fisheries is mandatory. Size limits should not be applied to aquacultured specimens.
2. There may be some reduction of yield (fecundity) associated with removal of largest animals, but implementation of a maximum size is not practical because different species of seahorses grow to

different maximum sizes. This approach would not be supported by TCM markets due to higher value/demand of large specimens. Also, seahorse fecundity does not appear to increase exponentially with size as seen in long-lived species like groupers. Thus the benefits gained by protecting the largest animals may not be offset by economic losses. It is not clear if larger animals effectively contribute with more offspring and thus an important reduction of fertility can be inflicted by catching larger animals. Topological studies in seahorses are needed to determine this.

3. Continued pressure on the largest animals may result in a progressive long-term shift (decline) in the size at maturity, which may cause reductions in number of offspring.
4. The WG proposes to explore the possibility of two minimum sizes to account for the larger maximum size of *H. kelloggi*, *H. ingens* and *H. abdominalis* (e.g, minimum export size for these could be 20 cm). However, it may be difficult to differentiate these three from other species. Additionally, *H. kelloggi* is reported to be taken primarily in deeper water by trawls and there may be even more waste associated with discards of small animals. Some expressed concerns that a 10 cm minimum size may exclude certain species that have recently appeared in live trade (e.g., *H. bargibanti*). Thus it may be appropriate to identify certain species that might be exempt from minimum size limits. Simple ways to identify these species and to ensure that other species with a larger maximum size are not traded as juveniles should be found.
5. More research is necessary on size specific fecundity, longevity and reproduction and to develop a conversion factor between proposed "trade height" and length for all species to facilitate inspections and enforcement.
6. The importance of domestic markets should be considered when setting a minimum export size because small animals may still be retained and sold locally for curios, TCM, Jamu etc.
7. If CITES makes the recommendation that countries could use a minimum size as an initial measure for non-detriment, is should be with the recognition that the benefit of this measure from a biological standpoint will depend on the species and location, and other measures should be considered based on available knowledge.
8. Variations in the proportion of different traded species to total height must be quantified.

B. Spatial closures

1. While spatial closures are currently the only "simple" way to address unsustainable bycatch, removal of juveniles and habitat degradation associated with fishing, there is likely to be considerable opposition by fishers on any limits to where they can fish as a result of potential socioeconomic impacts.
2. Depending on level of community support, distance from communities, existing capacity, and the amount of fishing by nonresidents, it may be difficult to enforce spatial closures.
3. There are already closures for trawl fisheries in inshore shallow waters in Thailand (3 km), Malaysia, Philippines (15 km), Indonesia, and Mexico (0-5 fathoms depth and 5 km from river mouths, estuaries and bays).

4. Research is needed to determine if these nearshore areas are prime seahorse habitat and whether this protective measure can help sustain surrounding fished areas. Nearshore areas are known to provide nursery grounds for other food fishes. Research could also be focused on identifying key areas for seahorses reproduction, vulnerable habitats or areas characterized by a high diversity or presence of rare seahorse species.
5. Closures have clear benefits to habitats and all species that occur in these habitats, and may enhance fisheries in surrounding open areas, but proper design is a key consideration. The science of area restrictions is in its infancy – what species benefit etc. needs to be evaluated.
6. To be effective, closures should be developed through a consultation process with resource users. Training in benefits of this measure is a key element.
7. If seahorses have small home ranges and if juveniles do not disperse to surrounding fished areas, these may offer minimal benefits for seahorse fisheries.

C. Temporal closures

1. Temporal closures may benefit particular species or locations by restricting effort.
2. Setting appropriate closures in areas with multiple species is difficult, due to variations in reproductive period.
3. Temporal closures may be more effective for some temperate species that have shorter reproductive periods.

D. Rotational harvest

1. This management measure is a combination of a spatial and temporal closure. With rotational harvest, habitat has an opportunity to recover.
2. It is very difficult to enforce, since it is hard to notify fishers of closures and to identify specific areas.
3. It is unclear whether this measure will benefit target species. Further data is needed on the fishery, along with fishery independent monitoring. The effects of different exploitation levels and different durations of closed and open periods should be investigated to determine the optimal timing for closures.

E. "Sex selective fishing" (not taking pregnant males) or "caging"

1. This management measure consists of collecting animals and caging pregnant males until they give birth. Unless a high survival of animals taken as bycatch is found, these measures will only potentially be valuable for target fisheries.
2. Research should accompany this measure to identify best placement of cages to address environmental (salinity, water quality, temperature etc.) and habitat concerns and to evaluate survival of juveniles.

3. If caging is used, the spawning biomass of the animals should be determined to assess the value of protecting one brood, protecting multiple broods in one year, and the total number of broods in the seahorse lifespan to determine the benefits to the population.

4. Research is needed to evaluate the potential implications of changes in sex ratio of wild populations.
5. If sex selective fishing is chosen as a tool to enhance populations by managers, but fishers do not want to adopt this, they could "induce" birth by squeezing the brood pouch.

H. Total allowable catch or export

1. It would be possible to control landings but not catch, except in the case of small-scale fisheries where buyers have a specific quota. Thus there could be wastage of undesirable animals once the fishers reach their quota.

2. Substantial biological data would have to be collected in order to monitor populations for changes.
3. The working group discussed the possible application of a maximum cap on exports equivalent to some historical mean annual level. It was decided that this would not be a good management tool without sufficient data. This measure could prevent unacceptable fisheries growth, but it has not been demonstrated to work in other fisheries. In addition, in most areas, seahorse populations are in decline and this approach could drive a resource to unacceptably low levels and contribute to sequential overfishing.

I. Tenure or Community-based management

1. This technique provides for management by local communities. However, the working group had many concerns about its implementation, particularly where a community is already overfishing a resource.
2. A high degree of technical training in how to manage the resources would be needed for this type of management.
3. This technique can increase commitment of community to conserve and manage resources, but it requires that the community undertake monitoring of its resources.
4. This method has worked historically when there was a lower population density and resources were harvested primarily for subsistence, not a "cash crop"
5. Theoretically, this measure would reduce investment needed in enforcement by government agencies because the communities will police the area.

5. Identify pragmatic ways to change fishing effort or landings under an "adaptive management" approach for seahorses.

The Working Group believed that a possible approach to work towards sustainability could involve choosing pilot fisheries in one or more locations to evaluate possible options:

1. For seahorse fisheries in general, adopt a voluntary minimum size for the May 2004 Appendix II listing.
2. At the same time, implement a monitoring program to collect information on the response of this measure to trade (through CITES permits), population changes (fishery independent monitoring) and fisheries (catch/effort; observer programs).
3. Assess data from monitoring program and judge the effect of this measure.
4. If it appears to be working, continue this measure.
5. If it is not working, modify the size limit and/or add additional measures.
6. Continue monitoring resources and fishery over time to assess changes.
7. Add new measures as necessary until you achieve sustainability.

Adaptive Management

Decision12.54 directs the Animals Committee to identify minimum size as one component of an adaptive management plan. The working group recommends that all Parties do this. An adaptive management plan should be a consultative process, developed with input from stakeholders. It is explicitly experimental and iterative (learn, change, learn, change), and it is a process without end. Plans should be reviewed and revised on the timeframe of the lifespan of the seahorses it covers. Parties are encouraged to set up index (indicator or sentinel) fisheries for tracking changes as they occur. Adaptive management plans do not involve any radical new measures. Parties apply well-known and tested methods as they build capacity to determine the best measures and implement them. As the fishery is better understood, managers can take more complicated measures.

Additional Comments

In many cases, seahorses are only one component of ornamental fish trade. It is possible that a Party might have a management plan for ornamental fisheries overall, but due to export requirements fishers/exporter must report seahorses to species level. Many of the issues facing target seahorse fisheries are similar to ornamental fishes overall (with exception of cyanide fishing)

Working Group Participants

Serafín ALMENARA ROLDAN

Jorge ALVAREZ

Noel BARUT

Julia BAUM

Andy BRUCKNER (co-chair)

Persona CONAPESCA

Sarah FOSTER

Debi GOENKA

Alfonso NIETO

Bob McMICHAEL

Oscar RAMIREZ (co-chair)

Report from Working Group 2

Enforcement of a CITES listing

The Enforcement Working Group was tasked with disscussing issues pertaining to the enforcement of CITES Appendix II requirements for the export and import of seahorses. The group was asked to 1) evaluate difficulties in distinguishing captive bred and wild-caught seahorses and tools and information that would be needed to enhance identification; 2) identify possible approaches to facilitate inspection of large volumes of dried seahorses; 3) address challenges faced by national authorities when issuing CITES permits in the seahorse industry; 4) evaluate difficulties in identifying seahorses and identify research, training and tools that are necessary to improve the ability of law enforcement to identify and verify CITES shipments of seahorses; and 5) identify methods to improve communication between Enforcement, Management and Scientific Authorities.

1. Discuss pragmatic ways to distinguish captive bred and wild caught seahorses

The participants discussed three possible avenues for distinguishing captive bred and wild caught seahorses: morphological differences between captive bred and wild caught specimens; methods of marking captive bred specimens; and the use of documentation.

Morphological differences between captive bred and wild caught specimens

The participants concluded that it may be possible, in some cases, to distinguish captive bred vs. wild caught live specimens of seahorses via visible damage to a specimen from predation, parasites, etc. However, the attendees made the following conclusions:

- The morphological indicators would not be consistent or reliable.
- The varied life histories of the different species of seahorses means that the capability to distinguish captive bred vs. wild caught live specimens would likely differ between species.
- The capability to distinguish captive bred vs. wild caught live specimens would be affected by the length of time a species had been in captivity; and methods of capture and transport.
- Long-term captive breeding efforts could eventually result in varieties of seahorses that exhibit colours or morphological forms that are not known (or common) in the wild. Documentation of these variations would be valuable indicators that specimens were captive bred.
- It would not be possible to determine whether dried specimens of seahorses were captive bred or wild caught using morphology.*Marking captive bred specimens*

The participants discussed seven different possible methods for marking captive bred seahorse specimens, as follows:

- Collar tags (tags looped around the neck of seahorse specimens). Although this method would be easily instituted by captive breeding facilities, it would also be easily falsified and the tags may be lost in transport.
- Coloured polymer injected under the skin of specimens in a recorded pattern. This method would be both easily falsified and labour intensive.
- Coded wire tags inserted into the body of specimens. The attendees noted that this method had not been tested; that this method would be very labour intensive considering the large number and small size of specimens likely to be produced from a captive breeding facility; and that the method would be easily falsified.
- Natural morphological differences between the otoliths (the small bones in the internal ear of vertebrates) of captive bred vs. wild caught specimens. The attendees noted that these differences would likely not be consistent, plus examination of otoliths would require sacrifice of live specimens and laboratory analysis.
- Marking of the otoliths of captive bred specimens using stable isotopes such as strontium chloride. The attendees noted that this method would likely result in a high mortality rate
- Chemical marking of the skeleton (including the otoliths) using tetracycline. The pros to this method would be the ease in which it could be applied; that it couldn't be falsified and that it would be permanent. The con to this method would that verification by enforcement officers would require sacrifice of live specimens and laboratory analysis.

In general, the participants felt that the marking of captive bred specimens was not practical for routine enforcement of the trade in seahorses. However, marking could be useful in the process of certifying and monitoring captive breeding facilities and that marking could provide valuable forensic support for prosecution of seahorse smuggling cases.

Documentation

The participants noted that certification or registration of captive breeding facilities would provide documentation that could accompany shipments and provide additional information for enforcement (e.g. permit verification). In discussing this issue, the attendees noted the following:

- There is a need to include enforcement authorities in the certification or registration process.
- There is a need for routine monitoring and inspection of captive breeding facilities.

Recommendations:

- Chemical marking using tetracycline should be encouraged as part of the certification of captive breeding facilities and used to monitor these facilities.
- Marking methodology should be standardized among CITES Parties.
- Chemical marking should not be used for routine identification of CB specimens due to need to kill specimens.
- Certification or registration of captive breeding facilities should be instituted, and enforcement should be included in the process.
- Captive breeding facilities should be monitored through routine inspection by enforcement authorities.

2. List pragmatic ways to inspect shipments when handling and sampling large volumes of seahorses

The participants noted that this would mainly be an issue for shipments of dried specimens and that the response would depend on whether or not permits accompanied a shipment of seahorses. If no permits accompany a shipment, then there is a clear violation and there is no pressing need to identify what species the specimens are. An enforcement action is required no matter what species is involved.

If permits do accompany a shipment of seahorses, then permit validation is a required enforcement action. Permit validation must include the following actions:

- The specimens of seahorses in the shipment must be examined and identified in order to verify that the species listed in the permit match those being shipped.

- The volume of specimens in the shipment (whether number or weight of specimens) must be verified to be within the limits stated in the permit.

- If a minimum size limit is set as a condition of the permit(s) then specimens must be measured to ensure that the specimens in the shipment meet that size limit.

The participants also noted that the actions required to inspect shipments of seahorses may differ depending on whether the shipment contains a single species or multiple species.

Inspecting single species shipments: Establishing that the volume of a shipment matches the permit(s):

- If a permit lists the number of allowed specimens, it may be necessary to count all of the specimens contained within the shipment.
- If permit lists the allowed weight of specimens, then verification of the permit is much less labour intensive (the specimens may be weighed together).
- It would be valuable to have a formula which could be used to convert the weight of a shipment into an approximate number of specimens in that shipment. This would possibly resolve the need to count all of the specimens in a shipment (when a permit lists number of specimens) and would allow for better data comparison between permits (e.g. those listing number of specimens and permits listing weight of specimens).

- Identification and (if required) measurement:
    - Identification and/or measurement of seahorse specimens is very time consuming. When large shipments of seahorses must be inspected it was recommended that a sub sample of specimens be taken for identification.
    - The sub sample must include specimens taken from different locations within the shipment to ensure that all of the contents are represented.
    - The number of specimens taken as a sub sample needs to be large enough to provide good representation of the specimens contained in the shipment. The size of a sub sample may be dependent on the specific country needs and available resources.
    - The use of sub samples is pragmatic, but will likely result in missed violations.

Inspecting multiple species shipments

The participants noted that shipments of multiple species mixed together will be much more difficult more difficult to inspect than single species shipments. This will present a major problem for countries which export multiple species or import from "hub" countries (those through which shipments from different countries transit en route to their final destination) where species may be mixed before re-export. The attendees also noted that shipments will need to be sorted and the specimens contained therein identified by the exporters in order to comply with permits.

- Establishing that the volume of a shipment matches the permit(s):
    - If the permit(s) lists the total number of specimens of each species it may be necessary to count all of the specimens of each species contained within the shipment in order to verify the permit.
    - If permit lists the allowed weight of specimens then each species will need to be separated in order to record a weight and verify the permit.
    - In either situation above, accurate identification of the different species will be necessary.
- Identification and (if required) measurement:
    - Identification of every specimen would be preferable – but this is unlikely to be practical for most shipments, unless there are a relatively small number of specimens contained within.
    - As for shipments of single species, it was recommended that when large shipments of mixed species of seahorses must be inspected, a sub sample of specimens should be taken for identification. The purpose of the sub sample is to verify the shipment does not contain undeclared species and that the permit conditions are met (e.g. species composition and ratio, size, source, etc.). It will be important to ensure that the sub sample represents the contents of an entire shipment.

Recommendations

- Parties should be reminded that permits for seahorse shipments need to be issued to the species level, and not just genus.

- Parties should be encouraged to use the weight of specimens (rather than number) on permits for any shipment of more than 1 kg.

- If possible, a crude conversion factor should be developed to determine the approximate number of specimens per kg for each species or group of species (for example by specimen size).

- When issuing CITES Export permits for shipments of multiple species of seahorses, exporting countries should add a condition that invalidates the permits if the species are not separated within the shipment. This would greatly assist the inspection process.
- Enforcement authorities should identify species for permit validation of large shipments by taking sub samples that represent the different areas of a container; provides a good representation of the species involved; and minimizes the chance of a missed violation.
    - o Sub sample(s) would be used to verify the shipment does not contain undeclared species and that the permit conditions are met.
    - o Countries should quantify the number of specimens required as a sub sample in consideration of their specific policy and logistic restrictions.

3. List and address the hurdles faced by national authorities when issuing CITES permits in the seahorse industry

The participants noted that it was an issue to be addressed by CITES Management and Scientific Authorities as it was not an enforcement problem. The attendees also noted that aspects of this issue were being discussed in other topics of Working Group 2 (e.g., the need for good communication between enforcement, Management and Scientific Authorities; oir the need to include enforcement in monitoring activities.

4. Discuss problems and solutions for identifying seahorses

The participants noted that the problems and solutions for identifying seahorses varied depending on whether the specimens to be identified were live, dried or derivatives (e.g. used as an ingredient in pharmaceuticals).

- Shipments of live seahorses will generally have smaller numbers of specimens than shipments of dried seahorses and will therefore be easier to inspect from the point of view of volume.

- Shipments of live seahorses may provide a better paper trail due to the need for expediency of transport, and this may assist with inspection activities.

Problems and solutions for identifying dried seahorses

The attendees discussed this issue and noted the following:

- The seahorse identification guide produced by TRAFFIC and Project Seahorse was designed primarily to assist with the identification of dried specimens, and therefore will be of particular value for inspecting shipments of dried seahorses.
    - o Eventually the identification guide will be available as a hardcopy; on compact disk; and through the internet.
    - o The identification guide will be used by the Secretariat to produce pages for the *Identification Manual* and therefore the species descriptions will be translated to Spanish and French. However, there is a pressing need for translation of the guide to other languages, especially Chinese.
- Inspections of shipments of dried seahorses will be a lesser problem for source countries as they will have a limited number of species to consider when inspecting and identifying specimens. For example, only four species of seahorse are distributed in the waters of Mexico, so enforcement staff inspecting shipments of seahorses on export would not normally have to identify species other than these four.
- Inspections of shipments of dried seahorses will be a much greater problem for ¨hub¨ countries and those countries which import seahorses from ¨hub¨ countries. For example, enforcement staff in inspecting shipments of dried seahorses passing through Hong Kong would need to be familiar with many different species from many different countries.
- Trade in *Hippocampus kuda, H. Kellogii* and *H. ingens* will be especially problematic for enforcement due to the morphological similarity of these species.
    - · The distribution of *H. ingens* does not overlap that of *H. Kuda* and *H. Kellogii*, so this problem may (in some cases) be resolved through documentation. However, distribution of *H. Kuda* and *H. Kellogii* overlap making inspection and identification of shipments of these species particularly problematic.
    - · Research is needed to establish a practical solution to this problem. The capability to identify *H. Kuda* and *H. Kellogii* through DNA analysis would be valuable. However, a more practical means of identifying these species needs to be established.

- Parties should be encouraged to support regional and/or national workshops for enforcement staff on the identification of seahorses. Such workshops would be valuable as they build both expertise and enthusiasm.
- Experts on seahorse identification need to be identified and placed in a database that is available to the Parties.

Problems and solutions for identifying seahorse derivatives

The attendees discussed this issue and noted the following:

- The seahorse identification guide produced by TRAFFIC and Project Seahorse will provide very limited assistance for identifying seahorse derivatives.
- There is currently no capability available for the forensic identification of seahorse species used in derivatives such as pharmaceuticals.
- Identification seahorse derivatives will best be accomplished through labelling of derivative products.

Recommendations

- Research should be directed at resolving the problems associated with identifying very similar species, particularly *H. kuda, H. Kellogii* and *H. Ingens.*
    - o Research into forensic identification through DNA analysis would be valuable. The development of DNA analysis should meet the standards of forensic science.
    - o Until this identification issue is resolved, countries should ensure that the legal status of *H. Kuda* remains the same as *H. Kellogii* (and vice versa).
- Resources should be located to hold national and/or regional species identification workshops. Countries with significant exports of multiple species should host identification workshops specifically designed for exporters.
- Resources should be located to translate the ID guide into languages in addition to English, French and Spanish.
- The development of a seahorse expert database should be encouraged..
- Exporters should be encouraged to pack live specimens in a manner that facilitates inspection and identification. Packing should always comply with the International Air Traffic Association (IATA) Live Animals Regulations.
- Countries should be encouraged to develop domestic legislation stating that if derivatives (such as pharmaceuticals) include CITES-listed animals or plants as ingredients on their packaging, then the ingredients will be considered accurate for the purposes of enforcement.
- Methods to assist with the identification of live specimens need to be developed in cooperation with non-governmental organisations, professional associations, and industry.

5. Communication between Enforcement, Management and Scientific Authorities

The attendees discussed this issue and noted the following:

- There are two different issues within this topic:
    - o The need for better intra-country communication between the enforcement authorities and Management and Scientific Authorities (e.g. the sharing of transaction records).

    - The need for better inter-country sharing of exporter information between management and/or enforcement authorities.
- For many countries, communication between enforcement authorities (intra and inter) would be enhanced through better access to technology and capacity building opportunities (e.g. internet, workshops, training, international meetings, databases, etc.).
- There is a limit as to how much information can be shared by enforcement with Management and Scientific Authorities due the need for confidentiality that is inherent in enforcement actions (e.g. investigations leading to prosecutions).

Recommendations

- Parties should be encouraged to recognize and involve enforcement authorities in management activities such as permitting, monitoring of captive breeding facilities, etc.
- Resources need to be found and directed towards providing communication tools for enforcement authorities (e.g. internet access, workshops, training, international meetings, databases, etc.).
- Parties should be encouraged to foster intra and inter-country sharing of information on enforcement activities (e.g. exporters and importers involved in significant violations). This information may be significant for instigation of enforcement activities and/or affect permit issuance in source countries.

Working Group Participants

Ernest COOPER (Chair)

Zhi Yong FAN

Shekhar Kumar NIRAJ

Vladimir PLIEGO MORENO

Liliana URBINA

Leonel URBANO

Erendira GARCIA

Beatriz BUGEDA

Report from Working Group3

Non-detriment findings

1. Discuss and define non-detrimental aquaculture for species of Hippocampus.

There was considerable discussion of CITES captive-bred certificates, and the exemptions provided in the treaty for particular types of aquacultured organisms. If the following conditions are met, then a national Management Authority issues a certificate stating that specimens are captive bred and exempt from needing NDFs (as per Resolution 10.16):

- Operation produces F2 generation or beyond (or using techniques that yield F2), or is managed in a manner that has been demonstrated to be capable of reliably producing second-generation offspring in a controlled environment.
- Wild broodstock is rarely used, obtained in accordance with CITES measures, and recommended by the Scientific Authority to reduce inbreeding, dispose of confiscated animals, or (rarely) to obtain new animals for breeding.
- Closed system (no unintentional releases of gametes or individual specimens into the wild)
- Controlled environment (major environmental parameters controlled by humans). Parents mated and gametes exchanged in controlled environment

The Secretariat member also pointed out that the Scientific Authority must be consulted (Resolution 10.3) when new operations apply for the issuance of captive-bred certificates for CITES-regulated trade. He also pointed out that there is no requirement that operations have to register with Management Authorities or the Secretariat for Appendix-II listed species.

It was clarified that any other type of seahorse aquaculture operation (that does not produce "bred in captivity" offspring as per the CITES definition) would need to obtain a CITES export permit prior to exporting specimens (dried or live). This would necessitate a formal NDF for all exports from these other aquaculture operations. This type of production is often called "born in captivity", and typically produces F1 generation offspring in captivity. However, it is relatively easy for Scientific Authorities to issue NDFs for these types of exports because of the lower conservation risk and almost zero dependence on wild populations.

The chairman then encouraged the group to provide guidance on how to analyze such operations in the context of CITES. It was agreed that any minimum size limit for trade should not apply to aquacultured F1 or F2 seahorses. National authorities have a responsibility to validate aquaculturists' claims of F1 or F2 production, and ensure that a given operation is not a cover for wild harvest.

The group then discussed potential marking techniques, but the chairman reminded them that Working Group 2 (Enforcement) will be discussing this point in detail. Some participants mentioned the use of tetracycline dips and coded wire tags to mark small captive-born fishes. It was agreed that a "paper trail" or chain of custody documentation would have to suffice for distinguishing captive-born F1 seahorses until safe and acceptable marking techniques were widely available.

The group then provided some general criteria for acceptable and "non-detrimental" aquaculture operations:

1. The operation can repeatedly rear a sufficiently high percentage of young to market size to remain economically viable.

2. The operation has sufficient controls to prevent the release of gametes or individuals into the wild. Reintroduction of captive-bred seahorses should only occur in rare circumstances and with the approval of the IUCN Reintroduction Specialist Group.

3. The operation has minimal reliance on wild broodstock, which is taken only to reduce genetic inbreeding.

4. The operation has an adequately controlled environment to prevent the outbreak of disease, excessive mortality, etc.

It was suggested that it would be useful to create an inventory of current seahorse aquaculture operations to evaluate any suspicious expansion in national seahorse aquaculture operations.

2. Discuss how monitoring data and size limits for wild seahorse fisheries can be interpreted to separate "detrimental" and "non-detrimental" trade.

The group started by talking about the utility of the minimum size limit (as per CITES Decision 12.54) compared to the utility of monitoring data for evaluating wild seahorse population status. The chairman clarified that the CITES treaty defined "species" not only as biological species, but also as national populations and geographically separate populations. This meant that CITES Scientific Authorities would have to evaluate trade for its impact at local and regional levels.

As the group began discussing the minimum size limit (currently under review by the CITES Animals Committee), they concluded that simple application of a size limit would not be sufficient to ensure non-detrimental seahorse trade in the long term. Participants quickly agreed that national monitoring programs

would be essential to evaluate the effects of trade and any benefits derived from imposing a minimum size limit. This led the group into a discussion of pragmatic and effective monitoring methods for wild seahorse populations. It became clear that countries would need to get some index of wild population status if they wished to ultimately limit or regulate harvest levels. It was agreed that almost all seahorse fisheries are data-poor, and complex modeling and quota setting are temporarily impossible for all seahorse exporting nations. However, the participants agreed that quotas are not the only way to establish non-detriment findings (NDFs) and that creative answers were needed in the interim while data on wild population status is gathered.

The chairman mentioned that some fisheries organizations, when faced with apparent overharvest of data-deficient species, have attempted crude but precautionary measures such as capping or limiting harvest to some fixed percentage of recent average landings. They then adjusted these limits up or down as they learned more about stock status and the fishery's dynamics.

A participant mentioned the idea of "sentinel fisheries", where geographically distinct but representative fisheries are intensely monitored. This could allow a wise use of limited funds and personnel to focus on a modest number of fisheries in major exporting areas. Such a program would involve trained observers collecting information at sea and at port on species harvested, discard rates, sex ratios, temporal and spatial patterns in fisheries, etc. Such "sentinel" seahorse monitoring programs could even be integrated into existing fishery monitoring programs where feasible, and would yield lessons about effective means to monitor populations and fisheries.

A participant from CONABIO intervened, and said that the group was focusing too much on long-term data collection and ignoring the short-term needs of Scientific Authorities in May 2004 when the listing goes into effect. It was agreed that the group would develop two lists of recommendations for this TOR: 1) short-term measures that Parties could use immediately after May 2004 to make conservative decisions about seahorse export permits; and 2) longer term minimum data needs that would assist in "adaptive management" of fisheries and exports. It was explained that adaptive management is a common practice in many fisheries, where: a) initial conservative limits are placed on harvest and/or trade; b) monitoring programs are initiated; and c) monitoring results give feedback on the effectiveness of initial regulations, which are modified and improved as necessary.

The group agreed on a number of short-term measures, as below:

- Primary recommendation: establish a minimum size limit for exported seahorses, if necessary in the absence of reliable data on national seahorse population status

    - It was understood that a final value for a uniform trade size limit had not been agreed on in the Animals Committee.

    - Deliberations at AC20 (March 2004) and COP13 should resolve Decision 12.54 and result in a recommended trade size limit.

    - In any event, the minimum size limit for traded seahorses would be a voluntary measure and Parties could choose to adopt it or reject it based on their particular situation.

- Auxiliary measure: consider "capping" or limiting exports to some portion of historic levels

    - The Secretariat postulated that this measure might be better for the live animal trade. Project Seahorse participants countered that existing trade data don't support a differential approach for live vs. dried seahorses.

    - After much discussion about how any limits on historic exports may be perceived as arbitrary and capricious, it was agreed that exports could be simply capped at recent average levels when there is clear evidence that seahorse populations are being affected and are declining. Export caps are relatively easy to monitor via CITES permit issuance, and several countries would have adequate trade data to generate reasonably accurate estimates of recent (last 3-5 years) export volumes.

    - Project Seahorse trade and population data could be used to determine degree of concern in various exporting Parties

- Auxiliary measure: cap effort via a limit on the number of licences to target fishers

    - The group agreed this approach would be useful in areas where a target fishery is the main source of seahorse exploitation

- Auxiliary measure: consider the proportion of actual or potential seahorse habitat within current and planned national marine protected areas (MPAs). This could help Scientific Authorities gauge the extent of seahorse refugia, and the relative impact of a particular export on a nation's seahorse population.

It was also noted by the group that any Party can develop complementary measures as they emerge and as more data are obtained, and that there may be other ways to do NDFs depending on the available information. The group noted the measures above would be voluntary, but can serve as useful recommendations while other measures are established. The Secretariat mentioned that any country could establish more and/or different measures (*e.g.* Brazil has already established quotas), and could ask the Secretariat to notify other Parties of such measures to facilitate their international enforcement.

The group also stressed the need for timely distribution of critical information to the Parties, before or shortly after the May 15, 2004 seahorse listing effective date. This included:

- The rapid publication of the updated 2000 Project Seahorse global trade report, with the required funding;

- A Notification to the Parties, discussing how nations can get information on pre-Convention seahorse "stockpiles", minimum size implementation, workshop proceedings, and other relevant topics.
- Parties should inform the Secretariat of any special measures applicable to their seahorse exports and include these on any export permits as special conditions.

The participants then went on to describe the minimum data necessary for defensible and adaptivemanagement of wild seahorse populations. It was agreed that two different types of data must be collected: population data and fisheries data, as described below.

Population data (collected via fishery-independent programs, or by sub-sampling commercial landings):

- Presence/absence
- Species composition
- Densities/abundance indices
- Sex ratio (males, females, juveniles)
- Size structure
- Reproductive status (males – pregnant/not pregnant)
- Habitats/depth of collection
- Variation in seahorse distribution in time and space

Fisheries data:

A participant also asked about the need to monitor domestic use of seahorses in addition to international trade. She hypothesized that monitoring domestic trade would be necessary for gauging the detrimental impact of potential exports. Governmental representatives and the Secretariat commented that few if any nations monitor internal trade in wildlife, and that this is interpolated by occasional scientific surveys of wild populations, industry consultation, and market studies.

A few participants stressed the need to make use of data "clearing houses", where national authorities could extract important but elusive information on seahorse presence and absence, habitat maps, and densities. One participant mentioned that one could potentially estimate national seahorse population size by combining data on typical densities in particular habitat types and the occurrence of those habitats across a country's coastal zone.

After agreeing on the minimum data sets desired for seahorse non-detriment findings, the group began discussing how a Scientific Authority could recognize the signs of detrimental or unsustainable trade. It was agreed that an unexpected change in any of the following parameters should signal potential problems in a given seahorse population:

- Presence/absence
- Size/age structure
- Species composition
- Relative abundance
- Extirpations
- Sex ratio
- Habitat quality/quantity (would include invasive species, pollutants, etc)
- Catch rates (per unit effort)
- Trade rates (per unit effort)
- Frequency of male brood pouch

The group noted that new fisheries would result in initial considerable declines in one or more of these parameters, but declines should not persist indefinitely. It is imperative for Scientific Authorities and fishery managers to consider what changes may be a normal response to extraction (i.e., sex ratio shifts in a sex-selective fishery), and which changes are "alarms" or signs of population collapse. The group agreed that removal rates need to be adjusted in the face of unexpected declines regardless of their cause (fishery or non-fishery).

The chairman encouraged a debate on what constitutes an "alarm" or a cause for concern when looking at changes in seahorse population parameters or fishery data. Some participants proposed that statistically significant changes should generate action or regulatory change. However, the chairman cautioned that many datasets might show considerable variance (particularly in early years) that would complicate the data and trend interpretation. Others felt that any decline are worrisome if unexpected, and should be cause for action.

Changes in population or fishery indices should be assessed over a given species' estimated lifespan as a minimum time frame.

Scientific Authorities will need to assess the magnitude and meaning of any change, and advise Management Authorities accordingly. In so doing, they should consider how changes repeat across multiple datasets (e.g., several indices all show decline over the same time period).

It was agreed that the declines in population or fishery indices should be considered in relation to:

- The species' estimated lifespan (a decline is more worrisome for a long-lived species than a short-lived species)
- Their absolute magnitude (i.e., 20%, 50%, order of magnitude)
- Redundancy or repetition across multiple datasets (e.g., several indices all show decline over the same time period)

3. Develop potential methods to monitor, interpret, and control the effects of non-selective fishing gear on Hippocampus *populations.*

The group decided that means to monitor and interpret the effects of non-selective fishing gear (i.e., bycatch) had already been addressed in TOR 2 and Working Group 1. However, the participants felt it was important to provide guidance to CITES Authorities and fishery agencies about how to ameliorate or reverse unsustainable bycatch of seahorses so that Appendix-II trade in these species could continue without detriment to wild populations.

One participant advocated the use of rotational harvest schemes to allow seahorse populations to recover from indiscriminate or excessive harvest. Another participant said that rotational harvest regimes had not succeeded in many parts of the world. Other possibiliites to address non-selective fishing include:

- Temporal and spatial closures (e.g., no-take MPAs and no trawling zones)
- Zoning of fishing grounds (i.e., specifying which gear types are allowed in particular parts of fishable habitat). Zones might be established on basis of life history characteristics, such as depth preferences, seasonal movements, breeding cycles of a given *Hippocampus* species.
- Application of existing trawling bans when assessing sources of specimens destined for export. Many countries currently ban trawling in coastal waters, but have little or no enforcement and high levels of seahorse bycatch for international trade. Seahorses collected from these illegal fisheries should not be exported under CITES provisions for legal acquisition. However, it would require close collaboration between national Management Authorities, Scientific Authorities, and law enforcement agencies to enforce trawling bans in real time and upon permit issuance.

- Comparison of abundance in fished vs. non-fished areas (this would help gauge the impact of bycatch fisheries on seahorse populations)

- Gear management: National Authorities should consider the potential retention and mortality of undersized/immature seahorses relative to legal or adult seahorses in various gear types. Gear modification could possibly reduce bycatch of unwanted seahorses in other fisheries.

As per CITES Decision 12.53, national CITES authorities should consider sending these findings to appropriate fishery agencies, FAO, and regional fishery bodies for consideration and action.

National authorities should provide the results of monitoring and research programs to international "clearinghouses" to promote maximum exchange of information on seahorse fisheries.

Working Group Participants

Hesiquio **BENITEZ**, CONABIO

Paloma **CARLON DE GRAMMONT**, Instituto Nacional de Ecologia (MX)

Tom **DE MEULENAER**, CITES Secretariat

John **FIELD**, USFWS (chair)

Sarah **FOSTER**, Project Seahorse

Manuel Osario **GRALINDO**, AZOO Mexico

José Antonio **MARTINEZ HERNANDEZ**, Acuario de Veracruz, Mexico

Ed **MATHESON**, Florida Fish and Wildlife Conservation Commission

Paola **MOSIG**, CONABIO

Judith **NUÑEZ LECUANDA**, Ingens Cultivos Marinos, Mexico

Arturo **PERARTA DELGADO**, CONAPESCA, Mexico

Ierecê Lucena **ROSA**, Universidade Federal de Braiba, Brazil

Amanda **VINCENT**, Project Seahorse

Eliezer Armondo **ZUÑIGA** V., Ingens Cultivos Marinos, Mexico

NATIONAL REPORT

-AUSTRALIA-

The Australian CITES Management Authority, the Australian Government Department of the Environment and Heritage (DEH)

I. Information on wild populations

a. Species of Seahorses in Australian Waters

See Table 1.

b. Survey Programs in Place, If Any

State fisheries management authorities manage Syngnathid fisheries and therefore management differs across the jurisdictions.

Tasmania

Project Seahorse in southeastern Tasmania undertakes regular surveys of *H. abdominalis*.

Western Australia

License holders in the West Australian Marine Aquarium Fish Managed Fishery are required to submit monthly catch and effort returns detailing the number of species taken and the locations of take. The returns are recorded in the management agency's Catch and Effort Statistical System.

New South Wales

Universities and scuba diving clubs have conducted a few localized studies. Most recently a study was conducted on specimens of *H. whitei* and *H. bleekeri* on a shark mesh net in Sydney.

South Australia

None.

Queensland

Occurrence of seahorses is being documented as part of various trawl fishery research and monitoring programs. However there are currently no specific *Hippocampus* programs.

Victoria

The Museum of Victoria has undertaken work in the past on the Victorian coast. The survey is not a formal survey as such but is a database collection of 'point data' i.e. lists specific places where the specimen was found. The database is continually added to over time, and therefore shows distribution over time and temporal information (for example species found in Port Phillip Bay from over 100 years ago). All specimens are retained, allowing for re-identification over time. There are 42 'lots' or 'events of collection' (1-20 individuals in a lot) of *Hippocampus breviceps* from Victorian waters.

Northern Territory

None known.

Current Research Projects

- "Competition or choice: sex roles and sexual selection in the big-bellied seahorse", Keith Martin-Smith, Project Seahorse and University of Tasmania
- "Interactions of the big-bellied seahorse *Hippocampus abdominalis* with artificial structures", Keith Martin-Smith, Project Seahorse and University of Tasmania
- "Life history parameters of seahorses in Sydney Harbor – growth, movement, dispersal, longevity and behavior", Keith Martin-Smith, Project Seahorse and University of Tasmania & Jonathan Clark-Jones, Sydney.
- Recently completed study "Short-term movement patterns and habitat use of *Hippocampus whitei* at Clifton Gardens, Port Jackson", Gina Barnett & Scott Wilson, Australian Catholic University. [2003]
- Recently completed study "Resource utilization and reproductive biology of syngnathid fishes in a seagrass-dominated marine environment in south-western Australia" Alan Kendrick, Murdoch University. [2002]

c. Area of distribution, and habitat types if known

See Table 1 above.

d. Abundance (including anecdotal information)

Abundance information exists for a limited number of species (taken from information provided by State fishery management authorities).

H. abdominalis

Very common in Port Phillip Bay, southern sections of Westernport Bay and sponge gardens off Wilson's Promontory in Victoria. Overall abundance fluctuates every year. The last 5-6 years the species has been very common in Victoria. Abundance is likely to be dependent on food (i.e. abundance of mysids).

Preferred habitat in Victoria: Clear water rather than estuarine habitat, colorful bryozoans and sponges, common short kelp such as *Ecklonia* kelp substrate.

H. breviceps

Common in pockets across Victorian coast in areas where there is a semi open exposed bottom. Large numbers have been observed in seagrass beds in the Tamar River, Tasmania. Rare in southern Tasmania, occasionally found in seagrass beds.

Preferred habitat in Victoria: Shallow water, semi sheltered, Sargassum weed substrate, just below intertidal zone and as deep as 10m. Can occur at sea but prefers estuarine environment.

H. abdominalis

Anecdotal information suggests that there are large numbers in the Huon Estuary and D'Entrecasteaux Channel in Tasmania where they have been observed around salmon marine farming leases and at wharfs and jetties.

H. subelongatus

Anecdotal information suggests large numbers of this species in the Swan River Estuary, Western Australia at certain times.

Most other species reported from Australian waters are considered to occur at low abundance, but systematic surveys have generally not been conducted.

II. Nature of Seahorse Fisheries

State fisheries management authorities manage Australian seahorse fisheries, and the management arrangements therefore vary across the States. For a. to f. please see Appendix A.

g. Conservation measures

International

Four of the 13 Australian species in Lourie et al. (1999) are listed as Vulnerable on the IUCN Red List while the remainder are listed as Data Deficient (IUCN 2003). The majority of these species were assessed in 2001, except H. abdominalis (1994) and the criteria for the Vulnerable listings were downward trends in population sizes. All the Vulnerable species are widespread Indo-Pacific species that are exploited commercially outside Australia.

Australian Government – Commonwealth Legislation

All syngnathids and solenostomids are listed marine species under Part 13 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). As a result of this listing, it is an offence to kill, injure, take or trade syngnathids and solenostomids in, or from, a Commonwealth area. The Act specifies that certain actions are not offences, including actions undertaken in accordance with an accredited management regime or in accordance with a permit under which the action is approved. Accidental capture may also provide a defense against prosecution.

Syngnathids are considered regulated native specimens under Part 13A of the EPBC Act, and therefore require an export permit from DEH. In order to get this permit, the operation from which the specimens are sourced needs to be an approved wildlife trade operation or an approved captive breeding operation under the EPBC Act. There are a number of requirements that need to be met in order for an operation to be approved under the EPBC Act. These requirements include ensuring that any commercial utilization of Australian native wildlife for the purposes of export is managed in an ecologically sustainable way, and that Australia's obligations under CITES are complied with. Permits may also be issued for non-commercial purposes including education and research. Further detail regarding requirements for an approved operation under the EPBC Act can be found at http://www.deh.gov.au/coasts/fisheries/index.html.

Western Australia

There is no specific legislation that relates to the taking of seahorses. The collection of specimens is prohibited in sanctuary zones and closed waters in marine parks and reserves.

Victoria

Under the Victorian *Fisheries Act 1995*, the family *Syngnathidae* is listed as Protected Aquatic Biota. Victoria's Marine Parks and Sanctuaries provide protection for a variety of habitats and species. A permit holder cannot take seahorses from a Fisheries Reserve or Marine Park.

South Australia

Current policy may limit the number of individuals taken from the same locality within a specified time period, particularly where there is the intent to collect male and female specimens, to avoid the removal of entire populations or breeding potential from one area.

Tasmania

Taking of *Hippocampus* species is prohibited in Tasmanian State waters under the Tasmanian *Living Marine Resources Management Act 1995*.

Queensland

None.

New South Wales

A discussion paper has recently been released on the New South Wales Government's proposal to protect all syngnathids from collection in the wild.

Northern Territory

None.

III. Extent of International Trade

This information has primarily been taken from an unpublished paper written by Keith Martin-Smith on syngnathid trade in Australia.

a. Number of levels (buyers, middlemen, exporters, etc.)

Best information suggests that there are usually up to 3 levels within the seahorse trade in Australia. The participants differ between the live and dried seahorse trade.

The live seahorse trade usually consists of three levels:

1. The fisher that harvests live specimens from the wild
2. The aquarium shop owner or aquaculture facility operator
3. The exporter

In some cases all three levels are undertaken by the one operation. Some captive breeding operations harvest a limited number of specimens from the wild themselves, before breeding them in an aquaculture facility and then exporting the progeny to overseas buyers. Wild specimens exported would generally only have 1 or 2 levels involved, either the specimen would be exported directly by the collector to an overseas buyer, or an exporter would be employed to manage shipment of the specimens.

The export of dried seahorses from Australia is very small and therefore little is known about this industry. It is likely that the trade would include a fisher, that harvests specimens from the wild, and an exporter, with a traditional Chinese medicine supplier potentially involved in the middle.

b. Information on value, retail and wholesale prices

Statistics for dried seahorses being exported to Hong Kong between 1998 and 2001 indicate that prices have varied between approximately US$270 and US$100 per kilo. Live seahorse prices over the period 1997-2000 have varied between an average of US$189 and US$9 per individual.

c. Customs/CITES involvement at ports

DEH relies heavily on the Australian Customs Service (Customs), as Australia's primary border protection agency, to implement CITES at ports of exit and entry. Under a formal memorandum of understanding, Customs performs the following major tasks:

- Inspection of CITES documents at ports of exit and entry;
- Seizure of items suspected of being exported or imported in breach of the Act;
- Short-term storage, transfer and secure destruction of seized items, subject to DEH direction; and
- Provision of technical and practical assistance in investigations and prosecutions of breaches of the Act, where border control has been compromised.

A strong relationship with Customs is essential to effective implementation of CITES in Australia. In order to further this strategic relationship by promoting inter-agency awareness, a Customs officer is permanently seconded to IWT, primarily to assist in investigations and to liaise with Customs.

DEH supports Customs in its work through regular and ad hoc training exercises, and the ongoing provision of technical advice (including a twenty-four hour call service).

d. Relationship between CITES offices and fisheries agencies

The EPBC Act is the primary legislative vehicle for the implementation of national obligations under CITES and domestic control of international trade in non-CITES wildlife. DEH (also the CITES Management Authority) is responsible for ensuring that Commonwealth managed and State export fisheries are assessed under the EPBC Act to ensure that they are managed in an ecologically sustainable manner. In fulfilling this requirement, DEH works closely with fisheries management authorities and ensures they are aware of CITES requirements.

e. Export volumes

Discrepancy exists between export figures for dried seahorses from Australia and import figures from other countries. Volumes of dried seahorses recorded by the DEH as exported from Australia in the period1998-2000 were less than 5kg, however imports to China, Hong Kong and Taiwan over the same period were 500kg. It is possible that this discrepancy is due to pipehorses from Australia being recorded as seahorses when they were imported to Taiwan and Hong Kong. It is also possible that there was a degree of under-reporting of export volumes.

There is reasonable consistency between live seahorses recorded as exported from Australia and import figures from the largest market, the U.S.A. The volumes of live seahorses exported have increased from 254 seahorses in 1998 to 3224 in 2000, the majority of which were *H. abdominalis*. The increase in seahorse exports represents the increase in commercial production from aquaculture operations in South Australia and Tasmania[1].

f. Statistics

No statistics are available.

(Footnotes)

[1] Martin-Smith, unpublished.

Table 1: Species of the genus *Hippocampus* in Australian waters (taken from Kuiter 2000, Kuiter 2001, Kuiter 2003-, Lourie *et al* 1999 and information provided by State fisheries management authorities).

a. Species of seahorses in Australian waters (endemic species marked with *)		**c. Distribution and habitat if known (According to literature and information provided by State fisheries management authorities)**
According to Kuiter 2000, 2001 and 2003	**Recognized by Lourie *et al* 1999**	
H. abdominalis (New Zealand pot-belly seahorse)	*H. abdominalis* (Big-belly seahorse)	New Zealand and southern Australian waters. Found on macroalgae and sponges to depths of 80m. In Tasmanian waters the species is found in estuarine sheltered waters and on man-made structures.
H. alatus * (Winged seahorse)	–	Northern Australia, soft bottom habitat from 10-80m depths.
H. angustus * (Western spiny seahorse)	*H. angustus* * (Narrow-bellied seahorse)	Northern Australian waters (Shark Bay, Western Australia to Torres Strait). Usually found on algal reef 12-25m and trawled from up to 60m.
H. bargibanti (Pygmy seahorse)	*H. bargibanti* (Pygmy seahorse)	Throughout the West Pacific, Coral Sea, southern Japan and ranging into Indonesia. Always found in association with soft corals in depths over 20m.
H. biocellatus * (False-eyed seahorse)	(Part of *H. trimaculatus*)	Shark Bay Western Australia. Occurs in shallow algae or weedy reef habitats to a depth of about 20m.
H. bleekeri (Australian pot-belly seahorse)	(Part of *H. abdominalis*)	Known in waters of South Australia, Victoria and Tasmania. Occurs in shallow estuaries and reefs in coastal waters to a depth of at least 35m.
H. breviceps * (Short-head seahorse)	*H. breviceps* * (Short-headed seahorse)	Southern Australia, in protected bays and estuaries associated with brown algae on low, shallow reefs.
H. colemani * (Coleman's pygmy seahorse)	–	New South Wales coast, only known from shallow sparse seagrass at Lord Howe Island
H. dahli * (Low-crown seahorse)	(Part of *H. trimaculatus*)	Coastal Queensland to Darwin, Northern Territory. Lives in estuarine channels and offshore on soft bottoms to 21m.

a. Species of seahorses in Australian waters (endemic species marked with *)		**c. Distribution and habitat if known (According to literature and information provided by State fisheries management authorities)**
According to Kuiter 2000, 2001 and 2003	**Recognized by Lourie *et al* 1999**	
H. elongatus * (West Australian seahorse)	*H. subelongatus* * (West Australian seahorse)	Sub-tropical West Australian waters, occurring mainly in sheltered bays in mixed reef and vegetation habitats from 1-25m depth often in high sediment areas.
H. grandiceps * (Big-head seahorse)	(Part of *H. spinosissimus*)	Eastern side of the Gulf of Carpentaria, in shallow water.
H. hendriki * (Eastern spiny seahorse)	(Part of *H. spinosissimus*)	Inner Great Barrier Reef area, Queensland.
H. histrix (Thorny seahorse)	*H. histrix* not recorded from Australia.	Range from Japan through Indonesia and the Coral Sea, Australia. Deep coastal slopes over 15m deep on soft bottom. (Occurrence of this species in northern Australian waters needs confirmation)
H. jugumus n.sp. * (Collared seahorse)	*H. fisheri* (Fisher's seahorse)	Only known from a single specimen at Lord Howe Island, New South Wales. Further work needed.
[*H. kampylotrachelos* (Smooth seahorse)]	(Part of *H. trimaculatus*)	A single specimen recorded from Ashmore Reef, Western Australia in a bird's nest – may have come from Indonesia.
	H. kuda (yellow seahorse, spotted seahorse)	Northern Australian waters, and throughout the Pacific and Asia. Shallow inshore waters to 50m, usually soft substrates.
H. minotaur * (Bullneck seahorse)	*H. minotaur* * (Bullneck seahorse)	Only known from a few specimens in southern New South Wales and Bass Strait region. Trawled from 64-100m
H. montebelloensis. * (Monte Bello seahorse)	–	Monte Bello Island in Western Australia.
H. multispinus (Northern spiny seahorse)	(Part of *H. angustus*)	Northern Australia waters and southern Papua New Guinea. Most specimens trawled 20-60m.
H. planifrons * (Flat-face seahorse)	(Part of *H. trimaculatus*)	Shark Bay to Exmouth, Western Australia. Lives in algae and rubble reefs in shallow bays to 20m depths.
H. procerus n.sp. (High-crown seahorse)	(Part of *H. whitei*)	Southern Queensland, on mixed algal reefs to depths of about 20m.

a. Species of seahorses in Australian waters (endemic species marked with *)		**c. Distribution and habitat if known (According to literature and information provided by State fisheries management authorities)**
According to Kuiter 2000, 2001 and 2003	**Recognized by Lourie *et al* 1999**	
H. queenslandicus * (Queensland seahorse)	(Part of *H. whitei*)	Inner reef waters of Queensland in depths of 20-63m.
H. semispinosus (half-spined seahorse)	(Part of *H. kuda*)	Specimens of this species possibly trawled from North West shelf, Western Australia. Further work needed.
	H. spinosissimus (Hedgehog seahorse)	Torres Strait and Gulf of Carpentaria. Muddy or sandy bottoms.
H. taeniopterus (Common seahorse)	(Part of *H. kuda*)	Found in the Moluccan seas, Papua New Guinea and tropical eastern Australia. Shallow water species, mainly in coastal areas to about 15m depths.
H. tristis * (Sad seahorse)	*H. kelloggi* (Kellogg's seahorse)	Distribution and taxonomy uncertain. Has been found in southern Queensland, northern New South Wales and Lord Howe Island, mostly from trawls between 18-53m depths.
H. tuberculatus * (Knobby seahorse)	(Part of *H. breviceps*)	Western Australia, offshore in floating *Sargassum*, settling on sponge reefs at about 20m depth
H. whitei * (White's seahorse)	*H. whitei* * (Sydney seahorse)	Found in estuaries of New South Wales.
H. zebra (Zebra seahorse)	*H. zebra* * (Zebra seahorse)	Queensland and southeastern Papua New Guinea. Soft bottom habitat in depth of about 20-60m.

Note: Lourie *et al.* (1999) has been adopted as standard taxonomy for CITES listing and IUCN Red Book listings. This gives a total of 13 species found in Australian waters with the possible addition of a 14th species, *H. histrix*. On the other hand, Kuiter (2001 and 2003) recognizes 25 species (with a possible two additional species). Further genetic and morphometric work is needed to ascertain the true number of species. For example Armstrong (2001) showed that there were no significant differences in the cytochrome b sequence of *H. abdominalis* and "*H. bleekeri*" suggesting that there is only one species. However, genetic sequencing of *H. biocellatus* has confirmed it to be a true species (Sara Lourie, pers. comm.) since the publication of Lourie *et al.* (1999) and there seems little doubt that *H. colemani* is a true species.

REFERENCES

Armstrong, P. 2001. *Genetic and Morphological Variation in Pot-bellied Seahorses (Hippocampus abdominalis): Is there evidence for two species?* B.Sc. (Hons.) thesis, University of Tasmania.

IUCN. 2003. *2003 IUCN Red List of Threatened Species*. < http://www.redlist.org>. Downloaded on 14 January 2004.

Kuiter, R. H. 2003. *A New Pygmy Seahorse (Pisces: Syngnathidae: Hippocampus) from Lord Howe Island*. Records of the Australian Museum 55: 113-116.

Kuiter, R. H. 2000. *Seahorses, Pipefishes and Their Relatives: A Comprehensive Guide to Syngnathiformes*. TMC Publishing, UK.

Kuiter, R. H. 2001. *Revision of the Australian Seahorse of the Genus Hippocampus (Syngnathiformes: Syngnathidae) with Descriptions of Nine New Species*. Records of the Australian Museum 53:293-340.

Lourie, S.A., A. C. J. Vincent and H. J. Hall 1999. *Seahorses: An Identification Guide to the World's Species and their Conservation*. Project Seahorse, UK.

Martin-Smith, K.M. *Syngnathid Trade in Australia*. Unpublished.

Appendix I. Management of State Seahorse Fisheries

State	Species taken	Commercial licensing/permitting requirements	Recreational licensing/ permitting requirements	No. Permits	Gear used	Landings data
South Australia	*Hippocampus abdominalis* (Big-bellied seahorse)	Collection from the wild for commercial purposes requires an exemption under Section 34(1) of the *Fisheries Act 1982*. Current policy is to only issue exemptions for the collection of broodstock for recognised and competent breeders for the aquaria trade.	Not covered under *Fisheries Act 1982*. It is believed that wild harvest for personal aquaria etc is negligible.	4 since 1st Jan 2000, roughly on an annual basis from a single known breeder	?	23, 20, 20, 10,
	Hippocampus breviceps (Short-headed seahorse)	As above	As above	3 since 1st Jan 2000	?	10, 6, 10,
	Hippocampus whitei (White's seahorse)	As above	As Above	0	?	0
Victoria	*H. breviceps* *H. bleekeri*	Permit required Application for permit must include a business Plan for consideration in the application	(*Sygnathidae* listed as Protected Aquatic Biota under the *Fisheries Act 1995*) Recreational take is prohibited.	3 permits issued allowing the *take and display* 1 permit issued allowing *take and sale*	Hand net	Landed and sold live. Very small quantities, the one Victorian permit holder authorised to sell, only harvests a small number (less than 10) each year for breeding.
New South Wales		There is currently no commercial harvest or aquaculture of *Hippocampus* sp in New South Wales.				
Northern Territory		Unknown				

State	Species taken	Commercial licensing/permitting requirements	Recreational licensing/ permitting requirements	No. Permits	Gear used
Western Australia	*Hippocampus angustus* (WA spiny seahorse)	Annual syngnathid quota of 750 individuals*. Required to submit monthly catch and effort returns detailing the number of species taken and the locations of take.	There is no recreational take.	13 licenses in the commercial fishery.	Collect specimens by hand or hand held nets.
	Hippocampus breviceps (Short snouted seahorse)	Same as above.	Same as above.	Same as above.	Same as above.
	Hippocampus hystrix (Spiny seahorse)	Same as above.	Same as above.	Same as above.	Same as above.
	Hippocampus kuda (Spotted seahorse)	Same as above.	Same as above.	Same as above.	Same as above.
Tasmania	*Hippocampus abdominalis, Hippocampus breviceps*	No commercial licenses. Permits issued authorising limited harvest for educational and community awareness purposes and scientific research (including one for aquaculture broodstock).	No recreational licensing.	4 current permits (duration less than 12 months)	
Queensland	*H. alatus* *H. bargibanti* *H. dahli* *H. grandiceps* *H. hendriki* *H. procerus* *H. queenslandicus* *H. taeniopterus* *H. tristis* *H. zebra*	Licensed marine aquarium fish collectors that may collect all ten species. Public aquaria are authorized to collect and display fish under a General Fisheries Permit. Aquaculture permits can also be obtained for broodstock collections.	Seahorses can be taken recreationally without permit authority using gear prescribed under the Fisheries Regulations 1995.	There are approximately 50 marine aquaria permits. Aquaculture permits have been issued.	

NATIONAL REPORT

-BRAZIL-

Ierecê Lucena Rosa
Universida de Federal de Paraiba
CCEN, Departmento de Sistematica e Ecologia,
CIDADE Universitaria,
58058-800 Joao Pessoa, PB Brazil
ierece@dse.ufpb.br

Data presented in this report were obtained through surveys conducted by the author and collaborators along the northeast coast of Brazil, and in Santa Catarina and Rio de Janeiro states. Supplementary information was obtained through visits to scientific collections, environmental agencies, loan of specimens and through underwater surveys carried out by the author, colleagues and local divers. Additionally, collection permits issued by the Brazilian federal environmental agency IBAMA (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis), were examined for the following states: Ceará, Paraíba, Pernambuco, São Paulo and Bahia.

Information on Wild Populations

Two seahorse species are recorded in Brazil: *Hippocampus erectus* (Perry, 1810), a medium-sized deep-bodied species, usually marked with horizontal lines and *H. reidi*, the slender seahorse, a medium-sized species (Lourie *et al*., 1999). Both species exhibit morphological variation and distinct color patterns that deserve further investigation from a taxonomic viewpoint (Dias *et al*., 2002; Rosa *et al*., 2002). Records of other species of seahorses in Brazil, such as *Hippocampus kuda,* result from misidentifications. *H. erectus* and *H. reidi* are found throughout Latin America, as far south as Argentina and southern Brazil. Within Brazil, *H. erectus* is known to occur in Bahia to Rio Grande do Sul, while *H. reidi* has been recorded in Pará to Rio Grande do Sul.

Both *H. erectus* and *H. reidi* are exploited for the dried and live trade in Brazil although traders did not discriminate one species from the other. Published biological data obtained in the wild is limited to Dias (2002) and Dias and Rosa (2003). In 2001, Argentinean biologists were about to research the basic biology of *H. erectus* in the wild. Both of these species are listed as Vulnerable (A2cd) by the IUCN (Hilton-Taylor, 2000). In the states of São Paulo and Rio de Janeiro they were considered a threatened species; population status has not been evaluated in the other states.

Seahorses were mostly strongly associated with mangroves (particularly in northeast Brazil), reefs and rocky areas, at depths ranging from 10cm to 30m. These fishes are also known to occur in deep areas and seahorse captures were reported to occur at depths ranging from 30-75m. Nine seahorses (six in October, two in November and one in December) have been found in the stomach of the oceanic dolphins *Coryphaena hippurus* captured off the southeastern and southern Brazilian coast (Zavala-Camin, 1986). In northeastern Brazil, one seahorse was found in the stomach of a *C. hippurus* captured in January 1999,

60 miles off the Ilhéus coast (Cláudio Sampaio, pers. comm., July 2001). Seahorses have also been captured in research trawls (depth 30m) in northeastern Brazil (A. Vera, pers. comm., February 2001). Respondents reported that seahorses were mostly found in areas where algae, sponges or corals covered the bottom suggesting that they prefer these conditions.

Initiatives to monitor the trade are being carried out in Bahia, Rio de Janeiro, Santa Catarina, Pernambuco and Ceará, as part of the broader study "Biology, population parameters and analysis of the seahorse trade (Teleostei: Syngnathidae: *Hippocampus*) in Brazil", coordinated by the author of this report, in partnership with IBAMA – Brazil's Federal Environmental Bureau.

Fisheries

- **Dried Trade**

Large quantities of dried seahorses have been exported from several South American countries in recent years. *Hippocampus erectus* and/or *H. reidi* were exported from Brazil to Hong Kong (240kg in 2001). Seahorses were incidentally caught, mostly in shrimp trawls, and also beach seines and were targeted or incidentally caught in cast-nets.

Beach seining was an important source of seahorses for the dried trade in the northeastern states; shrimp trawler fishery was the main source of dried seahorses in southeastern and southern Brazil. Fishermen from small coastal towns where the seahorse trade was not established explained that they released captured individuals or sometimes took them home and dried them for use as medicinal remedies, decoration or gifts. Where seahorse fishing had been commercialized, however, the vast majority of seahorses caught in nets were sold into the domestic dried trade.

Our data strongly suggest that most dried seahorses exported from Brazil, and the vast majority of specimens traded domestically in southeastern and southern Brazil are caught incidentally in Brazil's commercial shrimp trawl fisheries operating between Espírito Santo and Rio Grande do Sul. *H. erectus* possibly is the most caught species in shrimp trawls. Dried seahorses are also supplied by artisanal fisheries (beach seines and throw nets), divers, or lobsters nets (Ceará, Maranhão and Pará states) to both coastal and inland areas for sale in markets, *umbanda* (Afro-Brazilian religion) article shops, dried marine products/ crafts shops, and by street vendors. In 2002, interviews carried out during landings at the Itajaí port, Santa Catarina state (n=51 boats) resulted in a mean daily seahorse catch rate of 0.44 per boat. By combining the daily catches and the reported maximum number of days at sea (30 days), it is estimated that 13.2 seahorse specimens may be caught per month per boat. In 2002, 374 Santa Catarina boats equipped with shrimp trawls known as *arrasto duplo*, operated in southeastern and southern Brazil (UNIVALI, 2003). Since shrimp trawls that operate from the border of Bahia and Espírito Santo to Rio Grande do Sul can legally fish for nine months of the year (no fishing is allowed between March 1 to May 31 due to federal legislation), it is estimated that 44,433 seahorses may be brought to the Itajaí port by the *arrasto duplo* boats alone. Seahorse landings were reported at other four states: Rio de Janeiro, Ceará, Pará and Paraná, however no information on catch rates was available.

One hundred vendors of dried seahorses were located in Brazil (encompassing *umbanda* article shops, dried marine products or crafts shops, folk medicine booths in markets), and estimate that the domestic trade consumed a total of 15,000 seahorses (7-14 kg, depending on the species) annually. *Umbanda* shops and folk medicine booths in markets were the main places of sale. Seahorses were traded from one state to another, throughout the coast and in various inland municipalities, usually in conjunction with other marine products, such as starfishes and shells. Seahorses were sold either directly

from the fishermen to the distributor or through intermediate buyers. Retailers from Bahia State distributed seahorses to the coastal states of Paraíba, Pernambuco, Alagoas, Sergipe, São Paulo and Santa Catarina, and to some inland municipalities. We located one wholesaler in Rio de Janeiro who distributed specimens to Santa Catarina and Goiás – a landlocked state.

The dried seahorse trade is unregulated in Brazil. Exports of dried seahorses have not been officially recorded in the country but Hong Kong Customs data indicate that Hong Kong imported 240kg (approximately 110,000-220,000 specimens, depending on the species) of dried seahorses from Brazil in 2001.

Two fishermen from Paraíba mentioned in 2000 that they had been asked to sell dried seahorses to fishermen working on Taiwanese vessels operating in Cabedelo municipality, suggesting that seahorses may have been exported to Taiwan. One dealer from Santa Catarina mentioned that a member of the crew of a Japanese fishing vessel had 15,000 dried seahorses (7-14 kg, depending on the species) to be sold in China. Unofficial records of exports to Honk Kong were obtained in Rio de Janeiro and Espírito Santo (n=2 dealers). It is likely that dried seahorses were also being exported from Brazil to Hong Kong, China and Taiwan but remained unreported. The frequencies with which seahorses were exported, and volume estimates are unknown. Interview and monitoring of one dealer in southern Brazil suggested that minimally 15,000 dried specimens were traded in 2001. Only two other dealers reported sales of 10,000 or more seahorses per annum (one at Rio de Janeiro, another at Espírito Santo). One boat owner interviewed in Espírito Santo state informed that most exported specimens were from Rio de Janeiro, and were sold by the kilogram, through trader levels 1 to 4. Many dried specimens were sold domestically, mainly for medicinal purposes.

Seahorses were largely (but not exclusively) collected in the northeastern states of Espírito Santo and Rio de Janeiro, the southeastern state of Santa Catarina, southern Brazil, and traded from one state to another. Traders in Rio Grande do Norte may have also supplied dried specimens to the Alagoas market for medicinal and religious purposes. One trader at an *umbanda* store mentioned that she imported seahorses from the Red Sea and India through a retailer in São Paulo, however we found no sound evidence of seahorse imports.

Only occasionally were specimens displayed to consumers; they were generally kept hidden in cans. Most traders interviewed (n=38) expressed their concern about being caught by environment officials because they perceived their activity as being illegal. Five traders believed that the trade was illegal because seahorses are under threat of extinction. Two traders reported that IBAMA officials had seized their stock of dried seahorses because "selling seahorses was illegal". Numbers of seahorses traded are difficult to estimate at this point. The number of traders in the seven markets visited in the northeast ranged from one to 30 and each had a standing stock of 30 to 150 seahorses. Five respondents mentioned they usually bought 100 seahorses at a time but they could not say how long on average it took to sell the specimens. One informant mentioned that she could sell 12 seahorses per day while another said he once sold 30 per day. Traders usually sold other dried animal products, such as sloth's claw and starfish, along with seahorses.

Retailing prices varied with the size of individuals, their origin and degree of preservation, and ranged (n=730) from 1.00 to 6.50 Reais (approximately equivalent to US$0.45 to $3.00 at the time the surveys took place). One trader said that when there was a shortage of seahorses, prices reached US$5.00

to $7.50. Retailers buy dried seahorses from fishermen, usually for less than US$0.50. Specimens were unbleached and sometimes had small sections of the body missing owing to mouse bites or insects. Seahorses imported to Hong Kong had a declared value of HK84,000 (US$10,769.36), equivalent to 44.87/kg.

- **Live Trade**

In South America, live seahorses were traded predominantly by Brazil. Brazil is one of the world's leading exporters of ornamental fishes and was among the 15 most important global traders between 1995 and 1997 (FAO, 1999). In a recent review of the global trade in marine ornamental fishes, Wood (2001) considered the Brazilian fishery for marine ornamental as large, involving 23-25 wholesalers. *Hippocampus erectus* is Brazil's sixth most important marine ornamental export (Monteiro-Neto *et al.,* 2000). Live seahorses were exported from Brazil to 20 countries in the Americas, Asia and Europe; according to Brazilian Custom's data the United States is the main market for these fishes.

Live seahorses were also traded domestically in Brazil. Permits were required to trade live seahorses but quotas were not well enforced. In 2000, live seahorse traders had to register at the Ministry of Agriculture and then request an authorization from IBAMA to capture a given number of seahorses. Traders generally did not have to indicate collection sites or final destination of the specimens. Generally, each company authorized to catch seahorses for the aquarium trade was allowed to catch a maximum of 10,000 seahorses per year (5000 each *H. reidi* and *H. erectus*). However, owing to misidentification, permission to capture 5000 *H. kuda* was also frequently given, thus inflating the quota. Color morphs were also listed as species on a few permits, thus artificially increasing the quota. Additionally, one marine fish dealer reported that because the contents of the live fish shipments were not checked, when the maximum quota for seahorses was reached they were sold as another species. In 2003 each company could export 2000 seahorses per year (1000 each *H. reidi* and *H. erectus*).

To export live seahorses, traders had to obtain an additional license that indicated the number of exported seahorses. However, officials did not check the numbers of both captured and exported seahorses provided by traders and figures provided by different sources differed markedly from one another. Live seahorses were exported under the general commercial category 'ornamental fishes' (code 0301.10.00 of '*Nomenclatura Comum do Mercosul*') that also included freshwater species. Thus pertinent Governmental offices had no export statistics for the live trade.

Although all marine aquarium fishes exported from Brazil are combined into the single commercial category of 'ornamental fishes', upon request Brazilian Customs sorted out seahorses from other ornamental fishes exported and provided official numbers of the trade. According to 1999 Brazilian Customs data, 1050 seahorses were exported to eight countries. However, that year in a monitoring program carried out by one IBAMA office, a single wholesaler from northeastern Brazil declared to IBAMA that he exported 3215 seahorses, more than the supposed total for all of Brazil. The discrepancies in numbers of exported seahorses clearly indicate the need to monitor trade and to integrate the various levels of data collection. In 2000, according to information provided by Brazil's Customs, 11,519 seahorses were exported to 19 countries; in 2001 (between January and April) 5561 were exported to 13 countries, the United States being the largest importer (2611 seahorses imported). In northeastern Brazil, seahorses were mainly exported through wholesalers located in Ceará, Pernambuco and Bahia. To a lesser extent, Alagoas also

exported seahorses. In southeastern Brazil, exporters existed at least in the state of São Paulo and Espírito Santo. Apparently the southern states did not have a significant role in seahorse exports.

Seahorses were sold either directly from fishermen to exporters or through intermediate buyers (up to three). Seahorses caught by artisanal fishermen were either taken immediately to the wholesaler or kept with the fisherman, possibly for up to one week. Fishermen, who worked on boats owned by the wholesalers, took seahorses directly from the boat to the holding facility. Three dealers mentioned that they could sell as many colorful seahorses as they could obtain. No estimates of daily sales were obtained but at one holding facility 150 seahorses were in stock to be sold when the author visited. One fisherman mentioned that one intermediate level buyer from northeastern Brazil shipped 300 seahorses to Rio de Janeiro.

During visits to two holding facilities in northeastern Brazil, a large number of pregnant seahorses were found. The quality of holding facilities varied greatly, ranging from one facility with inadequate sanitary conditions and tanks with precarious aeration systems, to a few well-equipped companies who had invested in equipment, such as UV filters and skimmers. At two holding facilities visited in northeast Brazil specimens were individually packed; the maximum number of seahorses shipped daily mentioned by respondents was 300.

Fishermen were paid between US$0.45 and (unusually) US$3.50 for each seahorse. Prices mostly depended on color, with red, orange and yellow specimens being most, and black ones least, valuable. One trader in northeast Brazil claimed that the price of black specimens had decreased in the last 10 years whereas the price of colored ones had markedly increased. One buyer (Level 2) in northeast Brazil mentioned that seahorse prices tripled at each level. In hobby shops seahorses were sold for prices ranging from US$7.50 (Alagoas) to 20 (Santa Catarina). United States import data from January 1996 to April 2000 show that Brazilian seahorses were imported, at a price of US$0.80-18.00 each. On a North American Internet site, Brazilian seahorses were advertised at US$45 each.

Fisheries regulations were not well enforced in Brazil. For instance, Brazilian law prohibits blast fishing and ichthyotoxics but both practices were known to occur in northeast Brazil. One fisherman explained that in the past he used ammonia and insecticide to aid in the collection of fishes for the aquarium trade and that in 2000 he used commercial anesthetic. Beach seines with stretched mesh sizes below 30mm (Raul Borba, pers. comm., June 2001) were prohibited by law, however enforcement was virtually non-existent. Furthermore, fishing was allowed in most existing protected areas. In fact, seahorses were captured for commercial purposes within the boundaries of at least two Marine protected areas in northeast Brazil (APA Mamanguape in Paraíba and APA do Litoral Norte in Bahia).

However, concern regarding the marine aquarium trade was growing. In November 2000, IBAMA promoted a workshop specifically to analyze the marine fish trade and to gather information to support the first statutory regulations of the trade. Additionally, when interviewed some traders of live specimens showed disposition to collaborate with monitoring initiatives. Additional technical meetings were promoted by IBAMA to analyze the marine ornamental trade. The main goal of the 2003 technical meeting was to conclude the preparation of the first national regulatory measure for the marine ornamental trade.

Seahorse Catch in Brazil

Seahorses were caught for the aquarium trade along most of the Brazilian coast. Fisheries directed at live seahorses occur at least in the following states: Pernambuco (one company licensed in 2000), Bahia (two companies licensed in 2002), Ceará (eight companies licensed in 2000), Alagoas (one company licensed in 2000) and Espírito Santo (8 companies licensed in 2002 – Iberê Sassi, personal communication). These fisheries were mostly conducted by self-taught divers, who generally also practiced subsistence fishing, or by former artisanal fishermen. Exporters bought catches from several locations and even from different states, either directly from fishermen or through intermediate buyers. In 2000, each company was authorized to capture a total of 10,000 seahorses (5000 of *H. erectus* and 5000 of *H. reidi*) per year. However, one collection permit examined by the author had four color morphs listed as separate species, potentially resulting in the collection of 20,000 seahorse specimens.

Population Declines

Most fishermen (n=25/29) interviewed reported declines in seahorse catches since 1990. One reported that, while in 1990 he could catch 500 seahorses daily and had a choice of colors, in 2000 he caught no more than five or six per day. Another, who could catch 150 per day in 1990, had since stopped collecting seahorses because it was no longer financially attractive. Six other fishermen indicated that seahorses, previously common, had disappeared locally.

Most respondents mentioned heavy fishing pressure as the cause for these declines. Additionally, two fishermen from Alagoas expressed their concern about blast-fishing and reported seeing a small number of dead seahorses floating after some of the explosions. Two fishermen in northeast Brazil mentioned pollution as a possible cause for the observed decline in seahorse numbers. Finally, one trader expressed his concern about the effects of trawling and disorganized tourism on reef fishes in general.

A high number of pregnant seahorses (live and dried) were found for sale. One fisher explained that in order to avoid problems with environment officials, whenever he found pregnant seahorses he squeezed the pouch to get rid of the offspring. Traders of live specimens said that newborn seahorses usually died shortly after birth; three collectors said that they occasionally released the newborn in the wild.

Lack of Monitoring

A major cause of concern for seahorse conservation stems from the near total lack of monitoring of the marine aquarium trade and the poor collection-permit system. After receiving the authorization, few traders reported on how seahorses were actually captured. Captures by unregistered traders occurred, at least in some northeast Brazilian States, and exerted an additional pressure on wild seahorse populations. This aspect is particularly relevant given the fact that since 1995 seahorses have become one of the top species in the Brazilian marine aquarium trade (Monteiro-Neto *et al.,* 2000).

The lack of control of the dried trade is also a major cause for concern. Numbers of traded seahorses should be further investigated in localities such as Rio de Janeiro, Guarapari and Vitória (Espírito Santo Sate), Paranaguá (Paraná State), Itajaí (Santa Catarina), Camoçim and Sobral (Ceará).

Habitat Destruction

Mangrove destruction and pollution of estuaries represent additional threats for seahorses (especially in northeast Brazil). Despite being protected by law, some mangrove areas were being lost to logging and clearance for aquaculture ponds. For example, aquaculture ponds are found in Rio Jaguaribe in Pernambuco,

and Rio Mamanguape in Paraíba. Aquaculture brings additional threats: three fishermen (from Santa Catarina) and one biologist (from northeast Brazil) who cultivated oysters stated that many seahorses were found in the aquaculture ponds, using the culturing lines as holdfasts. One of the fishermen, as a result, had decided to place all caught seahorses in a confined area to sell them.

Conclusions for Brazil

Brazil exported dried seahorses to Hong Kong in 2001 (240kg), and has been a major exporter of live seahorses at least since 1999. There is a need to integrate the various steps in data collection and to closely monitor the trade at least to guarantee that reliable capture, mortality and dried and live trade estimates are obtained.

In order to conserve seahorse populations in Brazil the following recommendations should be considered: trade regulations should be implemented and enforced; quotas should be reviewed to avoid overexploitation of local seahorse populations; education programs and small-scale aquaculture initiatives should be promoted; further research on taxonomy, population parameters and ecology should be stimulated; suitable sanctuaries should be delimited, where fishing is prohibited or strictly regulated.

In 2002, the Brazilian Institute of the Environment and Natural Resources, IBAMA (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis) had no list of marine fishes that could be captured (such a list exists for freshwater fishes). Hence, captures were authorized by IBAMA regardless of the species. A list of authorized marine fishes would facilitate control of the live seahorse trade because, for example, it could be updated to accommodate population declines in a State or area. An unpublished list of threatened marine fish species prepared in 2000 by the Brazilian Society of Ichthyology listed both *H. erectus* and *H. reidi*.

Customs/CITES Involvement at Ports

During our surveys no involvement at ports was observed. With regards to interactions between CITES and Fisheries agencies, as far as the seahorse trade goes, no evidence of information exchange or collaboration was found.

REFERENCES

Dias, T. L. P. 2002. *Ecologia populacional de Hippocampus reidi Ginsburg, 1933 (Teleostei: Syngnathidae) no Estado do Rio Grande do Norte, Brasil*. M.Sc. thesis, Universidade Federal da Paraíba, Brazil, 78 pp.

Dias, T. L. P. & Rosa, I. L. 2003. *Habitat preferences of a seahorse species, Hippocampus reidi (Teleostei: Syngnathidae)*. Aqua Journal of Ichthyology and Aquatic Biology.

Dias, T. L.; Rosa, I. L. & Baum, J. K. 2002. *Threatened fishes of the world: Hippocampus erectus Perry, 1810 (Syngnathidae)*. Environmental Biology of Fishes 65: 326.3.

Rosa, I. L.; Dias, T. L. & Baum, J. K. 2002. *Threatened fishes of the world: Hippocampus reidi Ginsburg, 1933 (Syngnathidae)*. Environmental Biology of Fishes 64 (4): 378.

FAO - Food and Agriculture Organisation of the United States. 1999. *Yearbook Fishery Statistics*, *v.85 (1997)*. FAO: 192pp.

Hilton-Taylor, C. (compiler). 2000. *2000 IUCN Red List of Threatened Species.* IUCN, Gland, Switzerland and Cambridge, UK. xviii + 61pp. Downloaded on 28 October 2001.

Hong Kong Customs Data. 1998-2001.

Lourie, S. A., A. C. J. Vincent, and H. J. Hall. 1999. S*eahorses: An identification guide to the world's species and their conservation*. Project Seahorse, Montreal, Canada and London, UK. 224 pp.

Monteiro-Neto, C., B. P. Ferreira, I. L. Rosa, L. A. Rocha, M. E. Araújo, R. Z. P. Guimarãe, S. R. Floeter and J. L. Gasparini. 2000. *The marine aquarium fisheries and trade in Brazil*. A preliminary report submitted to IUCN. Fortaleza, Brazil.

UNIVALI. 2003. *Boletim Estatístico da pesca industrial de Santa Catarina – ano 2002: ações prioritárias ao desenvolvimento da pesca no Sudeste e Sul do Brasil*. 93 pp.

Wood, E. M. 2001. *Collection of coral reef fish for aquaria: global trade, conservation issues and management strategies*. MCS, UK. 80pp.

Zavala-Camin, L. A. 1986. *Conteúdo estomacal e distribuição do dourado Coryphaena hippurus e ocorrência de C. equiselis no Brasil (24oS, 33oS)*. B. Inst. Pesca 13(2): 5-14.

NATIONAL REPORT

-CHINA-

FAN, Zhiyong
The Endangered Species Import and Export Management Office of the People's Republic of China (CNMA)
18 Hepingli Dongjie, Beijing 100714, China
zhiyongfan@21cn.com

In order to attend the International Workshop on Seahorse Fishery Management in Mazatlan in February 2004 and write the National Report on Seahorses, ten branch offices of The Endangered Species Import and Export Management Office of the People's Republic of China (CNMA) were requested to investigate the catch, captive breeding and trade of seahorses in ten provinces along the Chinese coast from December 29, 2003 to January 29, 2004. The following report is a summary of the results.

1. Seahorse Species Used in TCM in China

There are seven species of seahorses in China (Meng *et al*., 1995) (Table 1). Others report that six species of seahorses range in Chinese seas (Huang 1994). They are mainly distributed in areas around Taiwan, the South Sea and the East Sea of China. Several species occur in Yellow Sea and Pohai Sea of China. At this time, biological information is lacking and it is impossible to estimate the size of populations and their dynamics (CNSA, 2002).

Some species have been used as Traditional Chinese Medicine (TCM) or as tonics from as early as AC 502 and have been sold as whole dried specimens or as prepared medicines. All seven species of seahorses are listed as being TCM (Gao, 1996), but genuine TCM books record only five of them (NJMC, 1977; Gao, 1996) (Species in Table 1 with *). The common species used in TCM are *Hippocampus kuda, H. trimaculatus* and *H. japonicus*. A few species such as *H. abdominalis* have been introduced as aquarium fish or pet fish in recent years (Table 4).

2. Seahorse Catch or Harvest

The main threats to seahorse populations are widespread declines in abundance as a result of habitat loss and overfishing. Other threats include bycatch in trawl fisheries, pollution and the degradation of mangroves, grass beds and reefs. Fishermen do not specifically target seahorses in China, and seahorses are collected as bycatch or during low tide. There are no records of annual harvests in China. According to this investigation, less than 6000 kg dried seahorses are harvested annually in some provinces (Table 2).

The estimation of the harvest suggests about 20 tons on average per year (Zhao, 2002, pers. comm.). The main wild harvests are from Guangdong, Guangxi and Zhejiang Provinces and the harvested

specimens are sold countrywide. Other harvest regions include Putian and Tong-an of Fujian Province, and Laotin, Tangshan and Qinhuangdao of Hebei Province. Wild resources were rich in China before the 1960s and have decreased since the 1970s due to excessive harvest and habitat destruction (CNSA, 2002).

In 1988, one species, *H. kelloggi*, was listed as being protected species of national importance under Category II of the Chinese Wild Animal Protection Law, which allows for limited collection and trade only under special permit. There are no action plans or programs to protect or re-establish the population of seahorses in China but some *ex situ* breeding programs are being carried out by local governmental wildlife conservation agencies.

3. Captive Breeding of Seahorses

Captive breeding programs have been developing since the 1950s and during this investigation we learnt that some facilities have been built in Guangdong, Guangxi, Hainan, Fujian, Zhejiang, Shandong and Liaoning Provinces. The facility to produce the first captive-born seahorse (*Hippocampus trimaculatus*) in South China in 1957 was the Shantou mariculture Test Farm in Guangdong Province. In 1987, seahorses were successfully bred in captivity in Rizhao, a city of North China's Shandong Province (Zhang, 2000). Species in captivity are *Hippocampus kuda*, *H. trimaculatus*, and *H. japonicus*. These species could be bred in captivity but economic failure has forced breeding programs to remain in various stages of scientific research (CNSA, 2002). It has been reported in recent years that seahorse culture has been quite successful in some aquaculture companies in China (Ministry of Agriculture, 2002). More recently the test of aquaculture of seahorses has spread to Hainan, Guangdong, Fujian and Zhejiang Provinces. In order to make clear the actual situation of seahorse mariculture, a larger seahorses breeding facility was investigated by author from 21 to 24 May 2002. Guangdong Zhongda Richvast Bio-Tech. Co. Ltd. (ZRBT) (located at Lufeng City, Guangdong Province) began breeding research in 1995 and has produced seahorses since 1998. The main species in captivity is *H. kuda and H. trimaculatus*. F8 generations of *H. kuda* were born in 2001, which in turn could potentially give birth 8 times annually (Lu, 2002, pers. comm.).

Comparing captive seahorses with wild ones, many indexes increase significantly:

Growth rate increased 15%, pregnancy rate increased 50%, birth rate increased 60%, survival rate increased 30%, and brood rate increased 83.5%. The survival rate of one month young is 80% and that of more than one month is about 90%, the survival rate is as high as about 72%. The density of parent seahorses in captivity is 30 individuals/m^3 and sex ratio is 1:1. The density of young is 200-250 individuals/m^3. Hatching period is 20-25 days. The weight of an adult is 20-25g.

At present there are at least 6 seahorse aquaculture facilities in China. Some information is provided in Table 3. There are at least 1,906,800 seahorses in captivity and 27,200kg of dried seahorses are produced annually. A new and large breeding facility for seahorses is being built in Hainan, investing as much as 6,000,000 Chinese Yuan.

4. Seahorse Trade

The increase of domestic demand and international trade in traditional medicines is undoubtedly the chief cause for overexploitation of some species of seahorses worldwide. Vincent (1995) reported that the demand for seahorses for medicinal purposes increased ten-fold during the 1980s and have continued to grow by 8 to 10% annually in China alone and similar trends were likely to occur in other countries with large Chinese populations. TCM is one of the main pressures but not the only one on seahorses.

It seems that an increasing number of seahorses are used as tonics by consumers but not for medicinal purposes. Dried seahorses can be found at most tourism locations along China's coasts. It is obvious that the demand in China has been increasing.

Table 4, 5 and 6 are export and import records for seahorses from Mainland China customs and CNMA (Fan *et al.*, 2002). The highest import quantity was 15,333kg in 1992 and the lowest 184kg in 1999 with an average of 5204kg/year. The major export countries in order of importance are Thailand, Philippines, Indonesia, India and Australia. It seems that imports have decreased in the last ten years (Fig. 1). The reason for this is unclear.

The largest quantity exported was 1,933kg in 1995 and the lowest was 7kg in 1999 (Fig. 2) with an average of 567kg/year. The main importers include Hong Kong and Macao. The import quantity is ten times as much as the export quantity in China (excluding export quantity of TCM with seahorses). It can be concluded that most of the dried seahorses imported into China are consumed in China.

5. CITES Enforcement With Seahorses In Appendix II

Seahorse import and export have been monitored in Mainland China since 1998 when all species of seahorses were on the HS Commodity List of Import and Export of Wild Fauna and Flora in China. In China, non-CITES permits control the international trade of seahorse specimens. It will not be difficult for the CITES Management Authority of China to enforce CITES after May 15, 2004 when listing seahorses in Appendix II will become effective. China will implement this by replacing the non-CITES permits with CITES permits. Problems that are anticipated to arise for customs include the species-wise identification and recording of the live and dried specimens with new harmonized codes, which require a new monitoring system. It is also important to identify a minimum size criterion for specimens of all seahorse species in trade and the minimum size must be developed separately for each species. These technical issues need to be discussed in detail.

Table 1: The Species of Seahorses in China and Used in TCM

Common Name	Scientific Name	Detail Distribution
	*Hippocampus kelloggi**	Coastal areas along Guangdong, Fujian and Taiwan
	*H. kuda**	Coastal areas along Guangdong and Hainan
	*H. trimaculatus**	Coastal areas along Guangdong and Fujian
	*H. histrix**	Coastal areas along Guangdong and Fujian
	*H. japonicus**	Coastal areas along Guangdong, Shandong, Hebei and Liaoning
	H. coronatus	Coastal areas of Shandong, Hebei and Liaoning, Zhejiang and Jiangsu
	H. erinaceus	The Taiwan Straits

Table 2: Seahorse Harvest in China

Province	Trend	Harvest	Individual/ year	Kg/ year (dried)
Hainan	Decrease	Bycatch, collection	Less than 5000 (alive)	Less than 200
Guangdong	Decrease	Bycatch, collection	Some (alive)	Less than 1000
Guangxi	Almost disappeared inshore	Bycatch	80000-120000	1000-1600
Zhejiang	Decrease	By-catch	200000	3000
Fujian	Almost disappeared	By-catch	A few	A few
Jiangsu	Almost disappeared	By-catch	No data	No data
Shandong	Almost disappeared	By-catch	No data	Less than 10
Liaoning	Almost disappeared	By-catch	No data	A few
Tianjin	Disappeared			
Hebei	Almost disappeared	By-catch	No data	No data

Table 3: Seahorse Aquaculture Facilities In China

Information	Zhongda Richvast	Green Herbs	Pingtan	Wenzhou	Dongshan	Xiangshan
Province	Guangdong	Hainan	Fujian	Zhejiang	Zhejiang	Zhejiang
Species	*H. kuda*, *H. trimaculatus*	*H. kuda*	*H. kuda*	*H. trimaculatus*	*H. trimaculatus*	*H. trimaculatus*
Year Built	1995	1997	2000	1998	1997	1998
First Birth	1998	1998	2001	1999	1998	1999
First Products	1998	2000		2000	1999	2000
Scale Products	1999	2002		2002	2002	2002
Numbers in Captivity (individuals)						
1999	530000					
2000	780000					
2001	1000000					
2002	1600000	60000				
2003	1700000	80000	6000	40,800	50,000	30,000
Output (kg)						
1999	8000					
2000	11700					
2001	15000					
2002	24000	650				
2003	25000	700		600	600	300
Output Value (Chinese Yuan)						
1999	12,834,000					
2000	18,765,000					
2001	24,560,000					
2002	42,110,000	200,000				
2003	43,200,000	250,000				

REFERENCES

Vincent, A.C.J. 1995. *Trade In Seahorses For Traditional Chinese Medicines, Aquarium Fishes and Curios*. TRAFFIC Bulletin. 15(3): 125-128.

Huang, Zunguo. 1994. *Marine Species and Their Distribution in China's Sea*. Beijing: China Ocean Press. Pp. 690-691.

Meng, Qingwen et al. 1995. *Systematics of Fishes*. Beijing: China Agriculture Press. Pp. 519-530.

Gao, Shixian. 1996. *Record of Chinese Animal Material Medica*. Changchun: Jilin Scientific and Technological Press. Pp. 461-470.

Jangsu New Medical College (JNMC). 1977. *The Dictionary of Chinese Traditional Medicines*. Shanghai: Shanghai Scientific and Technological Press. Pp. 1923-1926.

Zhang, Chaohui. 2000. *A Study on Mariculture of Seahorses in China*. In: Zhang N. D. Eds. *The Protection of Resources of Endangered Medical Plants and Animals in China*. Shanghai: The Second Military Medical University Press. Pp. 96-101.

Ministry of Agriculture. 2002. A Document to CNMA on Seahorses.

CNSA (Endangered Species Scientific Commission, P.R.C). 2002. A Document to CNMA on Seahorses.

Fan, Zhiyong and Lu Xiaoping. 2002. *Native Species of Syngathidae and International Trade in Mainland China*. Technical Workshop on the Conservation of Seahorses and Other Syngnathids in Cebu, Philippines, May 27-29 2002. Unpublished.

Table 5: Import Data Of Dried Seahorses From 1992 To 2001 (Lack Of Data In 1998)*

Year	Country (region)	Quantity (kg)	Sum (US$)
1992	**Total**	**15333**	**876653**
	Hong Kong	280	27700
	India	1315	512
	Indonesia	1069	142610
	Japan	212	44647
	Philippines	4180	6897
	Thailand	8229	640803
	Australia	44	13366
	Other	4	118
1993	**Total**	**7708**	**936810**
	Hong Kong	150	22500
	India	869	34913
	Indonesia	427	59489
	Singapore	21	5350
	Thailand	6241	814558
1994	**Total**	**14545**	**1264047**
	Hong Kong	2618	440479
	Macao	15	369
	Indonesia	843	108188
	Singapore	290	47192
	Thailand	6611	646180
	Australia	4168	21639
1995	**Total**	**3815**	**523696**
	Hong Kong	770	124380
	Indonesia	295	29064
	Thailand	2715	360556
	Singapore	35	9696
1996	**Total**	**4904**	**569214**
	Indonesia	90	8575
	Japan	931	601
	Singapore	89	18627
	Thailand	3794	541411
1997	**Total**	**2290**	**143934**
	India	50	5250
	Indonesia	330	1320
	Japan	270	1080
	Thailand	1410	135690
	Taiwan	230	594
1998	**No data**		
1999	**Total**	**184**	**23735**
	Indonesia	184	23735
2000	**Total**	**1690**	**104068**
	Thailand	1690	104068
2001	**Total**	**1568**	**192451**
	Thailand	1568	192451
Ten years	***Total***	***52037***	***4634608***

* Data from customs

Table 6: Export Data Of Dried Seahorses From 1992 To 1999 (Lack Of Data In 2000 And 2001)*

Year	Country (Region)	Quantity (kg)	Sum (US$)
1992	**Total**	**1489**	**5541**
	Hong Kong	1485	4194
	Kazakhstan	4	1347
1993	**Total**	**896**	**2177**
	Hong Kong	896	2177
1994	**Total**	**685**	**3044**
	Hong Kong	345	1531
	Macao	340	1513
1995	**Total**	**1933**	**261729**
	Hong Kong	1832	261312
	Macao	101	417
1996?	**Total**	**196**	**670**
	Japan	180	298
	Macao	15	97
	Azerbaijan	1	275
1997	**Total**	**329**	**2162**
	Hong Kong	227	586
	Macao	55	330
	Taiwan	47	1246
1998	**Total**	**139**	**11849**
	Hong Kong	44	35
	Macao	5	23
	Korea	90	11791
1999	**Total**	**7**	**234**
	USA	7	234
2000	**No data**		
2001	**No data**		
Ten years	***Total***	***5674***	***287406***

* Data from customs

NATIONAL REPORT

-INDIA-

Debi Goenka
debi@beag.net

A rapid growth of human livestock population along with explosive urbanization and industrialization in the 20th century and consequent pressures of claiming land for development have taken a heavy toll of the country's and in particular coastal wilderness. In 2003, India had 600 wildlife sanctuaries, 89 national parks and 13 biosphere reserves covering about 155,000 km^2 or 4.76% of the geographical area under the Protected Areas network. However, the coasts have got much smaller representation than would be required for their comprehensive protection. Out of 10 biogeographic zones, the coasts with three provinces cover about 2.5% of the total biogeographic zone in India. The three coastal provinces cover 0.6% of the west coast, 9.1% of the east coast and Lakshadweep with less than 0.1%. Out of the thirteen Biosphere Reserves only one is constituted comprehensively for protection of the coastal region and that lies in southeastern India. The Gulf of Mannar Biosphere Reserve established in 1983 is the primary habitat for seahorses in India. The Gulf of Mannar Marine National Park and Palk Bay along the Tamil Nadu coast form the most important habitat for seahorses in India. However, seahorses are also reported from Pondicherry (off the coast of northern Tamil Nadu), the Andaman and Nicobar Islands and the coast of Kerala in the Indian Ocean. They have been reported from the Bay of Bengal in the east, the Indian Ocean in the south and Arabian Sea in southwest.

The Gulf of Mannar comprising of Bay of Bengal and Indian Ocean with a spread over 10,500 kilometers^2 spanning the Rameswaram and Tutikoran coastlines is a highly vulnerable zone. This is also where anthropogenic pressure is the most of all coastal regions in the country. There is concern that more than 80 marine species face threat of extinction in this biosphere reserve. Most of the seahorses of the single genus *Hipppocampus* and the family Syngnathidae have been reported from this region. The Central Marine Fisheries Research Institute (CMFRI) estimates occurrence of 30–40 species of seahorses. In India the legal commercial exploitation of seahorses was carried out from the states of Tamil Nadu and Kerala through July 2001. However, the catch and volume of exports showed a declining trend from 1998. There used to be regular export of seahorses from India, which was facilitated by the Marine Product Export Development Authority (MPEDA) based in Cochin, Kerala. The following table indicates the volume of trade:

Export of Seahorses from India

Year	Quantity in Kilograms	Country of Export
1996	3790	Singapore, Taiwan
1997	10443	Singapore, UAE, Japan
1998	14936	Singapore
1999	1269	Singapore
2000	1629	Singapore, UAE

Source: Marine Product Export Development Authority (MPEDA)

I. Extent Of Information On Trade

(a) Number Of Levels

There appears to be three levels in the trade from fishers to exporter on average. At Level Two it seems to be 2 to 7 buyers from fishers to each village involved in seahorse collection. These Level Two buyers and agents (middlemen) supply to Level Three buyers or the Exporter who finally export it out of India.

(b) Exportation On Value Retail And Wholesale Prices

Prices have increased substantially since the target seahorse fishery reportedly grew in 1989 or 1990. In 1995, fishermen received Rs.15 to Rs.45 (US $0.33–$1) per seahorse, based on size, with most being worth Rs.6 to Rs.12. Level Two buyers were paid from Rs.2000 to Rs.5000 but most received about Rs.2000 to Rs.3800 (US $62–$118) per kilogram of dried specimens based on size and the perceived quality. During the last six years the value of seahorses exported through India in million US$ are reported as follows:

Year	1996-97	1997-98	1998-99	1999-2000	2000-01	2001-02
Export in Million US$	0.05	0.07	0.06	0.01	0.03	N/a

However, these figures do not include the volumes and prices in illegal trade.

(c) Customs/ CITES Involvement At Port

As the figures suggest there was legal trade in India prior to July 2001 and it faced no restrictions. Since July 2001 exports and imports in seahorses have been stopped. Customs officials and CITES authorities are posted at each air exit to enforce the law and monitor the Export–Import points. After the inclusion of seahorses, it has been brought to the notice of all concerned to curtail the trade or exploitation in any form.

(d) Licensing/ Permitting Requirements

Till recently individuals were allowed to collect and export seahorses under a license from Marine Product Export Development Authority (MPEDA) and Director General of Foreign Trade. But due to inclusion of the entire family of Syngnathidae in Schedule I (Part III) of the Wildlife (Protection) Act of 1972, the trade, fishing, hunting and collection have been completely banned.

(e) Preferred Markets (Live vs. Dried), If Any

All seahorses are exported dried, mostly to Singapore and to some extent to Malaysia and occasionally used as medicines in local market in Tamil Nadu in South India.

(f) Volumes Landed, If Known

During 1993, 300 kilograms of seahorses were collected on average each month in Tamil Nadu and Kerala and the number of seahorses per kilogram was estimated to be about 250–300 specimens. The total annual estimate was at least 3600 kilograms (about 1,050,000 dried seahorses in trade).

During last six years, total collection of seahorses was reported as shown below:

MT = Metric Tons

Year	1996-97	1997-98	1998-99	1999-2000	2000-01	2001-02
Quantity	9 MT	11 MT	8 MT	1 MT	3 MT	N/a

Source: TRAFFIC

(

g) Conservation Programs For Seahorses

Based on export figures and the IUCN database, the Government of India has banned the collection (fishing) of seahorses since July 2001 and brought it under the protected species category. Indian fisheries biologists from the CMFRI keep a close watch on populations and habitat and monitor it through research programs. The research is not very focused and has recently drastically slowed down due to the inclusion of seahorses in the Protected Species category.

(A) Species Of Seahorses In Indian Waters

The taxonomy of Indian seahorses is not well researched. However, at least three to four species of seahorses are found in Indo–Pacific waters. Although neither scientific nor common names in use are reliable for most Indo-Pacific seahorses, four broad groupings of exploited species can be classified as follows.

(i) *Hippocampus kuda* or *Hippocampus tusai*

Complex species are medium sized, slender, smooth seahorses with fine coronets.

(ii) *Hippocampus hystrix*

Complex species are medium sized, spring seahorses with fine coronets.

(iii) *Hippocampus trimaculatus*

Complex species are smaller, deep bodied smooth seahorses with no cornet, characterized by three spots on the dorsal part of the upper trunk.

(iv) *Hippocampus kelloggi*

Complex species are solid-looking and smooth seahorses with thick coronets.

(B) Area Of Distribution

It is distributed from Tamil Nadu in the east to Kerala in the west and some of species are found in the Andaman and Nicobar Islands and Palk Bay.

(C) Abundance

Due to exploitation in trade, the seahorse population is reported to have declined in the wild. However, no accurate estimates are available. The report on abundance is based on the trend of fisheries catch and the volume of exports recorded over the years.

(D) Monitoring Programs

The Central Marine Fisheries Research Institute (CMFRI) and Fisheries Survey of India maintain an ongoing monitoring program for seahorse catch with a team of fishery biologists and research scientists.

II. Nature Of Seahorse Fisheries

(a) Commercial, Artisanal, Subsistence

Seahorses are occasionally used as medicines in Tamil Nadu with a limited role in curing whooping cough in children as used in Traditional Chinese Medicine. However, major collection is done for international markets. Trade has also been reported for aquariums in southern and western India especially in the metropolitan city of Mumbai.

(b) Estimated Number Of Fisheries

All villages along the Palk Bay participate in a targeted fishery for seahorses. The major fishers are from Thondi (90 fishers), Mullimunai (100 fishers), Tirupalaikudi (100 fishers), Diripattinam (60 fishers). Among those, around 10 fishermen are from Mullimunai and 60 fishermen are from Diripattinam. In some areas such as the Gulf of Mannar and Palk Bay, seahorses are collected as incidental fishing or bycatch.

(c) Type Of Gear Used

Fishers who are involved in the seahorse trade move as far as three to four kilometers offshore and fish for up to five hours in the middle of the day for six days of the week. They use a mask and wooden fines and free dive it waters up to eight meters deep. Five or more fishers work together to seek out all seahorses in a small area. Seahorses are caught by hand or with seize net and also by trawlers as part of other fishing activities.

(d) Relationship Between CITES Offices And Fisheries Agencies

Central Marine Fisheries Research Institute (CMFRI) in Cochin is a designated Scientific Authority under CITES. Whenever the CITES Management Authorities require any assistance with regard to identification, data or any other assistance, it is provided by CMFRI. With recent changes in the law regarding prohibitory clauses on seahorses, the MPEDA (Marine Product Export Development Authority) has been notified to take necessary steps to stop the collection of seahorses from the wild and to create awareness among fishermen.

(e) Volume Of Exports

Seahorse Export

Year	1996-97	1997-98	1998-99	1999-2000	2000-01	2001-02
Quantity in Metric Tons	3.79	10.44	14.94	1.27	1.63	N/a
Value in 000 Rupees	979.37	2225.96	3019.84	1296.00	896.67	N/a
Value in US Dollars	4500	12000	16000	6000	4200	N/a

Primary Trade Pattern For Seahorses In India

1. Seahorses in domestic trade
2. Trade in seahorses for aquariums particularly in Mumbai city
3. Trade in seahorses for smuggling to countries in Southeast Asia and East Asia, particularly China

Recent Seizures

Month and Year	Species/ Family	Number of Specimens/ Quantity	Nature of Offence/ Destination	Legal Action
May 2003	Unknown/ Syngnathidae	5.6 Kg	Shipment through foreign post office to Singapore	Case booked under the Customs Act, 1962 and the Wildlife (Protection) Act, 1972 (WLP)
June 2003	Unknown/ Syngnathidae	200 Kg	Through Tuticorin sea port to Singapore	Case booked under the Customs Act and the WLP
Sept. 2003	Unknown/ Syngnathidae	67 specimens	Open sale at Diu off the West coast	Person arrested and a case booked under the WLP

Note: A rough estimate suggests that the offence detection rate is not more than 20%

Modes Of Seahorse Smuggling

1. Through International Airports in personal baggage
2. Through postal and courier shipments via international post office and courier services
3. Direct sale to foreign tourists in coastal cities of importance to tourism
4. Export in shipments mixed with other articles and fishes from Ports in Chennai, Mumbai, Ernakulam etc.

Research And Development Of Seahorses In India

All seahorses belong to the single genus *Hippocampus* of the family Syngnathidae. There are about 30–40 species of seahorse under the genus *Hippocampus* which are tropical and sub-tropical in distribution and are found in large numbers in Indian waters. Since time immemorial seahorses have been used in medicines, as ornamental fishes to some extent as food and in modern times in aquariums as well as mythical medicines. They have been found to inhabit coral reefs, seagrass beds and also coastal mangroves. In India, commercial exploitation of seahorses is being carried out only in the states of Tamil Nadu and Kerala. As stated earlier, till the year 2001 the annual export of dried seahorses was about 3600 kilograms. The fisherman earned about Rs.10–25 (US $0.2–0.6) per dried seahorse while the middlemen received about Rs.4000–12000 (US $90–250) per kilogram. For the live seahorse the rates are considerably higher going up to Rs.3000–4500 (US $70-100) per pair of specimens. However, since July 2001, with inclusion of this species under the Wildlife (Protection) Act, 1972 these price structures have become highly skewed and unpredictable. It now depends more or less on the sources and the consumers.

In general no research work of significance has been conducted on the culturing of seahorses. There is a lack of an information database on the taxonomy and biology of seahorses.

Their low fecundity, highly selective habitat in fragile coral and seagrass ecosystems and high vulnerability to fishing due to slow movement warrant increased research and development input. The factors stated above also make the species highly endangered with a potential threat to its survival.

Like several other countries such as China, Thailand, Philippines etc., the attempted culturing of seahorses in India was plagued with high larval and juvenile mortality. Records in India show that the larvae of *Hippocampus kuda* have been successfully reared.

The Central Marine Fisheries Research Institute (CMFRI) is the nodal agency that has carried out research on the *in situ* breeding of seahorses. In artificially simulated conditions the animals reared were fed with reared brine shrimp adults besides amphipods, mysidies prawn & fish larvae collected from the wild. During the study period three spawning were observed. The larvae bred at the ratio of 1:10, showed sluggish movement, were fed live feed, reached a length of 3.2mm and recorded a survival rate of 24%. However, subsequent spawning showed a more promising trend reaching an average length of 31mm in three weeks and a survival rate of 70%.

Experiments Conducted At CMFRI, Mandapam

Hippocampus kuda is one of the species of tropical seahorses that occurs sparsely but is most common among Indian seahorses and is found in the Gulf of Mannar and Palk Bay off the coast of Tamil Nadu. The technique developed may be further improved to establish seahorse hatcheries along the Indian coast.

The experiments conducted were through maintaining the broodstock. The water temperatures ranged from 28–32C and salinity from 33–35 ppt in the broodstock tank. Three different live feeds were cultured and used for rearing the baby seahorses.

After one week of incubation, the baby seahorses resembled the adult in all morphological characteristics. An adult male with a fully developed brood pouch released approximately 250–300 babies in a single release.

The young ones were protected from exposure to bright light and physical injuries. They grew to 12mm at the end of 7th day. On the 10th day, the baby seahorses started accepting the artemia larvae and attained a size of 18mm. On the 30th day, the fishes attained a size of 30mm and started feeding on mysids, artemia and prawn post larvae.

The use of copepods showed better results and higher survival rates for larvae and growth due to a high level of Essential Fatty Acid (EFA). However, the experiments conducted so far are of little commercial significance. The present findings exhibit ample scope for improving rearing methods in the future. The very high price commanded in the international market and a huge gap between supply and demand has further stressed the need for increasing *in situ* rearing efforts for seahorses. These experiments have a significant impact on the conservation and management of these fishes in the Indian context.

Pressures On Seahorse Habitat

The main habitat of seahorses found in the Gulf of Mannar biosphere reserve is under severe stress from unregulated fishing, poaching of corals and seaweeds, targeted fishing of sea cucumbers and to a large extent trawl fishing. The Gulf of Mannar is known to harbor over 3600 species of flora and fauna making it one of the richest coastal regions in Asia. Among the species that figure on the endangered species list are dolphins, seahorses, sea cow (*Dugong dugon*), whales, corals, sea cucumbers (*Holothurians*) etc. Reports say that for every 1000 kilograms of fish collected, 325 kilograms of rare but untargeted organisms get discarded and are left to die on the shores. Sometimes out of ignorance the fishermen resort to destructive practices such as dynamite fishing and targeted fishing.

A recent survey estimates that about 160,000 people in 125 villages abutting the shores depend on coastal resources for a living in a core area of 560 Km^2. It is also estimated that nearly 9000 boats including mechanized ones enter the seas daily. The seahorses struggle for survival under such circumstances is low. The statutory Gulf of Mannar Biosphere Reserve Trust (GMBRT) aimed at integrated coast zone management and comprising of the departments of Environment and Forests, Fisheries, Rural Development

etc. in coordination with the Coast Guard and the Indian Navy has been created to provide management support to these vital resources. It has taken some of the primary steps that include creating awareness among the locals, providing alternative employment to fisherman through a US $40 million project by offering more economically viable and socially acceptable packages to them and finally by increasing the protection mechanisms for habitats.

Legal Issues

Seahorses (all Syngnathids) have been brought under the purview of Wildlife (Protection) Act, 1972 *vide* its amendment in July 2001. The entire Syngnathidae family has been included in Part III of Schedule I of the Wildlife (Protection) Act, 1972 (the Central Act 53 of 1972).

Section 9 prohibits its hunting. Section 39 makes seahorses Government property and Section 40–48 prohibit trade in all seahorse species and require the possessor of this species to declare their stock to lawful authorities. Sections 49 A, B, C and D of Chapter 5A necessitate that trade in this species is completely prohibited. Section 51 entails the offences related to this species as ineligible for bail and cognizant, thereby meaning that a person indulging in an offence related to this species can be arrested without warrant and after prosecution can be convicted for up to a maximum rigorous imprisonment of seven years with a minimum fine of US $500.

The Export-Import Policy 2002–2007 of the Government of India also prohibits the export of Syngnathid species from India under the Export–Import (Development & Regulation) Act, 1991. Import has also been prohibited since July 2001, or restricted to only special purposes with permits and certificates issued by the designated authorities. Under the ITC (HS) classification under theExport–Import Policy, both export and import of this species covered under Schedule I and Part II of Schedule II stands prohibited.

The Government of India is also in the process of drafting a new CITES Act 2003–2004 which will provide the necessary support for CITES implementation in India.

NATIONAL REPORT

-MEXICO-

Mexico's Seahorse Fisheries And Trade

Very few studies have been focused on seahorses in Mexico and, therefore, hardly any information is available about seahorse populations and fisheries in Mexico. Currently, no permits for capturing seahorses are issued in Mexico; therefore, traded specimens are incidentally captured in other fisheries, captive-bred or captured illegally. In 2000, people from Project Seahorse carried out a study concerning seahorse capture and trade in Mexico (Baum and Vincent, unpublished). They conducted informal interviews with fishermen, buyers, middlemen, as well as some governmental and research institutions. This study has not yet been published. However, it offers an overall picture of the capture and trade of these species in the country and, therefore, has been referred to and cited frequently throughout this report. In addition, the archives of governmental dependencies and other bibliographic material, as well as experts on this topic, were consulted.

I. Information on Wild Populations

a. Seahorse Species in Mexican Waters

Four seahorse species have been recorded in Mexican littoral and continental waters.

Hippocampus erectus

Common name: Lined Seahorse, Northern Seahorse, Caballito de mar, Caballito de mar del Norte (synonyms: *H. hudsonius, H. marginalis, H. fascicularis, H. punctulatus, H. hudsonius punctulatus*)

It reaches a size of up to 18.5 cm. It generally inhabits marine grass beds in shallow waters, but has been found in depths up to 70m (Indiviglio, 2002). Its color is quite variable, brown olive, orange or yellow with dark lines throughout its neck (Colección Ictiológica del IB-UNAM).

This species is often associated with submerged marine vegetation. It only occasionally penetrates into fluvial bodies and, in fact, it is uncommon in low-salinity waters. Nonetheless, Spring and Woodburn (1960) found it in waters with salinity between 21 and 34% near Tampa, Florida.

H. reidi

Common name: Slender Seahorse, Longsnout Seahorse, Caballito de hocico largo

It reaches a size of up to 18 cm. *H. reidi* inhabits waters with depths between 15 and 60m, and has been found attached to marine algae such as *Sargassum* (Indiviglio, 2002). It is distinguished from other seahorses by its long snout and its numerous dark-brown spots contrasting with its light-brown body (Colección Ictiológica del IB-UNAM). Baum and Vincent (unpublished) estimated this species' average weight from 3 dry specimens. It was 3.34 ± 1.85g.

H. zosterae

Common Name: Dwarf Seahorse (sinónimo: *H. regulus*), Caballito enano.

It reaches a size of only 2.5cm; only the pygmy seahorse of the Australian southeast coast is smaller. It is found in shallow waters and is often associated with marine grass beds, especially with species of the *Zosterae* genus, from which its scientific name is derived (Indiviglio, 2002). It is distinguished by the dark margin of its dorsal fin (Colección Ictiológica del IB-UNAM). Baum and Vincent (unpublished) indicate that this species is not in the market because it is very small and also because it is hardly trapped in trawl nets. However, Espinosa (pers. comm.) states that he has found this species in the curio trade.

H. ingens

Common name: Pacific Seahorse, Caballito del Pacífico

It normally reaches a size of 19cm, although 30cm specimens have been reported. This species generally inhabits shallow waters but has also been found in depths of up to 60m (Indiviglio, 2002). It is usually found in open waters associated with reefs and other consolidated structures, as well as with coral banks and sponges; it is also closely linked to macro-algae beds; it is not easily observed in part due to its ability to camouflage itself among the algae (De la Cruz, 1991). *H. ingens* specimens are more often found between the surface and waters within 10m depths. In contrast to the majority of seahorses, this is a nocturnal species. It reaches sexual maturity in one year and gives birth to approximately 400 seahorses after a two-week gestation period. Its coloration is principally dark red or yellowish green with bands throughout its body every six or seven rings; it can also display white spots (Colección Ictiológica del IB-UNAM). In laboratory conditions, it has been observed that this species reaches maturity after 6 months and it can give birth to as many as 3000 young (Barón and Sandoval, pers. comm.).

b. Area of Distribution

Hippocampus erectus

From Nova Scotia and Georges Bank (Canada) to Argentina, including the Gulf of Mexico and the Caribbean.

Reported Mexican localities: Tamaulipas: Desembocadura del Río Bravo; Veracruz: Sistema Estuarino Lagunar Tuxpan-Tampamachoco; Campeche: Laguna de Términos, Sonda de Campeche, Playa Bonita; Yucatán: Plataforma continental; Quintana Roo: Plataforma continental.

Localities from anecdotic data: Veracruz: Sistema Arrecifal Veracruzano (reefs of Isla Verde, Cabezo and Isla de Sacrificios), Playón de Hornos, the mangrove zone of Boca del Río and Las Barrancas (Martínez, pers. comm.).

H. reidi

From North Carolina (U.S.) to Río de Janeiro (Brazil).

Reported Mexican localities: Quintana Roo: Canal de Bacalar Chico.

Localities from anecdotic data: Quintana Roo: Contoy, Mujeres and Cozumel Islands; Yucatán: Bahía de Celestún and Puerto Progreso (Baum and Vincent, unpublished).

H. zosterae

From Florida to the south occidental part of the Gulf of Mexico.

Reported Mexican localities: Tamaulipas: Laguna Madre de Tamaulipas; Veracruz: Laguna de Tamiahua; Campeche: Laguna de Términos and Champotón.

H. ingens

From San Diego, California (U.S.) to the North of Peru, including the Gulf of California and the Galapagos Islands.

Reported Mexican localities: Baja California: Cabo San Miguel, Punta el Machorro; Baja California Sur: Loreto, Bahía Concepción, Bahía Magdalena, Laguna Ojo de Liebre, Laguna San Ignacio, Bahía de la Paz, Ensenada de la Paz, Bahía las Almejas, La Florida, Cabo Pulmo y Cabo San Lucas; Sonora: Puerto Peñasco, Playa el Cochorit en Empalme, Bahía de Guaymas, Estero del Soldado, Isla Tiburón; Sinaloa: Río Piaxtla, Río Fuerte, Río Presidio; Oaxaca: Laguna de Chacahua, San Mateo del Mar; Chiapas: Los Mangas, Río San Nicolás.

Localities from anecdotic data: Guerrero: Bahía de Acapulco and Bahía de Zihuatanejo. In Sonora there have been seahorses trapped during the shrimp fishery of boats unloading at Puerto Yavaros (Sandoval-Muy, pers. comm.).

c. Abundance

H. erectus

The IUCN (2003), considers the worldwide population of *H. erectus* as vulnerable, based on inferred declines of at least 30% caused by targeted catch, incidental capture, and habitat degradation.

Particularly, in the reef area close to the Veracruz and Antón Lizardo localities, *H. erectus* is a not very abundant species. During the 10 years that the Veracruz Aquarium has been operating, only 5 specimens have been received as a donation (Martínez, pers. comm.).

This species' records as incidental capture in the scale fishery in Banco de Campeche are sporadic (Programa de Observadores Científicos de Pesquerías de Escama del INP). The prospecting cruises for shrimp trawl fishery report have captured some specimens during their activities (INP's technical reports and Programa de Observadores Científicos de Pesquerías de Escama).

H. erectus is the most abundant species in the Gulf of Mexico and the Caribbean Sea (Baum and Vincent, unpublished).

H. reidi

There are no published data on this species' abundance or population trends.

According to the World Conservation Union (IUCN, 2003), no data are available for this species.

H. erectus and *H. reidi* are not distinguished by the fishermen throughout the Caribbean coast. The fishermen mentioned that they capture the largest number of seahorses (*H. erectus* and *H. reidi*) in Quintana Roo near Contoy, Mujeres and Cozumel Islands, and in Yucatan near Celestún Bay and Puerto Progreso. Most of the fishermen associated the capture of large numbers of seahorses with rocky areas, and with coral reefs in that order. Few associated them with seagrass and algae. According to fishermen in Veracruz and Tampico, seahorse captures are scarce probably because the water is deeper (Baum and Vincent, unpublished).

H. zosterae

There are no published data on the abundance or population trends for this species.

According to the World Conservation Union (IUCN, 2003), no data are available for this species.

H. ingens

The IUCN (2003), considers the worldwide population of *H. ingens* as vulnerable, based on inferred declines of at least 30% caused by targeted catch, by-catch, and habitat degradation. According to fishermen interviewed by Baum and Vincent in 2000, the regions where most seahorse catches have been recorded were the Oaxaca and Chiapas coasts. Within these regions, Salina Cruz, Barra San Francisco and Puerto Arista were mentioned as the major catch areas. Interviewed divers and biologists mentioned that seahorses were very uncommon in the Gulf of California, and that populations in Puerto Vallarta have apparently declined since the early 1990s. Fishermen stated that they catch a great number of seahorses in algal areas, rocks and/or corals, and at depths between 1 and 55m, and more commonly between 20 and 35m. The species is abundant throughout the Mexican Pacific coast.

d. Monitoring Programs

A monitoring program has been set up in specific areas in Veracruz where seahorses have been recorded. In the short term the program intends to assess populations of *H. erectus* in the Veracruz Reef System (VRS). Recently, fieldwork has been limited by the presence of north winds in the Gulf of Mexico region. Since 1999, the Veracruz Aquarium, together with the University of Veracruz, has been carrying out several monitoring programs that include biological characterization of the VRS ichtyofauna, where seahorses have not yet been reported (Martínez, pers. comm.).

Fish monitoring programs, although not specific to seahorses, are being carried out in the Parque Nacional Arrecifes de Cozumel. Since 2001 a group of volunteers, mostly tourist service assistants coordinated by the park administration, carry out periodic fish censuses in several localities within the park.

The Natural Protected Areas and Marine Parks monitoring program include a flora and fauna research section at the ecosystem and community levels. Since 1997 the INP's (Mexican Fisheries Institute's) Scientific Observers of Inshore Fisheries Program (Programa de Observadores Científicos de Pesquerías de Escama) has been monitoring shrimp trawl catches in the Gulf of Mexico.

II. Seahorse Fisheries Nature

a. Commercial, Artisanal and Subsistence Fisheries

In Mexico no fishery targets seahorses. Nevertheless, seahorses represent a low bycatch percentage during some commercial fishing activities, mainly through shrimp fisheries with trawl nets, sometimes in nearby areas or within marine natural protected areas, as in the Biosphere Reserve "Alto Golfo de California and Delta del Río Colorado" or the VRS in the Gulf of Mexico, Laguna de Términos and Loreto (Pacific littoral).

According to Baum and Vincent (unpublished), although no fishery targets seahorses in the Gulf of Mexico or the Caribbean Sea, in the Pacific *H. ingens* is captured as black market aquarium fish. They mention that in Acapulco, hookah divers' cooperatives targeting seafood (e.g., oysters) also capture seahorses if they are found along the way. According to interviewed divers and aquarium traders, in 2000 there were between 10 and 15 divers in the area selling seahorses to Mexico City aquariums.

According to anecdotic reports of fishermen, the highest number of seahorses is captured between June and July. Baum and Vincent (unpublished) state that in the artisanal fishery, seahorse bycatch is very

scarce. The artisanal fishermen affirm that it is very difficult for seahorses to be caught in their nets because of the small mesh size.

Based on the information provided by Baum and Vincent (unpublished), probably a great part of the dry seahorses coming from Mexico and becoming part of the international trade are incidentally caught during shrimp fishing operations. In the year 2000, there were 658 shrimp fishery ships operating in the Gulf of Mexico and the Caribbean, and 1,313 in the Pacific (SEMARNAT, 2002). However, seahorses are not captured in every shrimp fishery zone, and the ships operate in different zones. Therefore, there does not seem to be a direct relationship between the size of the shrimp fishery float and seahorse bycatch. Besides, the number of shrimp fishery ships operating in Mexico each season tends to diminish due to age of the float, some are withdrawn and others do not work all seasons due to operation costs. Finally, sunken ships have not been replaced.

b. Cultured Seahorses in Mexico

Until now, five institutions that culture seahorses in Mexico have been identified: four of these institutions culture *H. ingens* in the Pacific (the Universidad Autónoma de Sinaloa, the Mazatlan Aquarium, Maricultura del Pacífico S.A. and Ingens Cultivos Marinos) and one in the Gulf of Mexico cultures *H. erectus* (Veracruz Aquarium). Three of them have reproduction programs linked to conservation.

Between 1997 and 2000, one of the farms sent between 1600 and 2400 specimens per annum to a wholesaler, although they indicate that production reached up to 400 individuals per week, apparently higher than the national market demand. They stated that there is a low mortality and that the selling season goes mainly from November to May (avoiding the warmer months to diminish the incidence of parasitic diseases). The specimen sizes varied between 5 and 6cm.

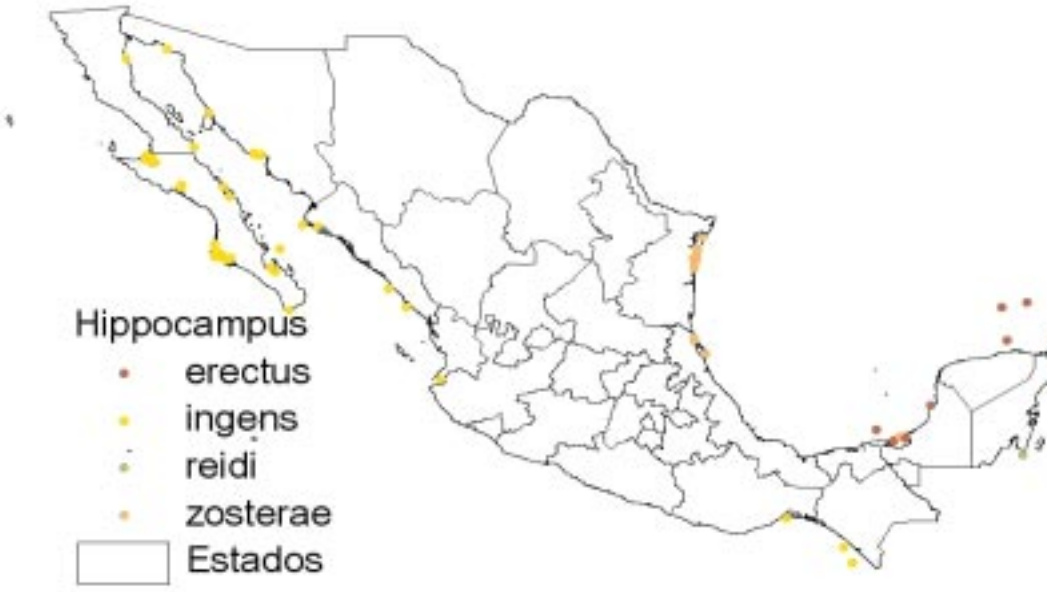
The Mazatlan Aquarium began a marine fish reproduction program with the goal of producing fishes for exhibition. On the other hand, the University of Sinaloa fish reproduction program includes seahorses, and since the beginning, the possibility of trading them has been considered. Both of these are low-tech hatcheries namely outdoor confiners (tanks). The parental generations used in these programs are adults of *H. ingens* caught in the wild, since none of the mentioned institutions use a close-cycle culture system. The Mazatlan Aquarium captures between 40 and 50 specimens per annum for this purpose, while the University captures approximately 10 specimens.

The main problem they face is juveniles to grow until reaching maturity, mainly related to their nourishment, followed by some problems due to algal growth in the tanks and infections during summer. Finally, the lack of resources for aquaculture programs is another fact that has negatively impacted both programs.

c. Estimated Number of Fishermen

There are no fishermen dedicated to seahorse fishing.

Map 1- Records of Hippocampus in Mexico from Scientific Collections



Map 2: Catch records of Hippocampus and Natural Protected Areas from Mexico (CONANP-

d. Fishing Gear

The incidental capture occurs during shrimp fishing with trawl nets.

e. Legal Frame

The legal frame that governs the use and protection of seahorses includes regulations currently in force. The most important are the following:

Ley General de Vida Silvestre (Wildlife General Law)

This was published in the Diario Oficial de la Federación (DOF; Federal Official Diary) on July 3, 2000. It regulates the use of all marine species included in any protection category. Specifically, it establishes the conditions for capture and transport permits and authorizations.

Norma Oficial Mexicana (Mexican Official Norm) NOM-059-SEMARNAT-2001

This was published in the DOF on March 6, 2002 and came into force on May 7, 2002. This provides for Environmental Protection of wild flora and fauna of Mexican native species, includes risk categories, and its listing specifications, exclusion or change as well as a list of species at risk list.

At present, the 4 seahorse species distributed in Mexico namely *Hippocampus erectus* (caballito de mar- lined seahorse), *H. ingens* (caballito del Pacífico- Pacific seahorse), *H. reidi* (caballito de hocico largo- long-snout seahorse), and *H. zosterae* (caballito enano- dwarf seahorse) are listed in the NOM-059-SEMARNAT-2001 as species subject to special protection. That is to say that they could become at risk due to factors that affect their viability, reason for which the need to propitiate their recovery and conservation, or the recovery and conservation of associated species' populations, is determined.

Trámite de certificación de la legal procedencia para el traslado de mamíferos y quelonios marinos (Certification of the legal origin for the transport of marine mammals and chelonians) as well as other marine species at risk PROFEPA-03-003 (May 29, 2003)

This requires those who want to transport organisms, parts or by-products of seahorses, to obtain the certification of legal origin before transportation.

Reglamento Interior de la Secretaría de Medio Ambiente y Recursos Naturales (Internal Regulations of the Environmental and Natural Resources Secretary)

This was published in the DOF on January 21, 2003, and establishes the obligation of the Federal Attorney's office of Environmental Protection (PROFEPA) to look after the enforcement of the in-force legislation regarding species at risk. PROFEPA carries out inspection and enforcement actions for priority species, particularly within natural marine and littoral protected areas. PROFEPA, together with the Mexican Marine Army Secretary, develops special operatives in priority marine zones to discourage illegal activities on the protected marine resources.

Código Penal Federal (Federal Penal Code)

From February 6, 2002 the Código Penal Federal, establishes in Article 420 that punishment of 1 to 9 years in prison and for the equivalent of a 300 to 3000 day penalty will be imposed on whomever illegally:

"*Carries out any activity with trafficking purposes, or captures, posses, transports, stores, introduces to the country or extracts from it, some specimen, its products or byproducts and other genetic resources, from prohibited terrestrial or aquatic wild flora or fauna species considered endemic, at risk, at risk of extinction, subject to special protection or regulated by any international treaty of which Mexico is party of; or damage to any specimen of terrestrial or aquatic wild flora or fauna species indicated in the previous paragraph.*"

Furthermore, the code states that an additional punishment of three or more years of prison and up to 1000 days of additional penalty will be applied when the conducts described in the article are carried out in or affect a protected natural area, or when they are carried out for commercial purposes. In any cases of illegal use of seahorses, PROFEPA is obliged to present the presumed offenders to the Federal Public Ministry.

The legal frame for seahorse protection in Mexico is relatively recent, and the enforcement of the legal frame through inspection and surveillance actions and based on true information on this species' trafficking is being strengthened.

CITES Appendix II

Includes all *Hippocampus* species and will be in force from May 2004.

To obtain an authorization to export specimens, parts or byproducts of a wildlife species not listed in the CITES appendices, it is necessary to fulfill the following requisites:

- Complete the official application
- Pay the corresponding rights
- Prove the legal origin of the organisms, products or byproducts to export, through notifications of port arrivals, capture permits or presenting selling bills (including the number captured or use the corresponding permit)

In the case of the species included in the CITES Appendices, it is also necessary to prove that the organisms came from a registered "Unidad de Manejo para la Conservación de la Vida Silvestre" (UMA; Management Unity for Wildlife Conservation). If it deals with live organisms, they must have a tracking system. The paper work is carried out at SEMARNAT's Dirección General de Vida Silvestre (DGVS; Wildlife General Administration). Once the product has been exported, the permit holder has ten business days to hand in a photocopy of the customs request and a selling invoice of the organisms.

e. Market Preferences in Mexico

Commerce of Dried Seahorses

Dried seahorses in Mexico are only used as handicrafts. Use in traditional medicine or other purposes have not been reported. A field survey carried out in the Crafts Market of Veracruz (an important commercial port in the Gulf of Mexico's Mexican coast) showed that seahorses were used for making key rings or were sold dry as curios. Prices varied according to the season and demand. According to the testimony of the retailers these were not captured in the VRS, but brought from Campeche (Martínez, pers. comm.).

Commerce of Live Seahorses

Capture of seahorses for aquaria is very limited. The aquarium industry in Mexico developed in the late 1980s. In 1994 all commercial permits for capturing marine ornamental species were cancelled. Only "pesca de fomento" permits (i.e., capture permits linked to research or population assessment) were issued. At the present time fishing permits do not allow for the capture of seahorses for any purpose. In the early 1990s the aquarium industry experienced a "boom" and most of the captures in the Pacific Coast were illegal. Baum and Vincent report that for the year 2000, Mexico along with Brazil, had the most important aquarium trade industry in Latin America in terms of volume and techniques.

Baum and Vincent's study (unpublished) states that there are two markets for aquarium fish in Mexico City, which normally offer low prices but in which fish are generally not looked after properly. Retailers normally store seahorses in independent aquaria so that they do not have to compete for food or defend themselves from other fish. Generally, seahorses attach to airing hoses or air pumps since there are no other suitable structures inside the tanks. Some retailers reported a high mortality of these animals during the process of national commercialization, since they are sometimes stored in plastic bags for up to 48 hours. On the contrary, some importers indicated that this mortality rate dropped in legally imported organisms (Baum and Vincent, unpublished).

According to the same study, the trade network for live seahorses for aquaria is complex. Several commercial routes and sources of supply exist since buyers could go to several wholesalers or sell their fish in several cities. Among the sources of seahorses identified in the study are the aquaculture centers in Mazatlán as well as illegal catches along the Pacific coastline, mainly in Acapulco (Guerrero). Puerto Escondido (Oaxaca) was another important source for live seahorses. Retailers also reported that these animals were imported from Hawaii, Indonesia, Fiji, Philippines, Brazil, Australia and the Indo-Pacific (Baum and Vincent, unpublished), normally via the United States of America.

Seahorse trade in Mexico includes several levels. Sometimes wholesalers buy from middlemen, who buy directly from the fishermen. In other cases retailers buy directly from fishermen. Finally, wholesalers also sell to other wholesalers. It could be said then that there are at least 4 identified levels: fishermen, middlemen, wholesalers and retailers. At least 10 wholesalers sell seahorses in Mexico City and half of them have available stock. In all, 54 retail aquaria were identified, although not all main cities in Mexico were surveyed. In Mexico City alone at least 42 aquaria of marine fish were identified, 36 of which sold seahorses and 26 of which sold imported animals, 3 sold national, 3 sold both and in 4 their origin was unknown (Baum and Vincent, unpublished).

According to Baum and Vincent in 2000 between 8,200 and 4,600 seahorses were marketed within the country. Most of them came from legal imports, followed by cultured animals and lastly organisms caught in the wild.The main market for cultured seahorses is Mexico City, although they are also sold in cities like Guadalajara and Monterrey. A seahorse farm in Mazatlán reported sales between 1996 and 2000 of 1,700 to 2,500 animals/year. These numbers suggest that some of the seahorses of unknown origin sold in the nation could come from farms (Baum and Vincent, unpublished).

f. Volumes Brought to Port

There are no official records.

g. Conservation Programs for Seahorses

Two institutions that grow seahorses in Mazatlán (Pacific littoral) have formal reproduction programs for conservation. Besides providing specimens for the national aquarium market, both programs reintroduceorganisms into the marine environment. Since 1996 the Mazatlán Aquarium has reintroduced

between 800 and 1000 individuals/year, while the Autonomous University of Sinaloa reintroduces 50% of their production on average, which is normally small as compared to the reintroduction rate of the Aquarium. The University indicated that they encountered only minor difficulties in capturing animals in the zone and they attribute this to the reintroduction efforts of the programs. Nevertheless there is no formal reintroduction program in the area.

The Aquaculture Department of the Center of Scientific Investigations and Superior Studies from Ensenada, Baja California (CICESE) is developing a research program related to the physiology and reproduction of *Hippocampus ingens* on the Pacific coast. On the Atlantic coast, the Veracruz Aquarium has exhibited mainly imported seahorses. However, after obtaining parental generations and introducing a Reproduction and Maintenance Program for Seahorses, successful breeding of *Hippocampus erectus* was achieved, with around 700 individuals at present. Some of these individuals are exhibited to the public, others are part of research programs and some others are donated or exchanged with other institutions. Recently the Aquarium of Veracruz donated 50 juveniles to the Interactive Aquarium of Cancún, apart from giving talks on their biology and culture to students of the Aquaculture Engineering program in the Technological Institute of the Sea in Veracruz. During the summer of 2003, children 5 to 7 years old were given talks about seahorses as part of the Environmental Education Program.

Ongoing research is exploring the use of fish excluding devices in order to reduce bycatch in shrimp fisheries with trawl nets (National Fishing Chart, 2000). Natural Protected Areas (ANPs) from Mexico (see map 2) have management plans for the conservation of the marine ecosystems and habitat, including in the main areas of seahorse distribution. In some areas stricter restrictions exist for carrying out fishing activities, such as shrimp trawling, in order to minimize bycatch and habitat destruction.

Among the most important ANPs for seahorses are the areas of protection of flora and fauna "Laguna de Términos", the national parks "Reefs of Cozumel", Western Coast of Isla Mujeres, Punta Cancún and Punta Nizuc, "Bay of Loreto", "Cabo Pulmo", "Veracruz Reef System", "Contoy Island", and the "Vizcaíno Biosphere Reserve".

h. Traffic

In 2002, in the state of Puebla, PROFEPA carried out an inspection against an import and export company for not establishing the legal origin of a black seahorse, coming from Los Angeles, California, U.S.A. However, during the administrative procedure, the necessary legal documentation was presented and the case was closed.

On the 7th of November 2003, in Isla Mujeres, state of Quintana Roo (Mexican Caribbean), PROFEPA started a legal procedure against an aquarium company for not crediting the legal possession of *Hippocampus* species, confiscating 199 individuals (151 young, 32 juveniles and 16 adults). This is now an ongoing case.

Among the priority strategies of PROFEPA to reduce illegal action on marine resources is community surveillance with the help of the communities of the main areas/zones where protected marine species are exploited. In these areas, community surveillance has been implemented through committees, which qualify, advise and encourage them to maintain contact with PROFEPA delegations in the entity, mainly in marine protected areas.

III. International Trade Magnitude

a. Number of Levels

In accordance with official registrations between 1998 and 2000, six exporters have been identified as having provided seahorses to eight addresses in the United States of America. In some cases the exporter buys seahorses directly from fishing cooperatives. However, this information is not complete.

b. Retail and Wholesale Prices

Commercial Value of Dried Seahorses

Seahorse prices vary. In the Crafts Market of Veracruz (Gulf of Mexico Coast) and other tourist markets, dried seahorses are sold at 65.00 pesos as key rings and at 35.00 or 29.00 pesos if dry. In all cases the average size was 15cm for both males and females. Other registered prices were from 25.00 to 100.00 pesos in localities where seahorses do not occur. Proprietors argued that those were the approximate prices that they managed.

Dry specimens were found only in 2 of 150 locations where diverse related crafts were sold and in 5 locations the retailers maintained that they could get them. Only one retailer argued that selling seahorses was illegal and it was very difficult to find for sale.

According to Baum and Vincent, divers and fishermen were paid by middlemen between 20 and 50 pesos (US$2.11 to US$5.28), who in turn sold them to wholesalers in Mexico City at between 80 and 90 pesos (US$8.45 to US$9.51). They in turn sold them at various prices from 80 to 140 pesos (US$8.45 to US$14.79). Finally, aquariums sold them at between 120 and 400 (223 pesos = US$23.56 on average) when it was medium or small individuals and between 220 and 600 pesos for big or red colored individuals (390 pesos = US$41.20 on average).

Alternatively, prices to wholesalers of cultured *H. ingens* varied according to size. For example, an aquarist reported the following: 5 to 6cm (18 pesos = US$1.90), 6 to 8cm (22 pesos = US$2.32) and 8 to 11cm ($25 peso= US$2.64), although according to information of the wholesalers (buyers) the prices of cultivated seahorses oscillated between US$1 and US$10 and the sale price was normally doubled (Baum and Vincent, unpublished).

Finally, the price of captive-bred seahorses was generally lower than wild-captured ones and again the sale price was approximately double that of purchase, although they had prices of between US$0.75 to US$7.0 for wholesalers and up to US$16.00 for stores. Some examples worth mentioning are black seahorses (~20cm) imported from the Indo-Pacific via Los Angeles, with prices from US$3.45. Other specimens from Sri Lanka varied between US$0.75 and US$1.00. Finally *H. reidi* from Brazil, varied in price according to their coloration and size: US$1.60 (small), US$3.0 to US$3.50 (medium) and US$7.00 (medium, brilliant coloration). The average price of these animals in stores was 255 pesos (US$26.94) (Baum and Vincent, unpublished).

c. Implication of Customs and CITES in Ports

The government agency responsible for verification of the execution of the dispositions in this matter is the Federal Attorney's Office of Environmental Protection (PROFEPA), which from 1996 began the Inspection Program in ports, airports and borders, with the purpose of verifying the strict execution of restrictions (not tariffs) to the import and export of goods subject to regulation for the SEMARNAT, counteracting in this way the illegal traffic of wild life.

Table 1: Approximate Commercial Value of Dried Seahorses on Both Coasts of Mexico

Littoral	Amount paid to fishermen	Amount paid by the exporter to the middlemen	Value of Mexican seahorses in national market	Value of exported seahorses in national market
Caribbean	1-5 pesos/piece (US$0.11-0.53)	ND	10-70 pesos (US$1.06-7.40)	ND
Pacific	1-5 pesos/piece (US$0.11-0.53), 350 pesos/kg (US$36.98/kg)	E.g. 5 pesos/piece (US$0.53)	9-115 pesos (US$0.95-1.2)	E.g. 55 pesos/piece (US$5.81)

Source: Baum and Vincent (unpublished), using data from 2000.

Table 2: Export Authorizations for Seahorses 1998 - 2000*

Authorization No.	Date	Amount Authorized	Legal Transit[2]	Amount Sold[3]
004505	23-Jan-98	65	0	0
005138	03-Oct-98	100	100	0
005389	06-May-98	43	43	43
005719	11-Jun-98	100	100	100
006248	13-Aug-98	25	25	25
006462	09-Sep-98	100	100	100
008089	06-Apr-99	33	33	33
007538	29-Jan-99	140	140	0
008437	10-May-99	150	150	150
008525	19-May-99	7,080	0	0
007653	16-Feb-99	765	0	0
11589	10-May-00	100	100	100
11684	18-May-00	25	25	25
12612	07-Sep-00	134	134	0
13418	05-Dec-00	15	25	0
13446	07-Dec-00	20	20	0
11526	02-May-00	765	0	0
11940	16-Jun-00	2	2	0
	TOTAL	**9,662**	**997**	**584**

* Amounts in kilograms

1. Includes all export permits issued between 1998 and 2000. Cases in which a new permit was issued for the remnant of previous authorized amounts (but for which validity had expired) have been omitted

2. Amount for which legal origin was checked

3. Amount for which sale was documented. Possibly not all permit holders have completed this step and, likewise, these data are not complete.

At present there are 68 points of inspection in the national territory including 20 ports, 24 international airports, 23 border points and one interior customs office, assisted by 71 inspectors that scrutinize imports and exports of wildlife in accordance with the precepts established in the General Law of Ecological Balance and Protection of the Environment, the Wildlife General Law, the Convention on the International Trade in Endangered Species of Wild Flora and Fauna (CITES), the International Epizoothian Organization and the International Convention of Phytosanitary Protection.

d. Relationship Between CITES Offices and Fisheries Agencies

The CITES Follow-up Committee in Mexico is integrated by relevant government and independent agencies. The Committee coordinates the activities of the Scientific Authority, the Administrative Authority and the Law Application Authority, in order to determine the politics and actions of management and conservation of species listed in the Appendixes of CITES; identifying national priorities and revising verdicts and files on proposals for modifying, including species in, or eliminating species from the Appendixes of the Convention. The Committee also acts in coordination with the Secretary of International Affairs for generating the country's positions for the Conferences of the Parties and other pertinent forums. The Committee is also formed by the General Wildlife Directorate (DGVS), PROFEPA, the Coordinating Unit of International Affairs (UCAI), National Institute of Ecology (INE), National Forest Commission (CONAFOR), General

Directorate for Forest and Soil Administration (DGGFS), the National Commission for the Knowledge and Use of Biodiversity (CONABIO) and two fisheries agencies namely, the National Fisheries Institute (INP) and the National Aquaculture and Fishing Commission (CONAPESCA).

e. Size of Exports

From 1998, export permits have been issued for commercializing the sale of Mexican seahorses. Due to the difficulty in determining the species from dried samples, this information is only available up to the genus level. It is worth mentioning that most exports were addressed to the USA, although few had a different final destination like China, Hong Kong and Australia. Research is currently being conducted in this regard.

It is worth mentioning that these figures indicate the amounts authorized for export per year, but do not indicate the actual amounts that have been exported. Permit holders usually request authorizations for exporting amounts that they consider can be sold or gotten.

In order to give an idea of the magnitude of trade by number of individuals, according to Baum and Vincent, the average dry weight of *H. erectus* is 2.28g ± 1.99g. For *H. erectus* and *H. reidi*, the average dry weight is 2.35g. Therefore approximately 425 individuals are considered to weigh 1 kg. Finally, for *H. ingens*, with an average dry weight of 4.18g ± 2.45g, 239 individuals are considered to weigh 1 kg.Baum and Vincent also present data on the amount of dry seahorses exported from Mexico to China, Hong Kong and the United States, according to the customs records in these countries.

Commercial catches were carried out before these species were included in the listing of protected species (NOM-059-SEMARNAT-2001). Starting in 2001, no permits have been issued and since 2002 no applications have been received.

Export of Live Individuals

In general, it could be said that the export of live individuals from Mexico does not exist. Nevertheless, Baum and Vincent report exports from Puerto Vallarta to Los Angeles (USA) in the late 1980s and at the early 1990s (when it was legal) and exports of *H. ingens* to a North American aquarium.

Also, they point out that in accordance with information obtained on interviewing wholesalers, it is believed that there are also exports from the cities of La Paz and Ensenada, in the Baja California peninsula, to the US. Unfortunately, the volumes of these exports are ignored. Export of cultured seahorses is allowed. However, these individuals are generally sold in the national market.

Imports of Dry Individuals

Import volumes of dry seahorses are small as compared to exports, as shown in Table 4. Baum and Vincent's survey identified imports from Guatemala (Camaronero del Pacífico), which in 1992 exported between 3.5 and 5.8 kg (US$0.19 to US$0.29) of dry seahorses to Mexico, possibly in order to be re-exported to Asia. On the other hand, a shell retailer in Acapulco indicated that seahorses were imported from the Philippines in order to be marketed as souvenirs, reporting annual sales approaching 110 seahorses.

Imports of Live Individuals

At least seven wholesalers in Mexico City and one in Guadalajara have been identified as importing seahorses to Mexico for retail sale. Among the identified countries of origin are Fiji, Hawaii, Philippines, Indonesia (mainly via Los Angeles, USA) and Brazil, although some of these were possibly first exported via Singapore. These imports occur due to the low costs of the individuals, apart from small transportation costs from Los Angeles to Mexico City when compared to the cost from Mazatlán to Mexico City. According to the survey, total imports were estimated between 4,366 and 7,118 individuals/ year in the late 1990s and until 2000 (Baum and Vincent, unpublished).

REFERENCES

National Commission for the Knowledge and Use of Biodiversity. 2004. *CONABIO's Data Base SNIB (Sistema Nacional de Información sobre Biodiversidad de México)*.

CONANP-CONABIO. 2004. *Map elaborated with CONANP's (Natural Protected Areas National Commission) and CONABIO's (National Commission for the Knowledge and Use of Biodiversity) databases*.

De la Cruz-Agüero, J. 1997. *Catálogo de los peces marinos de Baja California Sur. Centro Interdisciplinario de Ciencias Marinas/ Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, La Paz*. 346 p. (there was a mistake and it said 1991, but it is in fact 1997)

Indiviglio. 2001. *Seahorses: A Complete Pet Owner's Manual*. Hauppauge, NY. Baron's Educational Series.

IUCN. 2003. *2003 IUCN Red List of Threatened Species*. Retrieved from the world wide web on 2003: http://www.redlist.org/

National Fishing Chart. 2000. *Instituto Nacional de la Pesca, SAGARPA*. Retrieved from the Internet in 2003: http://inp.semarnat.gob.mx/CNP/anexo.htm

NOM-059-SEMARNAT-2001. *Norma Oficial Mexicana (NOM-059-SEMARNAT-2001), Protección ambiental-Especies nativas de México de flora y fauna silvestres-Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio-Lista de especies en riesgo*. D.O.F. del 6 de marzo de 2002.

SEMARNAT. 2002. Information provided by SEMARNAT.

Springer, V.G. and K.D. Woodburn. 1960. *An ecological study of the fishes of Tampa Bay*. Florida State Board of Conservation Marine Laboratory Professional Papers Series 1: 104p.

Table 3: Amount of Seahorses Exported from Mexico to China, Hong Kong and the United States, According to Customs Records from These Countries

Year	Destination	Amount (No.)	Amount (kg.)
1990	China	-	131
1996	USA (unknown origin – sent via Mexico)	1	-
1997	USA	9	-
	USA	-	35
1998	USA	449	-
	USA	-	38
1999	USA	6	-
	USA	-	36
	Australia (via USA)	50	-
	Hong Kong	-	140
2000	USA	-	31
	USA	1	-
	Hong Kong	-	23
	Hong Kong (re-exported to China, probably from the USA)	-	7607*

* Unofficial data

Source: Modified from Baum and Vincent (unpublished); customs data from China; Hong Kong and the USA

Table 4: Imports of Dry Seahorses Between 1998 and 2000*

Amount (pieces)	Origin	Transit	Date
1,000	U.S.A.	U.S.A.	30-Sep-98
720	Philippines	U.S.A.	10-Oct-00
288	Philippines	U.S.A.	10-Oct-00
60	Philippines	U.S.A.	10-Oct-00
720	Philippines	U.S.A.	10-Oct-00
TOTAL 2,788			

Source: Files of the General Wildlife Directorate, SEMARNAT.

NATIONAL REPORT

-PHILIPPINES-

Noel C. Barut
National Fisheries Research and Development Institute (NFRDI)
Quezon City 1103, Philippines
noel_barut@hotmail.com

I. Information on Wild Population

a. Species of Seahorses

Information on the actual number of seahorse species found in Philippine waters is still not known. Although surveys that have been conducted till now have not been that extensive, seven species of seahorses have already been identified. These numbers may still increase if studies and surveys on seahorses are carried out nationwide. The seven species of seahorses observed to occur in Philippine waters are as follows:

1) *Hippocampus barbouri*
2) *H. comes*
3) *H. kelloggi*
4) *H. kuda*
5) *H. spinosissimus*
6) *H. trimaculatus* and
7) *H bargibanti*

Another species of seahorse is reportedly present in the waters of Negros Occidental but this is yet to be confirmed.

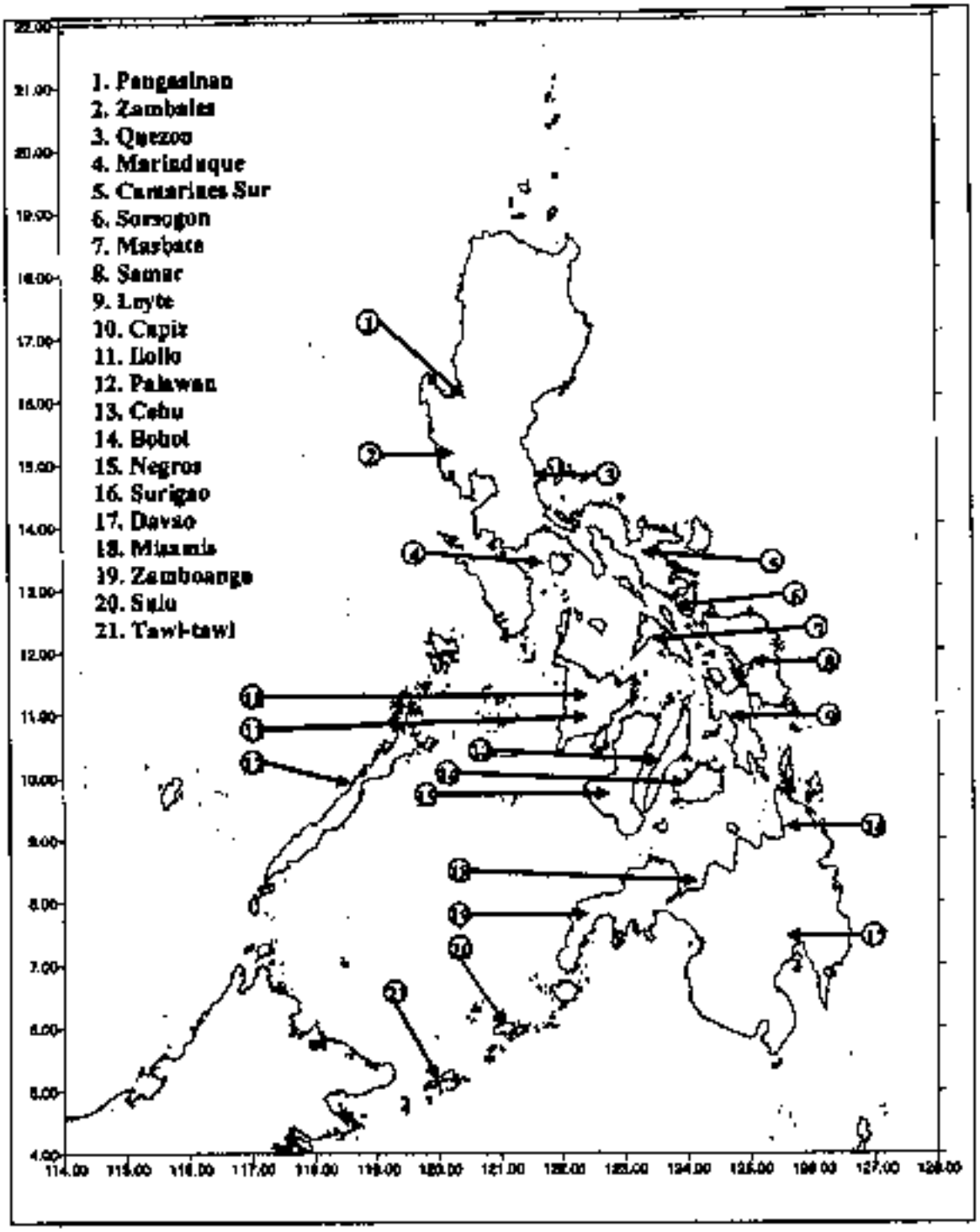
b. Areas of Distribution

Seahorses are found in waters of Pangasinan, Zamabales, Quezon, Marinduque, Camarines Sur, Sorsogon, Masbate and Palawan in Luzon Island. In the Visayas, they are reported to be present in waters of Iloilo, Capiz, Samar, Leyte, Cebu, Bohol, Negros Oriental and Negros Occidental. While in the Mindanao Island, they occur in the waters of Surigao, Davao, Misamis, Zamboanga, Sulu and Tawi–Tawi (Figure 1). In the waters of some provinces like Batangas, Mindoro and Antique, seahorses are reported to occur but are not collected or traded.

c. Abundance (Including Anecdotal Information)

Their abundance is not known since there is no regular collection of catch statistics. Based on information provided by gatherers, seahorses were once abundant but production has been observed to have rapidly declined over more recent years. Moreover, the size of seahorses observed and gathered has also decreased over time.

Figure 1: Map of the Philippines Showing the Occurrence of Seahorses.



d. Monitoring Programs

At present there is no monitoring program in place for seahorses but plans have been initiated to regularly collect seahorse statistics. The problem of identification is a major factor in the monitoring program given that present enumerators who collect catch and effort data for finfishes are not competent to identify seahorse species.

II. Nature of Seahorse Fisheries

a. Commercial, Artisanal, Subsistence

The Republic Act 8550 (R.A. 8550) differentiates the catch of commercial and municipal fishers by gear and fishing vessel type. Catch landed by fishing vessels with three gross tons and below are considered municipal or artisanal catch while catch of fishing vessels more than three gross tons are classified as commercial fisheries production or catch. Fishing vessels could be either motorized or non-motorized.

Seahorses are collected mostly by artisanal gatherers/fishers. Commercial catch of seahorses from trawl fisheries are considered to be incidental as they are not target species. The volume is minimal and in most cases the weight and number are not recorded.

b. Estimated Number of Fishers

Fishers who are directly dependent on seahorse gathering are estimated to be around 1,500 individuals while those who catch seahorses incidentally number around 2,000. The number of seahorse fishers may vary during seasons of the year, as during the peak seahorse season, the number of gatherers increases and the number of fishers declines during off-season. Again, the actual figure for seahorse fishers is estimated, as there are no actual surveys or records of seahorse fishers in the country.

c. Type of Gear Used

Municipal gatherers collect seahorses by handpicking them using lanterns at night in shallow waters. In the daytime, they use scoop nets or push nets. Other fishers use hookah compressors when they collect seahorses in deeper waters. Drag nets, seine nets like trawls and Danish seines also catch seahorses as bycatch or incidental catch.

d. Licensing/Permitting Requirements

The Philippine Fisheries Code of 1998 or R.A. 8550 categorized the fishing sector into two sectors, the commercial and municipal sectors. Licensing of fishers intending to fish within municipal waters is a function of the Bureau of Fisheries and Aquatic Resources (BFAR) devolved to the Local Government Unit (LGU) concern under R.A. 8850. Licenses are issued by the LGU concern where the fishers would operate. However, under the same law, local resident fishers are given priority in acquiring fishing licenses before other fishers from different LGUs are issued fishing licenses.

e. Preferred Markets (Live vs. Dried), If Any

Seahorses are marketed in the Philippines either live or dried. Dried seahorses are exported mainly to Hong Kong while live seahorses are exported mainly to North America and Europe for the aquarium industry.

f. Volumes Landed, If Known

The volume of seahorses landed or gathered is not known due to the lack of monitoring in designated landing centers. However, volumes of seahorse exports are known from available records at the One-Stop-Shop of the BFAR.

g. Conservation Programs for Seahorses

Seahorse conservation projects in the Philippines are mandated under R.A. 8550 on which policy on the conservation and management of marine resources is based. Project Seahorse initiated conservation programs for seahorses in close collaboration/coordination with the BFAR/National Fisheries Research and Development Institute (NFRDI).

The Southeast Asian Fisheries Development Center (SEAFDEC) have successfully conducted breeding program of marine ornamental fishes since 1996. Two species of seahorses, *Hippocampus barbouri* and *H. kuda* were included in this program. Seahorses were included in response to calls for global conservation. The study has successfully produced brood stock from hatchery seeds of these two species of seahorses. Their current research in progress includes manipulation of brood stock diets, stock density and feeding of young seahorses.

The SEAFDEC Marine Ornamental Fish Project focuses on:

1) Sea ranching and farming in pens of hatchery-reared seahorse juveniles and the transfer of the breeding and farming technologies to coastal fishers and
2) Breeding of the hatchery techniques in blue tang production.

III. Extent of International Trade

a. Number of Levels (Buyers, Middlemen, Exporters, etc.)

The municipal fishing activity in the Philippines passes through levels of middlemen to market their produce. For seahorse trading the fisher/gatherer sells their product either directly to the exporter or through the middleman if the buyer/exporter is not from the locality or far from their place. In the case of most fisheries products the goods pass only to one level or just the middleman or from fishers to middleman then to buyer/exporter.

b. Information on Value, Retail and Wholesale Prices

The price of dried seahorses varies with size. The average price is P8.00 (8 Philippine Pesos) per piece. The smaller size seahorses are sold at P3.50 per piece while the medium size dried seahorses are sold at P7.00 per piece. The price of large dried seahorses could reach P10.00 per piece.

c. Customs/CITES Involvement at Ports

In the Philippines, CITES management authority personnel are assigned in airports and seaports and are implementing national laws, rules and regulations as well as international agreements in close collaboration and coordination with other agencies involve in national and international shipping like the Customs Personnel, Quarantine Officers, Police Officers, etc.

d. Relationship Between CITES Offices and Fisheries Agencies

The BFAR is the CITES Management as well as the Scientific Authority for aquatic resources of the Philippines. However with the enactment of RA 9147 series of 2002 (the Philippine Wildlife Act of 2002) additional agencies and organizations were added to be part of the CITES Scientific Authority. Moreover, the creation of the National Fisheries Research and Development Institute (NFRDI) transferred the function of the Scientific Authority from BFAR to NFRDI. The CITES Scientific Authority of the Philippines therefore has now the following composition namely, the NFRDI, University of the Philippines-Marine Science Institute (UP-MSI), Philippine National Museum (PNM), Siliman University-Marine Laboratory (SU-ML) and the University of the Philippines in the Viasayas-College of Fisheries (UPV-CF).

e. Amount of Exports

Based on the study conducted by Project Seahorse, the 2001-2002 export of dried seahorses was 12.3 tons or 4.2 million individual seahorses while the live trade exported around 1.4 pieces. The 2003 export of dried seahorses to Hong Kong was 500kg valued at $27,500 based on the record of the BFAR One-Stop-Shop. However, records from Traffic Asia showed that in 2003 Hong Kong imported dried seahorses from the Philippines weighing 4,421kg valued at HK$2,461,765. Traffic Asia recorded the following volume and value of dried seahorses that Hong Kong imported from the Philippines from 1998 to 2003:

Year	Volume	Value (HK$ '000)
1998	6502	2317
1999	7189	2853
2000	5874	2716
2001	4512	1844
2002	8607	3762
2003	4421	2462

REFERENCES

R.A. 8550
Project Seahorse Foundation for Marine Conservation, Inc.
Southeast Asian Fisheries Development Center (SEAFDEC)
Traffic Asia

NATIONAL REPORT

-THAILAND-

THE CURRENT STATUS OF SEAHORSE CONSERVATION IN THAILAND

Mr. Samruay Meenakarn and Mr. Prapun Leepayakoon
Fishery Management and Administration Bureau
Department of Fisheries, Thailand

Population Status

Seahorses are characterized by sparse distribution and low population density, which may be related to their limited mobility and small home range. Based on fishery-dependent data and interviews with fishermen and traders, it is evident that seahorses have declined in abundance in many range states that have seahorse fisheries.

Reports and strong circumstantial evidence indicate both recruitment overfishing (declining numbers) and growth overfishing (diminishing size) among a number of the commonly traded species.

At least the following four species of seahorses are distributed in Thai (and adjacent) waters:

1. *Hippocampus kuda*
2. *H. trimaculatus*
3. *H. spinosissimus*
4. *H. mohnokei*

Researchers from Bangsaen Institute of Marine Sciences (BIMS), Burapa University have verified these 4 species. The other species such as *H. histrix*, *H. kellogi* and *H. comes* are being documented by researchers. At least two species, *H. kuda* and *H. spinosissimus*, are extensively landed, and both are generally considered abundant in Thai waters.

Distribution

Seahorses are distributed over most of the coastal environment and potential seahorse habitat is extensive. However, seahorse populations may exhibit a high degree of fragmentation due to the patchy nature of suitable habitat and extensive habitat loss resulting from human activities such as coastal development, dredging, infilling, and removal of mangroves and seagrasses. In Thai waters, seahorses are generally distributed in the Gulf of Thailand and the Andaman Sea.

Monitoring Program

Seahorse fisheries in Thailand have been operating since 1970 from fishing boats 5 to 6m long, equipped with small mesh nets. The harvesting depth is 3 to 5m offshore. At present seahorse fishing is declining and no fishing is aimed specifically at seahorses. The main source of seahorses is as bycatch from trawlers. The fishing effort yields approximately 20 to 30 seahorses per hour and the main species harvested are *Hippocampus kuda* and *H. spinosissimus*.

The high season for seahorse fisheries is from October to February. The yield of seahorses in Thailand is from 3 to 4 kg per fishing effort. However, there is no reliable record of seahorse capture as a result of illegal trawling in Thailand.

Seahorses are not among the protected species listed under the Wild Animal Reservation and Protection Act (WARPA) B.E.2535 (1992) which regulates hunting, possession, breeding, trading, import, or export of wildlife. The Thai Department of Fisheries has therefore issued the following fisheries environmental regulations under various related laws in order to protect seahorse habitat:

1. Entry and Exit of Goods Act, B.E.2522 (1979)

Four hundred species of live marine ornamental fish are listed in the Ministerial Regulation No. 46 B.E.2531 (1988). Under this Ministerial Regulation, the export of listed species of live marine ornamental fishes is prohibited. The list includes 4 species of seahorses namely: *Hippocampus kuda*, *H. trimaculatus*, *H. spinosissimus*, and *H. mohnokei*.

2. National Park Act, B.E.2504 (1961)

Eighteen areas are protected as National Marine Parks under this Act. Together these parks occupy an area of 3,671 square kilometers and cover 70% of the total coral reef area in Thailand. No person is allowed to collect and carry resources out of the park including seahorse species.

3. Fisheries Act, B.E. 2490 (1947)

Destructive fishing methods such as explosive dynamites, poisonous substances and direct electric currents are prohibited under this Act. Trawling within three kilometers offshore is illegal. The import of live Syngnathids is prohibited unless permitted by the Director-General of the Fisheries Department.

Nature of Seahorse Fisheries

Seahorses are harvested as bycatch in non-selective trawl fisheries to supply local and international markets. Bycatch currently accounts for majority of specimens intended for Traditional Chinese Medicine (TCM) and curio markets, whereas directed fisheries are usually the source of live specimens for the pet trade, as well as the dried specimen trade.

Seahorses are separated from fish during sorting, and once the fishing boats land at a port, seahorses are sold to local merchants. Exporters from Bangkok buy seahorses from local merchants every 2 to 3 months. The export volume is around 200 to 500 kilograms per shipment and the importing countries are mainly China, Hong Kong and Chinese Taipei.

Seahorses in Thailand come from Thai and foreign waters. Thailand has signed agreements on seahorse fishing with other countries such as Indonesia, Malaysia, Madagascar, Cambodia, Myanmar, Oman and Bangladesh. There are 1400 to 1500 fishing boats listed under these agreements for the year 2003-2004. The numbers of fish and other species landed monthly are between 21,000 and 30,000 metric tons. It is unfortunate that the quantity of seahorses harvested cannot be estimated from these figures.

Preliminary surveys conducted by researchers from the Bangsaen Institute of Marine Science, Burapa University showed that 2 to 5 kilograms of seahorses are harvested per fishing trip but there are no estimates from local fishing boats.

Fishing

Thai fishermen do not specifically target seahorses in Thai waters. The market for live seahorses for display in as aquarium fish is not large and hence few fishermen collect live seahorses. There is also a ban on exporting live seahorses from Thailand and therefore the demand for live seahorses is very low. As described earlier, dried seahorses mainly come from local and commercial trawlers and crab fishing boats.

Conservation Program

There are seahorse populations in the Gulf of Thailand and the Andaman Sea. The populations are declining and no specific studies have been conducted to determine the effect of fishing on the diversity of seahorse species. At present, no regulation is in place to protect seahorses from fishing activities.

In order to protect seahorses from overfishing, there are other programs such as the prohibition of fishing in protected areas. As described before, there are eighteen National Marine Parks that cover 3,671 square kilometers or approximately 1% of the total surface water (368,280 square kilometers). These protected areas cover up to 70% of the coral reef area in Thailand.

Seahorse Culture in Thailand

Bangsaen Institute of Marine Sciences, Burapa University, has conducted experiments on *Hippocampus kuda* culture since 1999. The females and males are collected and stocked in 2x5 meter concrete tanks or 3 cubic meter fiberglass tanks. They breed and spawn in the tanks. Each female can spawn up to 100-200 baby seahorses.

Seahorses can be differentiated by the naked eye as being male or female from when they are around 6 to 7 months old. From the study, the survival rate from the time of spawning to 1 month was 35 to 50% and from 1 month to 1 year was 10 to 20%.

At present, the Bangsaen Institute has had success in developing a culture technique to produce F2 generations. During 2542-2546, approximately 10,000 one to six month old seahorses have been released to sea.

International Trade

As Thailand is a party to CITES since 1983, aquatic animals are monitored under the Department of Fisheries' regulations. Department of Fisheries is the body that has the authority on management and science issues. Therefore, permits for fishing and import or export of fish and fisheries products has to be issued by this agency. There are many ports that import and export fisheries products. Fisheries staff work closely with staff from the Customs Department to inspect and control the export of dried seahorses. Thailand has issued a law to ban export of live seahorses. Only dried seahorses can be exported.

The Department of Fisheries has no right to inspect dried seahorses at the port of exit except if the importing country requires such inspection certificates. If a certificate is required, the Department of Fisheries can collect information on the quantity being exported. Otherwise no information is obtained.

Since seahorses will be listed under CITES from May 2004, seahorse exporters need to obtain permission from the Department of Fisheries. Thereafter, comprehensive information on seahorse exports from Thailand will be collected.

Seahorse Exports from Thailand

The major consumers of seahorses from Thailand include China, Malaysia, Hong Kong and Chinese Taipei. As part of the CITES agreements, Thailand's Department of Fisheries has issued 18, 31, 12, and 5 certificates for dried seahorses to exporters (3,630, 10,538, 2,760, and 1,440 kg respectively) from the year 2000 until 2003 (See Table 1).

Table 1. Amount of dried seahorses exported from Thailand in 2000-2003

Country	Year 2000		Year 2001		Year 2002		Year 2003	
	No. Of CITES Certificate	Dried seahorses [kg]	No. Of CITES Certificate	Dried seahorses [kg]	No. Of CITES Certificate	Dried seahorses [kg]	No. Of CITES Certificate	Dried seahorses [kg]
Chinese Taipei	13	1,630	13	3,848	2	160	-	-
Malaysia	1	100	3	720	-	-	-	-
Hong Kong	2	1,600	7	1,670	7	1,400	4	1,140
China	2	300	8	4,300	3	1,200	1	300
Total	**18**	**3,630**	**31**	**10,538**	**12**	**2,760**	**5**	**1,440**

Source: Department of Fisheries, Thailand

NATIONAL REPORT

-UNITED STATES OF AMERICA-

Bob McMichael[1], Ed Matheson[1] and John Field[2]

[1] Florida Fish and Wildlife Conservation Commission
Florida Marine Research Institute
100 8th Avenue SE
St. Petersburg, Florida 33701. USA

[2] US Fish and Wildlife Service,
4401 North Fairfax Drive, Room 750,
Arlington VA, 22203. USA

I. Information on Wild Populations

a. Species of Seahorses in U.S. Waters

As many as seven species of seahorses may occur in the waters of the United States (excluding territories). *Hippocampus fisheri* and possibly *H. histrix* and *H. kuda* occur in Hawaii; *H. ingens* occurs in California; and *H. erectus, H. reidi*, and *H. zosterae* occur along the Atlantic and Gulf of Mexico coasts.

b., c. Distribution, Abundance, and Biological Data

Little information is available regarding *Hippocampus fisheri*. This species definitely occurs in Hawaii, but records from Lord Howe Island and New Caledonia are equivocal (Lourie *et al.*, 1999). Taxonomic confusion complicates the literature on this species from Hawaii. For instance, in their volume on the fishes of Hawaii, Gosline and Brock (1960) list *H. fisheri* as a synonym of *H. kuda*. Lourie *et al.* (1999) indicate that museum specimens of *H. fisheri* were either collected offshore or from the stomachs of pelagic fishes. Based on the limited information at hand, we would assume that this is a rare, offshore species in Hawaiian waters, but Hoover[1] indicates that, although it is not frequently seen because of its offshore habitat, it is more abundant than *H. kuda* in Hawaii. *Hippocampus fisheri* adult heights range from 5 to 8 cm, and little is known regarding its life history (Lourie *et al.*, 1999).

The abundances (and perhaps even the presence) of *H. histrix* and *H. kuda* in Hawaii are questionable. Gosline and Brock (1960) include *H. histrix* in the Hawaiian ichthyofauna based on a single specimen collected by Fowler in 1928. Gosline and Brock (1960) also indicate that *H. kuda* is the abundant seahorse species in Hawaii, but as mentioned above, these authors did not recognize *H. fisheri*. Lourie et al. (1999) discuss the taxonomic problems associated with both *H. histrix* and *H. kuda* but include Hawaii in the range of both species. However, Kuiter (2000) indicates that *H. fisheri* may be the only seahorse found in Hawaii. Based on the information we have uncovered to date, we conclude that the most abundant seahorse in Hawaii is an offshore form, probably *H. fisheri*, and that *H. histrix* and *H. kuda* are either rare or absent in Hawaiian waters. *Hippocampus histrix* occurs at depths of at least 6 m and may be associated with sparsely vegetated substrates and/or sea-squirts and sponges (Lourie et al., 1999). Its adult height ranges from 8 to 14 cm, and little is known regarding its life history (Lourie et al., 1999).

Hippocampus kuda has been found in various inshore and estuarine habitats (e.g., mangroves, seagrass, mud bottom) and in drifting Sargassum (Lourie et al., 1999). Its adult height ranges from 7 to 17 cm, it matures in 7 to 8 months, and it is not known to be monogamous (Lourie et al., 1999).

The only species of seahorse from the Pacific coast of the continental U.S. is *Hippocampus ingens*. This species occurs from San Diego, California to Peru, including the Galapagos Islands and the Gulf of California (Miller and Lea, 1972; Fritzsche, 1980).

Hippocampus ingens is rare in California waters and is apparently only present during periods of high water temperature (Miller and Lea, 1972; Lourie *et al.*, 1999). This is one of the largest seahorse species, measuring from 13-19 cm (Lourie *et al.*, 1999). Little is known about the biology of this species, except that it appears to occur in deeper water than do many other seahorse species (10 m to maximum of 60 m [Lourie *et al.*, 1999; Fritzsche, 1980]) and is commonly associated with gorgonians or black coral (Humann and DeLoach, 1993).

Of the three species of *Hippocampus* that occur along the coastlines of the eastern U.S., *H. reidi* is the least abundant. This species occurs in the Western Atlantic from North Carolina through the Florida Keys and the Caribbean to Rio de Janeiro, Brazil (Vari, 1982). In his review of Western North Atlantic seahorses, Vari (1982) examined only 4 specimens from U.S. waters: one from off North Carolina and three from the east and west coasts of Florida. Other U.S. literature records are all from Florida: 1) Christensen (1965), one specimen, southeast coast; 2) Starck (1968), "rare", Keys; 3) Weinstein and Heck (1979), one specimen, southwest coast; 4) Gilmore *et al.* (1981), "rare", mid-east coast; and 5) Tremain and Adams (1995), one specimen, mid-east coast. Several offshore records from New Jersey to Chesapeake Bay and a record from Louisiana mentioned under the name *Hippocampus obtusus* by Hardy (1978) may also represent *H. reidi*. This is a moderate-sized seahorse, with adult height ranging from 10-18 cm (Lourie *et al.*, 1999). It has been collected at depths ranging from 15 to 55 m and is associated with gorgonians, seagrasses, mangroves or floating mats of *Sargassum* (Lieske and Myers, 1994; Lourie *et al.*, 1999). *Hippocampus reidi* forms monogamous pair bonds in the wild (Lourie *et al.*, 1999).

Hippocampus erectus occurs in the Western Atlantic from Nova Scotia, Canada, along most of the Atlantic and Gulf of Mexico coasts of the U.S., throughout the Caribbean, and along the Atlantic coast of South America to Uruguay (Hardy, 1978; Vari 1982). With the exception of rare specimens of *H. reidi*, this is the only species of seahorse found north of Florida on the Atlantic coast of the U.S. *Hippocampus erectus* is not common north of New York (Bigelow and Schroeder, 1953) but is common in many Atlantic coast estuaries from Florida to New York (Gilmore *et al.*, 1981; Murdy *et al.*, 1997; Able and Fahay, 1998), with the possible exception of some estuaries with little seagrass (e.g., Georgia estuaries and nearshore marine waters sampled by Dahlberg [1972] and Hoese [1973] and South Carolina estuaries sampled by Shealy *et al.* [1974]).

In Florida, *H. erectus* has been collected in most estuaries but is least common in estuaries of northeast Florida and the western panhandle (see presentation of monitoring results below). In the northern Gulf of Mexico (west of Florida), this species is "common" in Alabama (Boschung, 1992) and occurs in estuarine or nearshore marine waters of Mississippi (Franks *et al.*, 1972), Louisiana (Guillory, 1982), and Texas (Hoese, 1958; Parker, 1965). However, few studies conducted in the northern Gulf of Mexico are useful for determining the abundance of *H. erectus* in this region. Most northern Gulf studies merely list a few specimens or include this species in faunal lists without any indication of abundance (e.g., Hoese, 1958; Parker, 1965; Franks *et al.*, 1972; Guillory, 1982). Many studies conducted in this region include extensive species lists but do not include specimens of *Hippocampus* (e.g., Arnold *et al.*, 1960; Fox and

Mock, 1968; Adkins and Bowman, 1976; Felley and Felley, 1986; Zimmerman and Minello, 1984; Felley, 1987, 1989; Baltz *et al.*, 1993, 1998; Gelwick *et al.*, 2001). As mentioned above, for South Carolina and Georgia estuaries, many of these studies that include no *H. erectus* were conducted in areas with no seagrass. One extensive field survey of this species in Texas (Matlock, 1992) suggests that populations in that state are "small but stable"; however, it is unclear whether sampling effort remained the same over the 15-year course of this study. Adult height in this species ranges from 6 to 19 cm (Lourie *et al.*, 1999).

Most commonly found at depths beyond 1m, *H. erectus* has been collected to depths of 73 m and is associated with natural material (seagrass, gorgonians, sponges, mangroves, etc.) as well as human-made structures (Matlock, 1992; Lieske and Myers, 1994; Lourie *et al.*, 1999). A study of the reproductive biology of this species indicates they are monogamous, with the sex ratio skewed towards females (Teixeira and Musick, 2001). *Hippocampus erectus* can be abundant in the bycatch of shrimp fisheries (Baum *et al.*, 2003), and more data are needed to determine the impact of the fishery on populations of this species.

Hippocampus zosterae is a very diminutive seahorse with a restricted geographic range and well-defined habitat preferences. This species occurs in insular locations including Bermuda, the Bahamas, and Cuba; along Atlantic continental shorelines from northeast Florida through the Florida Keys; and in the Gulf of Mexico south to the Gulf of Campeche (Ginsburg, 1937; Vari, 1982; Dennis *et al.*, 2001). In Florida waters, *H. zosterae* occurs in most estuaries but is more abundant in south Florida and the Keys (see presentation of monitoring results below). In the U.S. Gulf of Mexico west of Florida, *H. zosterae* is widely distributed but does not appear to be common in many areas. Various authors report the presence of this species but give little indication of its abundance in either estuarine or nearshore marine waters of Alabama (Boschung, 1992), Mississippi (Ginsburg, 1937; Franks *et al.*, 1972), Louisiana (Guillory, 1982), or Texas (Ginsburg, 1937). Also, the numerous studies conducted in the northern Gulf of Mexico which produced no *Hippocampus* specimens indicate that this species is probably not very abundant in many areas (see above). Several studies indicate that *H. zosterae* occurs in at least moderate numbers in Texas waters, often in association with seagrass habitat (e.g., Hoese, 1958; Hook, 1991; Sheridan and Minello, 2003). This is one of the smallest species of seahorses, with adult height ranging from 2 to 3 cm (Lourie *et al.*, 1999), and it forms monogamous breeding pairs (Masonjones and Lewis, 1996, 2000).

Several studies conducted in Florida waters document abundance trends and habitat preferences of *H. zosterae*. Sheridan *et al.* (1997) and Matheson *et al.* (1999) indicated that this species was among the more abundant fishes associated with the seagrass canopy in Florida Bay during both the 1980s and 1990s but that abundance of this species declined in western Florida Bay over that decade. Also in Florida Bay, Matheson *et al.* (unpublished data)[2] found that *H. zosterae* was more abundant in higher salinity (~29 ppt and higher) portions of the bay, in areas with denser seagrass and higher seagrass canopies, and in areas with either mixed seagrass beds or beds dominated by *Syringodium filiforme*. Ecological factors correlated with *H. zosterae* distribution were also investigated in Florida Bay by Masonjones (unpublished data). Areas with robust seahorse populations generally included beds of *Thalassia testudinum* or mixed seagrass dominated by *T. testudinum*. These sites had moderate seagrass coverage (measured as blade density), moderate species diversity, mean salinities of 33.1 ppt and mean water temperatures of 31.12 C (measured during June, 2003). In terms of specific predictors of seahorse habitat, seahorse populations were significantly correlated with water flow, with individuals more likely to be found in low-flow areas. These low-flow areas tended to have sediment with relatively high organic content and are relatively protected bays and lagoons. Seagrass beds in higher flow areas (like near bridge cuts) never had measurable populations of *H. zosterae*. On a fine scale, the distribution of *H. zosterae*, as has been described for

other seahorse species, is quite patchy. Of 20 healthy seagrass beds surveyed in 2003 in the Florida Keys, only eight had seahorses and only five of those had robust populations (i.e., more than two seahorses recovered with a modified pushnet per sampling event). In areas with robust populations, the density of seahorses is roughly 0.4± 0.25 seahorses/m^2 (mean± standard deviation) (Masonjones, unpublished data). The same patterns have been observed for Tampa Bay, Florida populations of *H. zosterae* in terms of both their abundance and patchy distribution.

d. Monitoring Programs

Within the United States, most estuarine and nearshore fish monitoring takes place at the state level, with most programs utilizing both state and federal funds. Most coastal states in the U.S. have some sort of monitoring program in place, with most programs focusing on a few select species (generally those which are important in recreational or commercial fisheries). Few programs attempt to monitor entire fish communities. Only Florida has programs in place that monitor both wild populations and harvest rates for seahorses. This is primarily because Florida has both a community-level fisheries-independent monitoring program and an extensive fisheries-dependent monitoring program and because Florida is the only state with large enough inshore populations of seahorses to support a fishery which is detectable in commercial landings data. Florida's monitoring programs are discussed below.

The Florida Fish and Wildlife Conservation Commission's (FWC) Florida Marine Research Institute (FMRI) conducts applied marine research and monitoring in Florida's estuarine and nearshore marine environments. The FMRI conducts both fisheries-dependent and fisheries-independent monitoring programs. The fisheries-dependent monitoring (FDM) program monitors the commercial and recreational fisheries of Florida and will be described in detail below in Section II. The fisheries-independent monitoring (FIM) program monitors populations of estuarine fishes and selected macroinvertebrates throughout the state.

The mandate to provide accurate accounting of the condition of Florida's fisheries resources requires knowledge of the relative abundance of stocks at particular life stages. To gain this knowledge, biologists must conduct studies and gather data that are free of the reporting or gear biases usually associated with information obtained from recreational and commercial fishers. To this end, in 1988, scientists initiated the FIM program to monitor juvenile fish recruitment into Tampa Bay; since then, the program has expanded to include seven estuarine systems and the Florida Keys (Figure 1) and to include adult-fish monitoring. In this program, scientists use statistically valid sampling techniques to collect data that are used to estimate relative abundance of juvenile and adult fishes and invertebrates. More than two million fish and invertebrates are identified, counted, and released alive each year. These data provide juvenile recruitment indices and adult age tables used to evaluate the effects of current fishery regulations and predict future stock levels.

The FIM program consists of a number of interconnected components. The program's routine, stratified-random sampling regime generates information concerning the size-at-age, population age structure, and reproductive condition of many species. In addition to information about juvenile recruitment and adult abundance that can be used in stock assessments for important recreational and commercial fishery species, the FIM program produces data and specimens used in life-history, invasive-species, and fish-health studies and in studies directed at human health issues (e.g., mercury levels in edible fishes). This community-level fisheries-independent monitoring program uses a multi-gear approach to collect data on fishes and selected invertebrates from a wide range of habitats and life history stages. A 21.3-m center bag seine is used to collect juvenile and sub-adult fishes in shallow areas (< 1.8 m); a 6.1-m otter trawl is used to collect juvenile, sub-adult, and adult fish in deep water (1.0-7.6 m); a 183-m haul seine is used to collect sub-adult and adult fish in shallow water (< 2.5 m) along shorelines; a 183-m purse seine is used to collect sub-

adult and adult fishes in intermediate depths (1.0-3.3 m); and visual surveys are used to monitor reef fishes in the Florida Keys at depths to 30 m.

A stratified-random sampling design is used by the FIM program in all study areas. Each area is divided into sampling zones based on geographic and logistical criteria. Each zone is further subdivided into 1 sq.nm grids, and a subset of these grids is randomly selected for sampling. In most cases, the number of monthly samples collected in each zone with each gear is proportional to the number of grids in the zone that can be sampled with a particular gear. A single sample is collected at each randomly selected site, except during the visual sampling in the Florida Keys (four, 5 m radius, point-counts censuses are conducted per site). Sampling grids are stratified by habitat and depth, thereby identifying the gear types that can be used in each grid. All sampling is conducted during daytime hours (one hour after sunrise to one hour before sunset). Several different, habitat-dependent deployment techniques are used with some sampling gears, especially the 21.3 m seine.

All FIM sampling efforts generate both biological and environmental data. The sample work-up technique is similar for all net-collected samples, regardless of gear type or sampling regime. All fish and selected invertebrates are identified to the lowest practical taxonomic level, counted, and measured (standard length for most teleosts, height for seahorses, precaudal length for sharks, disc width for rays, carapace width for crabs, and post-orbital head length for shrimp). Animals are then released except for representative samples of each taxon (for laboratory confirmation of field identifications) and samples required for specific research projects.

During visual surveys of reef fishes, estimated lengths (natural total length) of selected reef fish species are recorded (5 cm length intervals for fishes <60 cm and 10 cm intervals for fishes >60 cm) by trained divers using SCUBA. Environmental data collected with each sample include water quality parameters, habitat characteristics, and physical parameters, such as current and tidal stage.

For seahorses, the most productive and quantitative sampling gear is the dropnet or throw-trap (usually 1-m^2). Dropnets were used to sample seagrass habitats in Tampa Bay and Charlotte Harbor from 1989 through 1994 and in the Indian River Lagoon from 1990 through 1994. Estimated densities of seahorses based on samples collected with dropnets were higher than those based on any other FIM program sampling gear (see below). Dropnets are a very quantitative gear for sampling small, cryptic, slow-moving organisms such as seahorses, but they are not efficient at collecting larger more mobile species. The latter factor led to the removal of this gear type from the regular FIM sampling regime.

Throw-traps similar to the FIM program dropnets have been used recently by FIM program biologists to study seagrass-associated fauna in Florida Bay (Matheson et al., 1999; Matheson et al., unpublished data[3]).

Data collected by scientists in the FIM program indicate both spatial and temporal trends among seahorse populations in Florida. Both *Hippocampus zosterae* and *H. erectus* were generally more abundant in middle to southern portions of the Florida peninsula (Figure 2). *Hippocampus zosterae* was also moderately abundant in the western panhandle, and *H. erectus* was also moderately abundant in the eastern panhandle.

Hippocampus zosterae was the most abundant seahorse in shallow water, represented by seine and dropnet collections, and *H. erectus* was the most abundant species in deeper water, represented by trawl collections.

Annual abundance estimates for both species varied, with some indication of an increase in more recent years (Figures 3 and 4).

II. Nature of Seahorse Fisheries

a. Commercial, Artisanal, Subsistence

In the U.S., commercial seahorse fisheries are limited to the state of Florida. As mentioned above, the commercial harvest of seahorses in Florida is monitored by the Fisheries-Dependent Monitoring (FDM) program. Florida law (Chapters 370.021, .06 (2) (a) and Administrative Code 16R-5.002) requires that anyone wishing to sell their catch of saltwater products must have a valid Saltwater Products License, and that licensed wholesale dealers must maintain records of each sales transaction. This is accomplished by the dealer filling out a Marine Fisheries Trip Ticket for each purchase of saltwater products from a fisherman. Retailers who produce their own products must also maintain records of the saltwater products that they produce for sale through their retail license. Trip tickets are used to quantify commercial landings (pounds and value) of fish and shellfish. Annual landings of about 120 million pounds worth an estimated $200 million dollars are reported on 380,000-445,000 trip tickets. This information provides resource managers with a measure of fishing effort (trips) and trends in fisheries. Required information includes Saltwater Products License number, dealer's license number, date of purchase, time fished, county landed, gear fished, number of sets, traps pulled, species code, size code (if species graded), amount of catch (usually in pounds), area fished, depth, unit price, and dollar value.

In addition to the trip ticket program, Florida has a biostatistical sampling program. This program involves fisheries scientists visiting commercial fish houses and sampling the catch as it is off-loaded. Biostatistical samplers gather information on length frequencies of landed catch by gear type; verify species identification; collect hard parts, biological tissues, and gonads; provide direct contact with fishermen and dealers; and provide information which can be used to verify trip ticket data. Currently eight samplers conduct approximately 1500 interviews per year.

Data collected by the FDM program indicate that seahorses are harvested commercially in Florida; both as a targeted fishery and as bycatch in trawl fisheries targeting other species (primarily shrimp).

b. Estimated Number of Fishers

The FDM program has on record approximately 40 saltwater products license holders with reported commercial landings of seahorses or pipefishes. This number has held fairly constant since 1996, with 60 or more license holders from 1991 to 1994. The majority of these fishers reported landings from the southeast Florida/Keys region, and these landings were based on between 150 and 325 commercial trips/ year (Figures 5 and 6).

c. Type of Gear Used

Most of the Florida seahorse harvest is conducted by divers using nets or by fishers using trawls (as bycatch in a live, bait-shrimp fishery); gear type was not recorded for approximately 24% of the seahorses landed. Some specimens are also harvested by seine or dredge. From 1990 to 2003, divers collected 18 to 90% of the annual harvest of *Hippocampus zosterae* and trawlers collected 0 to 60%. Gear type was not specified for 27% of the total landings of *H. zosterae*, with 84% of these fish being harvested during the early 1990s. From 1990 to 2003, divers harvested 0 to 70% of *H. erectus* and 0 to 85% were harvested by trawlers. Overall, divers collected approximately 90% of the *H. zosterae* harvested in the southeast Florida/Florida Keys region and slightly more than 50% of those harvested in southwest Florida. Divers also collected approximately 48% of the *H. erectus* harvested in the southeast Florida/ Florida Keys region.

d. Licensing/Permitting Requirements

As stated above, Florida law (Chapters 370.021, .06 (2) (a) and Administrative Code 16R-5.002) requires that anyone wishing to sell their catch of saltwater products must have a valid Saltwater Products License and that licensed wholesale dealers must maintain records of each sales transaction.

e. Preferred Markets (Live vs. Dried), If Any

Most of the seahorses harvested in Florida are sold dried in the curio market, but a substantial number are also sold live in the aquarium trade (John Field, U.S. Fish and Wildlife Service, pers. comm.).

f. Volume Landed, If Known

The number of seahorses landed per year varies, but from 1990 to 2003, it has ranged from approximately 6,000 to 111,000 animals/year. *Hippocampus zosterae* comprised more than 91% of this harvest, with *H. erectus* and unidentified seahorses each comprising slightly more than 4%.

Harvest of *H. zosterae* has varied sporadically from 2,142 to 98,779 individuals per year, with lower harvest rates (<25,000 fish) in 6 of the 14 years in the dataset and higher harvest rates (>60,000 fish) in 7 of these years (Figure 7). Harvest of *H. erectus* has varied from 428 to 7,250 individuals per year, with approximately 4,000 to more than 7,000 fish harvested per year from 1990 to 1992 and less than 3,000 harvested in all subsequent years (Figure 8). The vast majority of *H. zosterae* are landed in southwest Florida, and a substantial number are also landed in the southeast Florida/Florida Keys region (Figure 7). On the other hand, most *H. erectus* appearing in harvest were landed in the southeast Florida/Florida Keys region, a moderate number were landed in the Big Bend region, and relatively few were landed in southwest Florida (Figure 8).

g. Conservation Programs For Seahorses

In 1983, the Florida Legislature created the Marine Fisheries Commission to conserve and manage Florida's marine fisheries. This commission was mandated with the task of ensuring the health and abundance of Florida's marine resources, using management decisions that are fair and equitable to all the people of Florida. To do this, the Commission requires considerable background information that includes current and accurate utilization rates of our marine resources.

The state was mandated by this same law to establish a Marine Fisheries Information System to gather the kinds of fisheries data necessary for management and research.

III. Extent of International Trade

a. Number of Levels (Buyers, Middlemen, Exporters, etc.)

The United States is probably one of the largest importers of live seahorses for the ornamental fish market (Wabnitz *et al.*, 2003) and also imports significant quantities of dried seahorses (USFWS, 2003)[4]. The United States also exports live and dried seahorses, although volumes are small in the context of global trade. See Section (e) below for more detail.

The import industry for live seahorses is characteristic of the U.S. marine ornamental fish market. Import operations act as wholesalers, purchasing live seahorses from foreign suppliers, acclimatizing them, and then distributing them to retail outlets throughout the country.

Transshippers are also involved in the trade, importing specimens and then directly shipping them to retail outlets without intervening in care (Wabnitz et al., 2003).

Import and distribution patterns for dried seahorses are less clear, mainly because federal and state authorities have not monitored this industry prior to the CITES listing for *Hippocampus*.

Seahorse capture fisheries and exports are centered in the state of Florida, which has the only known commercial seahorse fishery in the country. Other states have either unsuitable habitat for seahorses, or actively prohibit the collection of seahorses without a permit. The domestic fishery and export business for seahorses is quite simple, with seahorses taken primarily as bycatch in a live, bait-shrimp fishery and by divers in state waters. Some shrimp fishermen choose to obtain the required state license and sell seahorses, which must be landed alive as per state regulations. As noted above, the state also licenses wholesalers who either export specimens (alive and dried) or sell them to domestic retailers as prices dictate.

There are also limited quantities of aquacultured seahorses available from at least one U.S captive-breeding operation. This business sells directly to retail customers through the internet, bypassing wholesalers and retail outlets.

b. Information on Value, Retail, and Wholesale Prices

State and federal agencies collect little information on seahorse prices. The aquaculture operation mentioned in paragraph a) above sells specimens for USD$30-$150 per piece, whereas commercial bait shrimp fishermen sell their bycatch seahorses for about USD$1 per animal to wholesalers (J. Field, U.S. Fish and Wildlife Service, pers. comm.).

c. Customs/CITES Involvement At Ports

The U.S. Fish and Wildlife Service (USFWS) is the primary agency involved in federal wildlife law enforcement, including implementation of CITES provisions for import and export. USFWS inspectors are stationed at 15 designated ports throughout the country, and process over 100,000 shipments each year. U.S. seahorse importers and exporters, like all wildlife traders in the country, must purchase a standard wildlife import/export license each year, and pay fees to process each shipment they receive at a U.S. port. USFWS inspectors analyze each shipment's paperwork, including the importer's license, and make case-by-case decisions whether to perform visual inspections of the shipment itself.

Wildlife inspectors consider several factors when deciding whether to perform a visual inspection, including the species' status in the wild, the importer's violation record, and the species' CITES status. Currently, USFWS inspects approximately 25% of all wildlife shipments (seahorses and other species), and these inspections may cover the entire shipment or just selected specimens.

d. Relationship Between CITES Offices and Fisheries Agencies

Under the U.S. constitution, almost all fisheries management in coastal waters is the responsibility of state (provincial) governments. This applies to seahorses, which are only commercially harvested in the waters of the state of Florida in the United States. The USFWS is a federal (national) agency with sole responsibility for enforcing CITES measures for the United States. The federal U.S. National Marine Fisheries Service (NMFS) provides technical expertise on various seahorse issues and has joined with the USFWS and the Florida state government to work collaboratively on implementing the CITES seahorse listing for the United States. The state government has already begun work with the USFWS to develop a public relations and outreach plan for seahorse harvesters and wholesalers after the listing becomes effective in 2004.

e. Amount of Exports

From 1996 to 2003, the U.S. Fish and Wildlife Service recorded 33 records of seahorse exports, with nearly 1,000 live animals and thousands of dried specimens for either the curio or medicinal trade. In the same time period, the U.S. Fish and Wildlife Service recorded more than 200 imports including more than 31,000 live animals and hundreds of thousands of dried specimens. These values probably largely underestimate the U.S. trade volumes since 1) they occurred prior to the CITES listing and the associated record-keeping, and 2) most seahorses are traded with other tropical fish and coded as such by customs officials in the United States. The CITES listing (effective May 2004) should help to correct this bias in U.S. trade data, since the treaty will require seahorse shipments to be declared to the species level.

Chinese Taipei reported approximately 500 kg of seahorse imports from the United States from 1983-2000, although some of these may be re-exports[5]. The state of Florida showed seahorse harvest ranging from 6,000 to 111,000 animals per year from 1990-1998, but it is unclear how many of these were exported.

REFERENCES

Able, K.W. and M.P. Fahay. 1998. *The First Year In The Life Of Estuarine Fishes In The Middle Atlantic Bight.* Rutgers University Press, New Brunswick, New Jersey. 342 p.

Adkins, G. and P. Bowman. 1976. *A Study of The Fauna In Dredged Canals of Coastal Louisiana*. Louisiana Wildlife and Fisheries Commission, Tech. Bull. 18. 72 p.

Arnold, E.L., Jr., R.S. Wheeler, and K.N. Baxter. 1960. *Observations On Fishes And Other Biota Of East Lagoon, Galveston Island*. U. S. Fish Wildl. Serv., Spec. Sci. Rept. Fish. 34. 30 p.

Baltz, D.M., J.W. Fleeger, C.F. Rakocinski, and J.N. McCall. 1998. *Food, Density, And Microhabitat: Factors Affecting Growth And Recruitment Potential Of Juvenile Saltmarsh Fishes*. Environ. Biol. Fishes 53:89-103.

Baltz, D.M., C. Rakocinski, and J.W. Fleeger. 1993. *Microhabitat Use by Marsh-Edge Fishes in a Louisiana Estuary*. Environ. Biol. Fishes 36:109-126.

Baum, J.K., J.M. Meeuwig, and A.C.J. Vincent. 2003. *Bycatch of Seahorses (Hippocampus erectus) in a Gulf of Mexico Shrimp Trawl Fishery*. Fisheries Bulletin 101: 721-731.

Bigelow, H.B. and W.C. Schroeder. 1953. *Fishes of the Gulf of Maine*. Fish. Bull. 53. 577 p.

Boschung, H.T. 1992. *Catalogue of Freshwater and Marine Fishes of Alabama*. Bull. Ala. Mus. Nat. Hist. 14. 266 p.

Christensen, R.F. 1965. *An Ichthyological Survey Of Jupiter Inlet and Loxahatchee River, Florida*. M.S. Thesis, Florida State University, Tallahassee. 318 p.

Dahlberg, M.D. 1972. *An Ecological Study Of Georgia Coastal Fishes*. Fish. Bull. 70(2): 323-353.

Dennis, G.D., K.J. Sulak, and D.C. Weaver. 2001. *Nekton Species Inventory For The Timucuan Ecological and Historical Preserve*. Report to the National Park Service Timucuan Ecological and Historic Preserve.

Felley, J.D. 1987. *Nekton Assemblages of Three Tributaries to the Calcasieu Estuary, Louisiana*. Estuaries 10(4): 321-329.

Felley, J.D. 1989. *Nekton Assemblages of the Calcasieu Estuary*. Contrib. Mar. Sci. 31:95-117.

Felley, J.D. and S.M. Felley. 1986. *Habitat Partitioning of Fishes in an Urban, Estuarine Bayou*. Estuaries 9(3): 208-218.

Fox, L.S. and W.R. Mock, Jr. 1968. *Seasonal Occurrence of Fishes in Two Shore Habitats in Barataria Bay, Louisiana*. Proc. La. Acad. Sci. 31: 43-53.

Franks, J.S., J.Y. Christmas, W.L. Siler, R. Combs, R. Waller, and C. Burns. 1972. *A Study of Nektonic and Benthic Faunas of The Shallow Gulf of Mexico Off The State of Mississippi*. Gulf Res. Repts. 4(1): 1-148.

Fritzsche, R.A. 1980. *Revision Of The Eastern Pacific Syngnathidae (Pisces: Syngnathiformes), Including Both Recent And Fossil Forms*. Proceedings of the California Academy of Science 42(6): 181-227.

Gelwick, F.P., S. Akin, D.A. Arrington, and K.O. Winemiller. 2001. *Fish Assemblage Structure in Relation of Environmental Variation in a Texas Gulf Coastal Wetland*. Estuaries 24(2): 285-296.

Gilmore, R.G., Jr., C.J. Donohoe, D.W. Cooke, and D.J. Herrema. 1981. *Fishes of the Indian River Lagoon and Adjacent Waters, Florida*. Harbor Branch Foundation, Inc., Tech. Rept. 41. 28 p.

Ginsburg, I. 1937. *Review of the Seahorses (Hippocampus) Found on the Coasts of the American Continents and of Europe*. Proceedings of the U.S. National Museum 83: 497-595.

Gosline, W.A. and V.E. Brock. 1960. *Handbook of Hawaiian Fishes*. University of Hawaii Press, Honolulu.

Guillory, V. 1982. *An Annotated Checklist of the Marine Fish Fauna of Grand Isle, Louisiana*. La. Dept. Wildl. Fish. Tech. Bull. 35:1-13.

Hardy, J.D., Jr. 1978. *Development of Fishes of the Mid-Atlantic Bight: An Atlas of Egg, Larval and Juvenile Stages*. Vol. II. Anguillidae through Syngnathidae. U. S. Fish Wildl. Serv., FWS/OBS-78/12. 458 p.

Hoese, HD.1958.*A Partially Annotated Checklist of the MarineFishesof Texas*. Publ. Inst.Mar. Sci.Univ.Tex. 5:312-352.

Hoese, H.D. 1973. *A Trawl Study of Nearshore Fishes and Invertebrates of the Georgia Coast*. Contrib. Mar. Sci. 17: 63-98.

Hook, J.H. 1991. *Seasonal Variation in Relative Abundance and Species Diversity of Fishes in South Bay.* Contrib. Mar. Sci. 32: 127-141.

Humann, P. and N. Deloach. 1993. *Reef Fish Identification: Galápagos*. New World Publications, Jacksonville, Florida.

Kuiter, R.H. 2000. *Seahorses, Pipefishes and Their Relatives: A Comprehensive Guide to Syngnathiformes*. TMC Publishing, Chorleywood, UK. 237 p.

Lieske, E., and R. Myers, 1994. *Collins Pocket Guide: Coral Reef Fishes: Indo-Pacific & Caribbean Including the Red Sea*. Harper Collins Publishers.

Lourie, S.A., A.C.J. Vincent, and H.J. Hall. 1999. *Seahorses: An Identification Guide To The World's Species and Their Conservation*. Project Seahorse, London, UK.

Masonjones, H.D., and S.M. Lewis. 1996. *Courtship Behavior in the Dwarf Seahorse, Hippocampus zosterae*. Copeia 1996(3): 634-640.

Masonjones, H.D. and S.M. Lewis. 2000. *Differences in Potential Reproductive Rates of Male and Female Seahorses Related to Courtship Roles*. Animal Behaviour, 59: 11-20.

Matheson, R.E., Jr., D.K. Camp, S.M. Sogard, and K.A. Bjorgo. 1999. *Changes in Seagrass-Associated Fish and Crustacean Communities on Florida Bay Mud Banks: The Effects of Recent Ecosystem Changes?* Estuaries 22(2B): 534-551.

Matlock, G.C. 1992. *Life History Aspects of Seahorses, Hippocampus in Texas*. TheTexas Journal of Science 44: 213-222.

Miller, D.J., and R.N. Lea. 1972. *Guide to the Coastal Marine Fishes of California*. California Department of Fish and Game, Fish Bulletin 157. 249 p.

Murdy, E.O., R.S. Birdsong, and J.A. Musick. 1997. *Fishes of Chesapeake Bay*. Smithsonian Institution Press, Washington, D.C. 324 p.

Parker, J.C. 1965. *An Annotated Checklist of the Fishes of the Galveston Bay System, Texas*. Publ. Inst. Mar. Sci. Univ. Tex. 10:201-220.

Shealy, M.H., J.V. Miglarese, and E.B. Joseph. 1974. *Bottom Fishes of South Carolina Estuaries-Relative Abundance, Seasonal Distribution and Length-Frequency Relationships*. South Carolina Marine Resources Center, Tech. Rept. Ser. 6. 189 p.

Sheridan, P.F., G. McMahan, G. Conley, A. Williams, and G. Thayer. 1997. *Nekton Use of Macrophyte Patches Following Mortality of Turtlegrass, Thalassia testudinum, in Shallow Waters of Florida Bay (Florida, USA)*. Bull. Mar. Sci. 61(3): 801-820.

Sheridan, P.F. and T.J. Minello. 2003. *Nekton Use of Different Habitat Types in Seagrass Beds of Lower Laguna Madre, Texas*. Bull. Mar. Sci. 72(1): 37-62.

Starck, W.A., II. 1968. *A List of Fishes of Alligator Reef, Florida With Comments on the Nature of the Florida Reef Fish Fauna*. Undersea Biol. 1: 4-40.

Teixeira, R.L., and J.A. Musick. 2001. *Reproduction and Food Habits of the Lined Seahorse, Hippocampus erectus (Teleostei: Syngnathidae) of Chesapeake Bay, Virginia*. Revista Brasileira de Biologia., 61 (1): 79-90.

Tremain, D.M. and D.H. Adams. 1995. *Seasonal Variations in Species Diversity, Abundance, and Composition of Fish Communities in the Northern Indian River Lagoon, Florida*. Bull. Mar. Sci. 57(1): 171-192.

Vari, R.P. 1982. *The Seahorses (Subfamily Hippocampinae)*. Pp. 173-189 In: J.E. Bohlke et al. (eds.). *Fishes of the Western North Atlantic, Part Eight*. Sears Found. Mar. Res., Yale University, Mem. 1, New Haven, Connecticut.

Wabnitz, C., M. Taylor, E. Green, and T. Razak. 2003. *From Ocean to Aquarium*. UNEP-WCMC, Cambridge, UK. 64 p.

Weinstein, M.P. and K.L. Heck, Jr. 1979. *Ichthyofauna of Seagrass Meadows Along the Caribbean Coast of Panama and in the Gulf of Mexico: Composition, Structure and Community Ecology*. Mar. Biol. 50: 97-

Figure 1: Florida localities sampled by the Fisheries-Independent Monitoring Program (smaller text and rectangles) and Florida regions as defined by the Fisheries-Dependent Monitoring Program (underlined text and arrows).

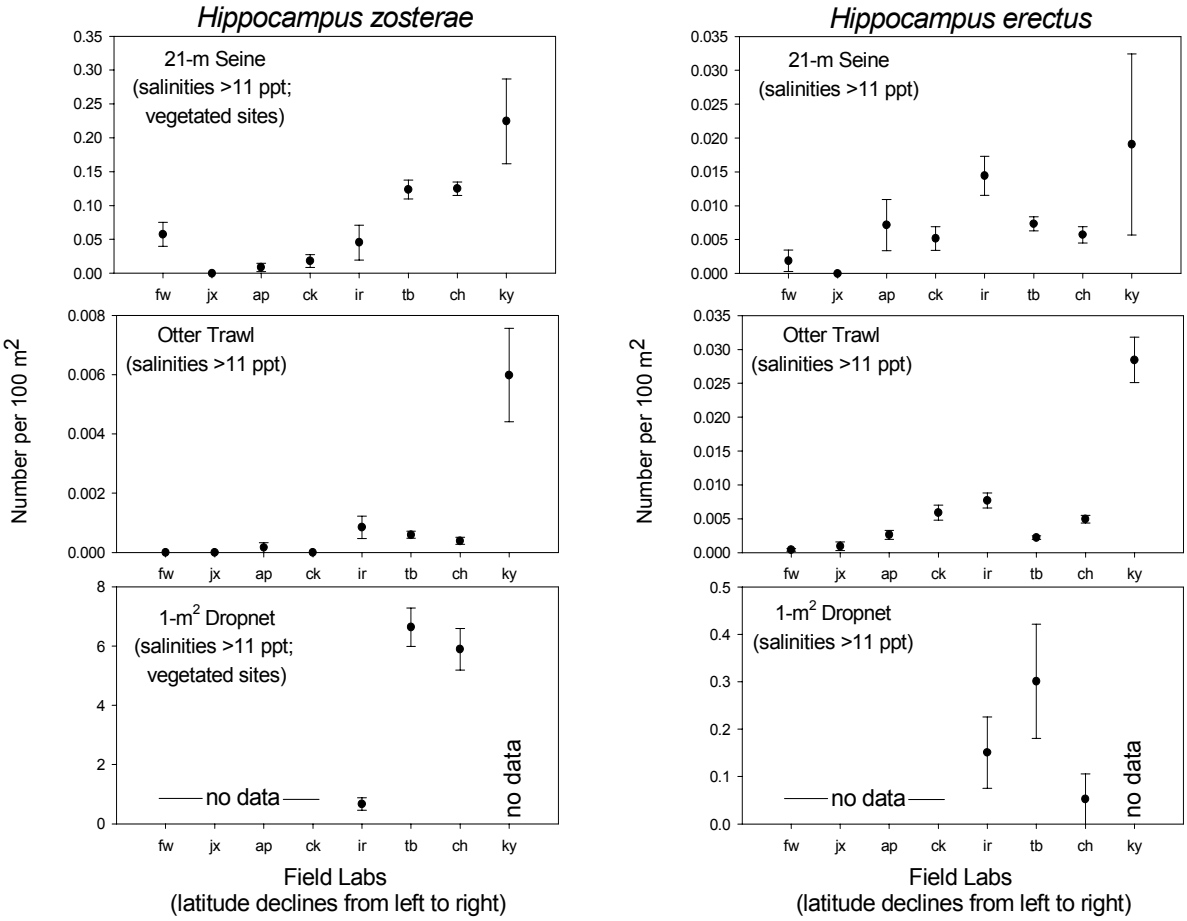


Figure 2: Relative abundances of *Hippocampus zosterae* and *H. erectus* in 8 estuarine systems in Florida. Data collected by the Fisheries-Independent Monitoring Program of the Florida Fish and Wildlife Conservation Commission. Years included in dataset as follows: Fort Walton (fw) —1992-1997, Jacksonville (jx) — 2001-2002, Apalachicola (ap) — 1998-2002, Cedar Key (ck) — 1996-2002, Indian River (ir) — 1990-2002, Tampa Bay (tb) — 1989-2002, Charlotte Harbor — 1989-2002, and the Florida Keys (ky) — 1997-2002. Although the entire estuarine systems were sampled, data were filtered to include only habitats where seahorses are likely to occur: salinities > 11 ppt and, for *H. zosterae* seine and dropnet data, vegetated substrates. Values represent mean ± one standard error.

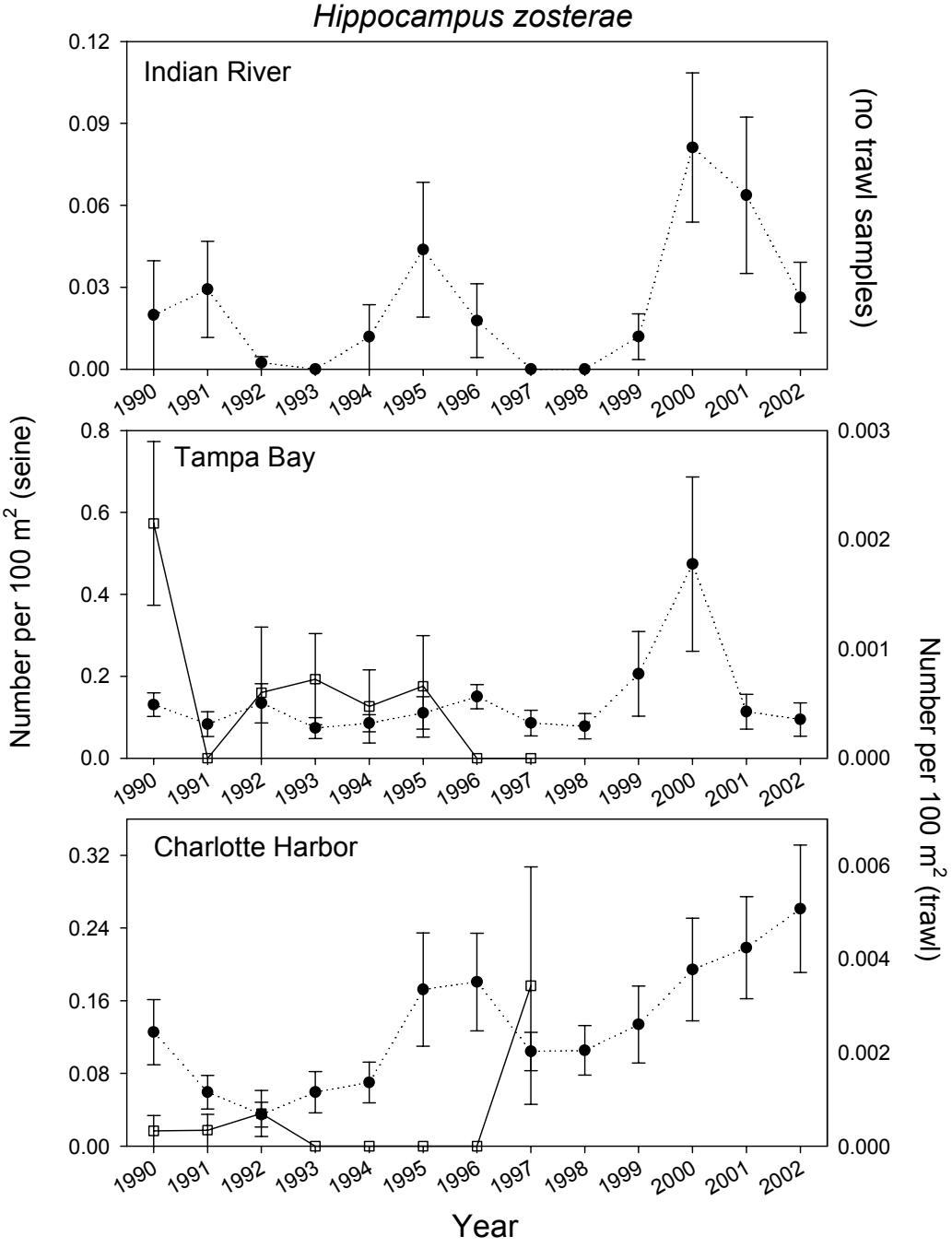


Figure 3: Annual relative abundance of *Hippocampus zosterae* from 1990 through 2002 in three estuarine systems in Florida. Data collected by the Fisheries-Independent Monitoring Program of the Florida Fish and Wildlife Conservation Commission. Data from spring (Mar-May) and fall (Sept-Dec). Although the entire estuarine systems were sampled, data represent only habitats where seahorses are likely to occur: salinities > 11 ppt and vegetated substrates (seines only). Seines represented by solid circles and dotted lines, and trawls represented by open squares and solid lines. Values represent mean ± one standard error.

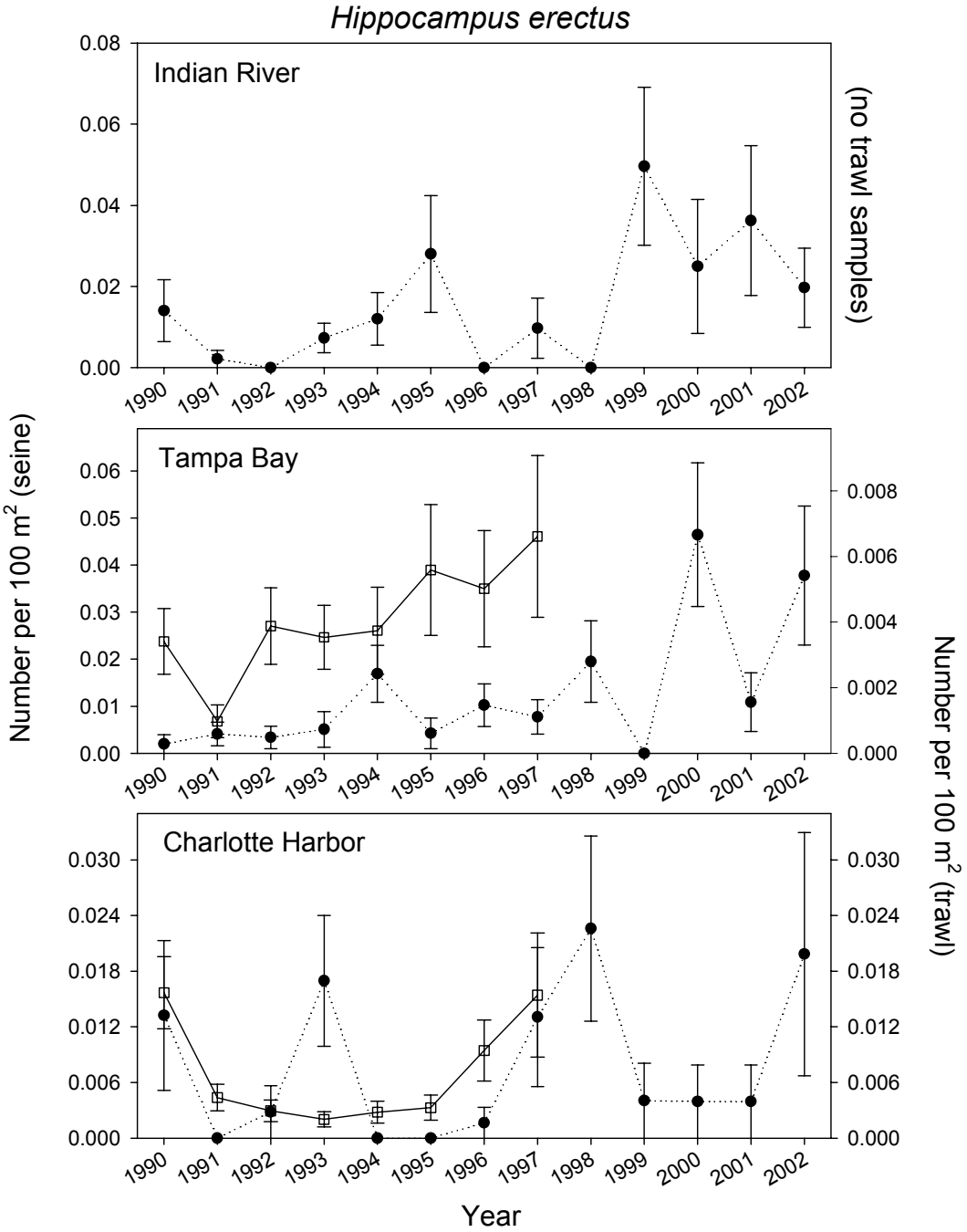


Figure 4: Annual relative abundance of *Hippocampus erectus* from 1990 through 2002 in three estuarine systems in Florida. Data collected by the Fisheries-Independent Monitoring Program of the Florida Fish and Wildlife Conservation Commission. Data from spring (Mar-May) and fall (Sept-Dec). Although the entire estuarine systems were sampled, data represent only habitats where seahorses are likely to occur: salinities > 11 ppt. Seines represented by solid circles and dotted lines, and trawls represented by open squares and solid lines. Values represent mean ± one standard error.

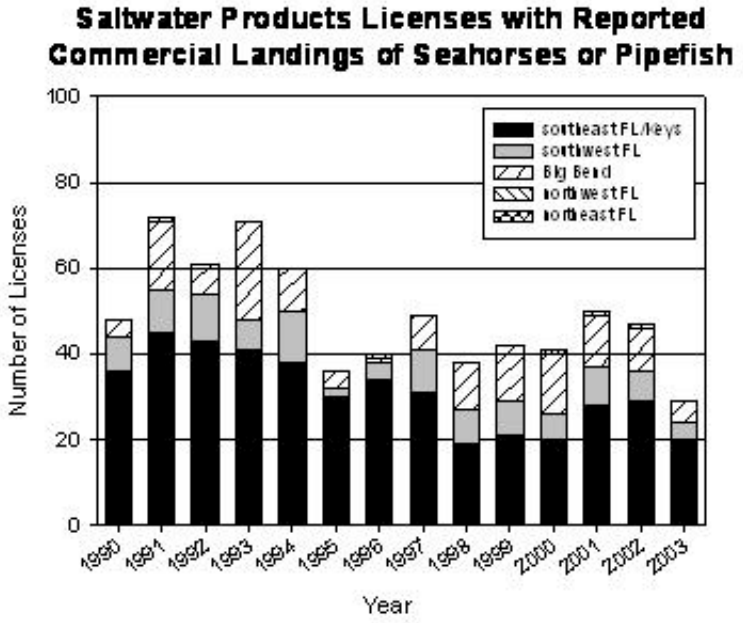


Figure 5: Annual saltwater products licenses with reported commercial landings of seahorses or pipefish in five Florida regions. Data collected by the Fisheries-Dependent Monitoring Program of the Florida Fish and Wildlife Conservation Commission.

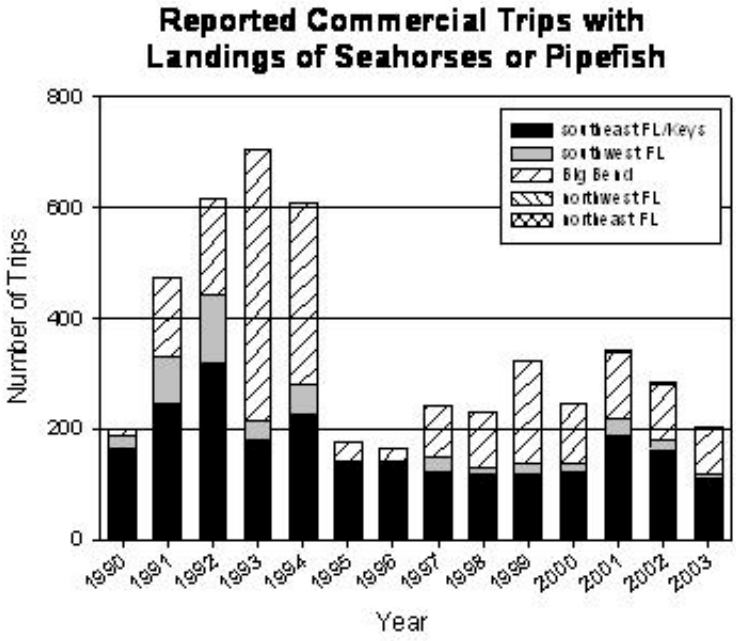


Figure 6: Annual reported commercial trips with landings of seahorses or pipefish in five Florida regions. Data collected by the Fisheries-Dependent Monitoring Program of the Florida Fish and Wildlife Conservation Commission.

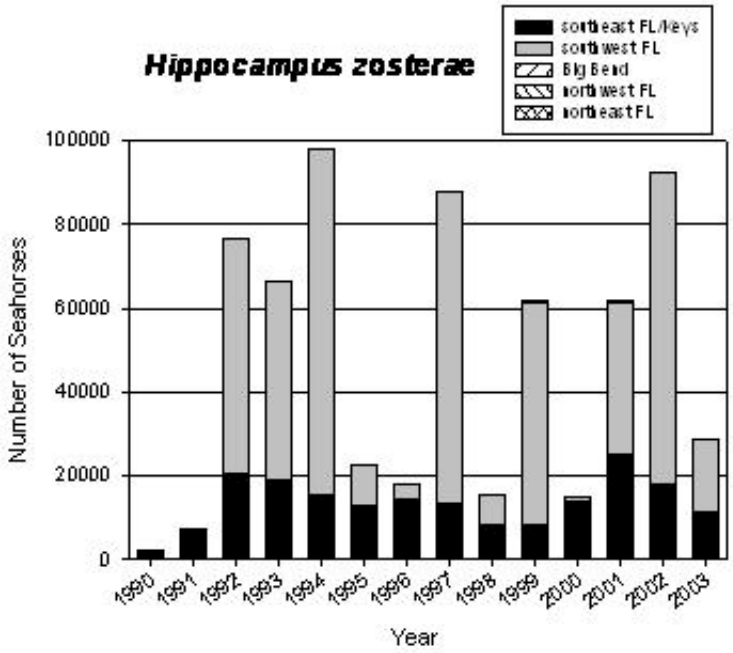


Figure 7: Annual commercial harvest of *Hippocampus zosterae* in five Florida regions. Data collected by the Fisheries-Dependent Monitoring Program of the Florida Fish and Wildlife Conservation Commission.

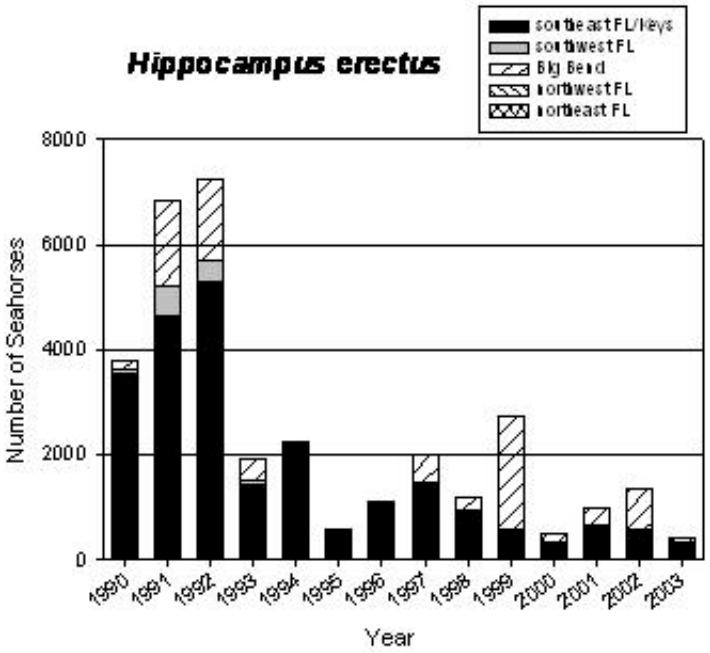


Figure 8: Annual commercial harvest of *Hippocampus erectus* in five Florida regions. Data collected by the Fisheries-Dependent Monitoring Program of the Florida Fish and Wildlife Conservation Commission.

Summary of the Biology and Taxonomy of Seahorses

Sarah Foster
Project Seahorse
s.foster@fisheries.ubc.ca

This document was originally prepared by Project Seahorse for the CITES Secretariat for the Technical workshop on seahorses and other members of the family Syngnathidae (Cebu, Philippines), 27-29 May 2002), and has been revised by Project Seahorse for the CITES Secretariat for the International workshop on seahorse fishery management (Mazatlán, Mexico), 3-5 February 2004).

Life history and conservation

A dearth of knowledge on the biology of seahorses, particularly life history parameters, makes it difficult to manage effectively a population, let alone a species. However, existing information on life history does indicate that many species may be susceptible to high levels of exploitation: low population densities mean that seahorses may have trouble finding a new partner; low mobility and small home range sizes mean that adult seahorses will be slow to recolonize over-exploited areas; possible low rates of natural adult mortality means that heavy fishing will place new pressures on the population; male brooding means that survival to birth of the young depends on the survival of the male; monogamy in most species means that a widowed partner stops reproducing, at least temporarily; and a small brood size limits the potential reproductive rate (although this may be offset by higher juvenile survival).

Taxonomy

All seahorses are members of the family Syngnathidae, along with the pipefishes, pipehorses, and seadragons. These fishes are found in the same order (Gasterosteiformes) as the trumpetfishes, snipefishes, cornetfishes, and pegasids (sea moths). About 33 species of seahorse (genus *Hippocampus*) are currently recognized from morphometric and genetic analysis, although a few more species may emerge from further taxonomic research. The vast majority of seahorse species have not been studied adequately in the wild.

Distribution and movement

Seahorses occupy both temperate and tropical coastal waters, with a distribution from about 50 degrees north to 50 degrees south. Most seahorses are generally found among seagrasses, macroalgae, mangrove roots, and corals, while others live on open sand or muddy bottoms. Some species are also found in estuaries or lagoons. Seahorses tend to be patchily distributed at low densities, and are highly influenced by anthropogenic activities, especially habitat degradation.

Seahorses swim using the propulsive force of the quickly oscillating dorsal fin, and employ the pectoral fins on either side of the body for steering and stability. More adapted to maneuverability than speed, seahorses apparently rely on camouflage to avoid detection from predators, rather than on speed for escape. Most seahorse species studied to date exhibit high site-fidelity and small home range sizes, at least during the breeding season.

Morphology

Seahorses have a head at right angles to the body and a fully prehensile tail that wraps around any suitable holdfast, including human made objects (e.g. fish cages, shark nets). Their thin skin is stretched over a series of bony plates that are visible as rings around the trunk and tail. The number of rings is useful in identifying species, as are the cheek spines, fin rays, and coronet on top of the head. Some species also have bony bumps or skin filaments protruding from these bony rings. Seahorses are masters of camouflage, changing colour and growing skin filaments to blend in with their surroundings. Short-term colour changes may also occur during courtship displays and daily greetings.

Seahorses are either measured in height (coronet to tip of uncurled tail) or in standard length. Adult seahorse heights vary among species, ranging from the large Australian big-bellied seahorse (*H. abdominalis,* > 30 cm) to the tiny pygmy seahorse (*H. denise*, < 2 cm). Sexual maturity in males can be recognized by the presence of a fully developed brood pouch. Seahorse weights vary with reproductive stage, increasing a great deal when they have ripe eggs (females) or are pregnant (males). Young seahorses look like miniature adult seahorses, are fully independent after birth, and receive no further parental care. Newborns of most species measure 7-12 mm.

Survival

Lifespans for seahorses are estimated (generally from laboratory observations) to range from about one year in the very small species to about 3-5 years for the larger species. Mortality from predation is probably greatest in juveniles, which are eaten by many fish and invertebrates. Adult seahorses are presumed to have few predators as a result of excellent camouflage, and unappetizing bony plates and spines. Crabs may be among the most threatening predators. Seahorses have also been found in the stomachs of large pelagic fishes such as tuna and dorado and are eaten by skates and rays, penguins, other water birds, and the occasional sea turtle.

Feeding

Seahorses are voracious feeders, typically relying entirely on live, moving food. They are primarily ambush predators, sucking passing prey quickly out of the water with their long snouts. Their eyes move independently of each other, allowing the seahorse to maximize its search area. They will ingest prey small enough to fit into their mouth, mostly small crustacea such as amphipods, but also fish fry and other invertebrates. Seahorses have neither teeth nor stomach, and pass food through an undifferentiated digestive system.

Reproduction

The male seahorse, rather than the female, becomes pregnant, although it is still the female that produces the eggs, and the male the sperm. The female deposits eggs into the male's brood pouch, where he fertilizes them. The pouch acts like the uterus of a mammal, complete with a placental fluid that bathes the eggs, and provides nutrients and oxygen to the developing embryos while removing waste products. The pouch fluid is altered during pregnancy from being similar to body fluids to being more like the surrounding seawater. Pregnancy lasts about 2 to 6 weeks, the length decreasing with increasing temperature. At the end of gestation the male goes into labour, pumping and thrusting for hours to release his brood.

Males of most species release about 100-200 young per pregnancy, but the total ranges from 5 for the smaller species, to well over 1000 young. The low number of young produced may be somewhat offset by their more advance stage of development at release, such that each young should have a higher chance of survival than in most fish, in the absence of other pressures.

The breeding season varies according to species, and is most likely dependant on water temperature, monsoon patterns, and the lunar cycle. Most (but perhaps not all) species of seahorses studied to date appear to be monogamous, forming pair bonds that last the entire breeding season. Pair bonds in monogamous species are commonly reinforced by daily greetings that are extended into courtships once the male gives birth.

REFERENCES

Foster, S.J. and A.C.J. Vincent. (2004). *The life history and ecology of seahorses, Hippocampus spp.: Implications for conservation and management*. Journal of Fish Biology 65:1-61.

Summary Of The 2003 IUCN Red Listings For Family Syngnathidae

Amanda Vincent
Project Seahorse

This document was originally prepared by Project Seahorse for the CITES Secretariat for the Technical workshop on seahorses and other members of the family Syngnathidae (Cebu, Philippines), 27-29 May 2002), and has been revised by Project Seahorse for the CITES Secretariat for the International workshop on seahorse fishery management (Mazatlán, Mexico), 3-5 February 2004).

Project Seahorse serves as the formal IUCN Red Listing Authority for syngnathids, by invitation of the Species Survival Commission. In undertaking species assessments, Project Seahorse is able to draw on its extensive library of references on syngnathids. We hold copies of virtually all primary papers on seahorses, along with many documents from management literature and popular media. In addition, Project Seahorse acts as a hub for syngnathid researchers, coordinating a network of scientists globally, and has been able to draw on their knowledge in compiling life history and conservation tables for all seahorse species.

In 2001 Project Seahorse revised the Red Listings of Syngnathidae for inclusion in the 2002 Red List. In our revision, we realigned species assessments to reflect correct taxonomic designation, including the removal of many synonyms. Our adjustment of names, synonyms and distributions for all species was conducted in accordance with the only formal taxonomic revision of the entire genus[1].

Having completed the taxonomic revision (with its many species adjustments), we undertook ten new species assessments, for *Hippocampus algiricus, H. angustus, H. barbouri*, *H. comes*, *H. fisheri*, *H. histrix*, *H. kelloggi*, *H. lichtensteinii, H. subelongatus* and *H. zebra*. Two of these assessments – *H. angustus* and *H. histrix* – represent changes to species that were ostensibly included on the 1996 IUCN Red List. In fact, however, the species designated by those names were revealed in the taxonomic revision to be quite different species: *H. subelongatus* and *H. barbouri* respectively. Rectifying these errors yielded four of the new assessments.

In 2002 Project Seahorse further revised the listings to bring all seahorse listing up to date, as well as add a new assessment for *H. denise*, a new species of pygmy seahorse[2]. This update increased the number of species now categorized as Data Deficient, and should serve as a call to action for biologists, fisheries managers and others with an interest in sustainable trade in marine resources.

Project Seahorse supports sound management decisions based on the best available science, and we caution against premature conclusions based on the new Red List. The reclassification of several species of seahorses from Vulnerable to Data Deficient is a reminder that conservation prospects cannot be evaluated without better information on how species are faring. Until our understanding improves, we run the risk of losing species about which we know little. At the same time, the threats to seahorse habitats are widely recognized, and the deteriorating state of coral reefs, mangroves, seagrass beds and other coastal ecosystems around the world should be cause for concern for all marine species on the Red List.

We are aware that Australian authorities are reassessing the conservation status of many marine fishes, including syngnathids. Project Seahorse expects to concur with Australian assessments of their endemic species, which will reflect new national conservation legislation for syngnathids (implemented since the 1996 Red Listing). Project Seahorse did not, therefore, evaluate or re-evaluate Australian

endemic species during its recent re-assessments; these comprise perhaps one-third of all currently recognised seahorse species. That decision notwithstanding, Project Seahorse did revise the assessments for *H. angustus* and *H. subelongatus* for the 2002 Red List, in order to rectify taxonomic confusion (see above). We are aware that the taxonomy used in the Australian revision will probably differ slightly from the one we use here, as a result of Rudie Kuiter's revision of their native species[3]. However, our understanding is that the assessments of *H. angustus* and *H. subelongatus* will not be affected. Project Seahorse will work with Australian authorities to undertake broader geographic assessments of species that are found in Australia and also elsewhere in the region.

The tables presented in this document summarize what is published in the 2003 IUCN Red List of Threatened Species[4] for syngnathids.

Project Seahorse is aware that the assessments for many of the other syngnathids originally listed in 1996 need to be reviewed. Since the ultimate goals of the Red List are to convey the urgency and scale of conservation problems to policy makers and the public, and to motivate the global community to try and prevent species extinctions, we especially need to ensure that critical species are listed. We intend to collaborate with experts on these species to ensure that syngnathids are one of the most represented taxa in the IUCN Red List.

For more information, we refer you to the following IUCN website: www.redlist.org.

(Footnotes)

[1] Lourie, S.A., A.C.J. Vincent, and H.J. Hall. 1999. *Seahorses: an identification guide to the world's species and their conservation.* Project Seahorse, London, UK. 214 pp. [ISBN 0 9534693 0 1].

[2] Lourie, S.A. and J.E. Randall. 2003. A new pygmy seahorse, *Hippocampus denise* (Teleostei: Syngnathidae), from the Indo-Pacific. *Zoological Studies* 42(2): 284-291.

[3] Kuiter, R. 2001. Revision of the Australian seahorses of the genus *Hippocampus* (Sygnathioformes: Syngnathidae) with a description of nine new species. Records of the Australian museum. 53: 293-340.

[4] IUCN 2003. *2003 IUCN Red List of Threatened Species*. < http://www.redlist.org >.

Table 1: Summary table of the 2003 IUCN Red List status for Syngnathidae. (DD = Data Deficient; VU = Vulnerable; EN = Endangered; CR = Critically Endangered)

	DD	VU	EN	CR
seahorses	23	9	1	
pipefishes	5			1
seadragons	2			
pipehorses		5		

Table 2: 2002 IUCN Status for seahorses (*Hippocampus* spp.)

Scientific Name	2001 IUCN Status	Date of Assessment
H. abdominalis	VU A2cd[i]	1996
H. algiricus	DD	2001
H. angustus	DD	2001
H. barbouri	VU A4cd[ii]	2001
H. bargibanti	DD	2003
H. borboniensis	DD	2003
H. breviceps	DD	1996
H. camelopardalis	DD	2003
H. capensis	EN B1+2c+3d[iii]	1999
H. comes	VU A2cd[iv]	2001
H. coronatus	DD	2003
H. denise	DD	2003
H. erectus	VU A4cd	2003
H. fisheri	DD	2001
H. fuscus	DD	2003
H. guttulatus	DD	2003
H. hippocampus	DD	2003
H. histrix	DD	2001
H. ingens	VU A4cd	2003
H. jayakari	DD	2003
H. kelloggi	DD	2001
H. kuda	VU A4cd	2003
H. lichtensteinii	DD	2001
H. minotaur	DD	1996
H. mohnikei	VU A2cd	1996
H. reidi	DD	2003
H. sindonis	DD	2003
H. spinosissimus	VU A4cd	2003
H. subelongatus	DD	2001
H. trimaculatus	VU A4cd	2003
H. whitei	DD	2003
H. zebra	DD	2001
H. zosterae	DD	2003

[i] A population decline of at least 20% in 10 years or 3 generations projected or suspected in the future based on a decline in area of occupancy, extent of occurrence and/or quality of habitat AND actual or potential levels of exploitation.

[ii] An observed, estimated, inferred, projected or suspected population size reduction of ≥30% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) a decline in area of occupancy, extent of occurrence and/or quality of habitat AND actual or potential levels of exploitation.

[iii] Extent of occurrence <5000 km^2 or area of occupancy <500 km^2 AND known to exist in ≤5 locations AND continuing decline in area, extent and/or quality of habitat AND fluctuating in the number of locations or subpopulations >1 order/mag.

[iv] An observed, estimated, inferred, or suspected population size reduction of ≥30% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) a decline in area of occupancy, extent of occurrence and/or quality of habitat AND actual or potential levels of exploitation.

Table 3: 2003 IUCN Status for pipefishes, pipehorses and seadragons

Scientific Name	2002 IUCN Status	Date of Assessment
Doryrhamphus dactyliophorus	DD	1996
Microphis caudocarinatus	DD	1996
Microphis spinachoides	DD	1996
Phycodorus eques	DD	1996
Phyllopteryx taeniolatus	DD	1996
Solegnathus dunckeri	VU A1d+2d[i]	1996
Solegnathus hardwickii	VU A1d+2d	1996
Solegnathus lettiensis	VU A2d[ii]	1996
Solegnathus robustus	VU A2d	1996
Solegnathus spinosissimus	VU A1d+2d	1996
Syngnathoides biaculeatus	DD	1996
Syngnathus abaster	DD	1996
Syngnathus watermeyeri	CR B1+2abd[iii]	1996

[i] A population decline of at least 20% in 10 years or 3 generations observed, estimated, inferred or suspected in the past AND projected or suspected in the future based on actual or potential levels of exploitation.

[ii] A population decline of at least 20% in 10 years or 3 generations projected or suspected in the future based on actual or potential levels of exploitation.

[iii] Extent of occurrence <100 km^2 or area of occupancy <10 km^2 AND known to exist in 1 location AND continuing decline in extent of occurrence AND area of occupancy AND number of locations or subpopulations.

Fisheries Management Options For Seahorses

Keith Martin-Smith
Project Seahorse
Keith.MartinSmith@utas.edu.au

This document was originally prepared by Project Seahorse for the CITES Secretariat for the Technical workshop on seahorses and other members of the family Syngnathidae (Cebu, Philippines), 27-29 May 2002), and has been revised by Project Seahorse for the CITES Secretariat for the International workshop on seahorse fishery management (Mazatlán, Mexico), 3-5 February 2004).

Executive Summary

This document presents approaches to managing syngnathid fisheries that might be alternatives to, or compatible with, trade controls. Eleven management options were identified by biologists and presented to stakeholder groups involved with an artisanal seahorse fishery in the central Philippines. These consisted of five input controls (number of fishers, gear restriction, temporal closures, spatial closures, and tenurial systems) and six output controls (total allowable catch, minimum, maximum, and slot size limits, sex-selective fishing and caging pregnant males). Feedback from fishery experts, fishers, resource managers, aquarium and traditional medicine groups was obtained. The degree of preference for each of the options from the different stakeholder groups was used to identify management options that had broad support. Highly favoured options from all groups were spatial closures (no-take Marine Protected Areas) and minimum size limits. Tenure over marine estate and temporal closures were also generally supported but may be difficult to implement whilst sex-selective fishing (leaving pregnant males) had moderate support but may be easy to introduce.. All the options are discussed in detail with examples from work on other species. Finally, we consider the functional equivalence of these management options to trade controls, and their application to other syngnathid fisheries. This consultative exercise will be continued, including thorough discussion at the CITES workshop.

Introduction

Purpose of this Document

This document has been prepared by Project Seahorse for a technical workshop convened by the Secretariat of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) to be held in Cebu, Philippines from 27-29 May 2002. The purpose of the workshop is to examine what action CITES might best take to advance conservation of syngnathids (seahorses, pipefishes and their relatives), including possible implementation of trade controls. This document present a range of management options for one particular seahorse fishery, developed by Project Seahorse in conjunction with stakeholder groups. These management options are neither comprehensive in themselves, nor incompatible with certain possible CITES trade controls.

Detailed consideration is given to outcomes of the consultative process for this focal fishery from the Philippines. Such dialogue reveals needs for information and for stakeholder involvement, both considered essential if management objectives are to be achieved successfully. A synthesis of stakeholder feedback is presented and conclusions for this particular fishery are drawn. Finally, the application of the management options to other syngnathid fisheries is considered.

It should be emphasised that the trade controls (under CITES Appendix listings) and the potential management options outlined here would probably operate in fundamentally different ways. CITES trade controls are essentially a 'top-down' form of management wherein regulation is primarily at an international level, enforced by national authorities. The potential management options are primarily designed as 'bottom-up' regulation, although they could benefit from associated national legislation. This means that the responsibility for compliance or enforcement lies primarily with the stakeholders: fishers or traders.

Definition of Terms and Abbreviations

Artisanal fisheries – Low-technology, low-capital fisheries that catch organisms primarily for subsistence use.

Bycatch – Non-target organisms that are caught by fishing gears with low selectivity. These may be discarded or retained.

CITES – Convention on International Trade in Endangered Species of Wild Fauna and Flora

Input controls – Restrictions on fishing effort.

Output controls – Restrictions on fish that can be retained by the fishery.

Syngnathids – Fishes belonging to the family Syngnathidae. These include seahorses, pipefishes, sea dragons and pipehorses.

Syngnathid Fisheries and World Trade

Syngnathids are widely distributed in temperate and tropical waters, although their diversity is greatest in tropical areas (see Briefing Document on Seahorse Biology for more details). They are caught both in target fisheries and as bycatch in a large proportion of their range. Syngnathids that are caught and retained are part of global trades in fish for non-food purposes, including fishmeal production (FAO, 2000; Bimbo, 2000), ornamental display (Green and Shirley, 1999; Wood, 2001), traditional medicines and curios (Wood and Wells, 1988; 1995). Dead syngnathids are traded for use as marine medicinals and curios while live syngnathids are traded as marine ornamental aquarium fishes (Vincent, 1990; see Briefing Document on Syngnathid Trade).

Current Management Arrangements

Generally, management of syngnathid fisheries around the world is not well developed. The majority of syngnathids in trade come from developing countries in the tropical Indo-Pacific where even the food fisheries are not strongly managed. Furthermore, much of the catch is from artisanal, multi-species fisheries and bycatch, both of which are extremely difficult to manage. The most-developed management arrangements in 2002 are probably in Australia.

Export of syngnathids from Australia is only permitted from fisheries operating under an approved management plan. However, the vast majority of syngnathids exported from Australia are bycatch from the Queensland east coast trawl fishery and there is controversy over the effectiveness of current arrangements to ensure sustainability of bycatch species (Imogen Zethoven, WorldWide Fund for Nature, in litt. 13 Dec 2001). For most other countries syngnathid fisheries are effectively unmanaged in any direct way. Syngnathids may, however, benefit from general policies that establish marine protected areas and/or control certain gear (e.g. trawling) in particular times and places (see Briefing Document on Syngnathid Trade).

Consultative Process On Managing A Seahorse Fishery In The Central Philippines

The Fishery

The seahorse fishery in the central Philippines has been studied intermittently by researchers from Project Seahorse and the Haribon Foundation since 1995, with a focus on catch characteristics and socio-economic importance (see Briefing Document on the Philippines Seahorse Fishery). All seahorse species are sought but the vast majority of the catch (over 90%, Perante *et al.,* 2002) is the tiger-tail seahorse, *Hippocampus comes*, the biology of which is summarized in Table 1.

The Management Challenge

The challenge of managing syngnathids is representative of fisheries issues globally, as we struggle to secure the long term future of fish populations in general. New forms of collaborative management are becoming essential as fisheries resources decline around the world (Watson and Pauly, 2001), with documented failures in sustainable utilization, economic efficiency and equity in access to resources (Botsford *et al.,* 1997; Cochrane, 2000). For marine capture fisheries, half of the world's stocks are considered to be fully exploited, a further 15-18% overexploited and 10% depleted or recovering from depletion (FAO, 2002). Overfishing is considered to be one of the three most significant threats to coral reef ecosystems (Roberts, 1995).

Management and conservation of resources in artisanal fisheries remain an enormous challenge, especially given the dearth of livelihood alternatives to fishing (for food and/or income) and of data with which to formulate management decisions (Jennings and Polunin, 1997, Johannes, 1998b, Mosquera *et al.,* 2000). Yet, faced with declines in resources and threats to species or populations, management measures have to be instituted. A further challenge is that many of the fisheries catch a wide range of species and are spatially dispersed (Pauly, 1997). In such circumstances, focal species often have to be used for conservation and management purposes as it is impractical to collect data for all species or to attempt to manage the ecosystem (Zacharias and Roff, 2001). Co-management, wherein stakeholders have a large involvement in decisions affecting the fishery, is increasingly considered to be essential to successful management of fisheries (Katon *et al.,* 1999; Westmacott, 2002). Cochrane (2000) urges that "*responsible management requires setting unambiguous objectives in co-operation with users and other interest groups*".

For this seahorse fishery the following management objectives were considered very important:

1. Increases in populations of seahorses;
2. Long-term sustainability of populations of seahorses (i.e. low probability of extinction);
3. Maintenance or increase in catch-per-unit-effort of seahorses;
4. Maintenance or increase in income for seahorse fishers.

Developing management options

Most information reported here comes from Project Seahorse consultative research, undertaken during 2001 and 2002 (Martin-Smith *et al.,* in review). We have explored management options for the *H. comes* fishery with six groups of stakeholders (Figure 1).

These stakeholder groups were as follows:

1. Fisheries Technical Workshop. Summaries of available information were presented at a scoping workshop comprising 13 scientists with a wide range of experience in fisheries modeling, fisheries management and socio-economic analysis. This group developed a list of possible management options, and ranked them qualitatively for their inferred overall utility (Table 2). The first ten of these options are employed in other fisheries, but the 11th is distinct to seahorses. Project Seahorse then presented the same options to other stakeholder groups, adjusting the language and format to be appropriate for each.

2. Seahorse fishers in the Philippines. Forty-six subsistence fishers from 18 villages were interviewed over a two day period in various groups about their suggestions for management options with no prior knowledge of the work of the biologists in (1). Over 70% of responses were for options suggested by the biologists, so fishers were then asked to indicate and explain their level of support for each of these options (Table 2).

3. Syngnathid policy group in the Philippines. A new management unit (Syngnathid Technical Working Group) comprising thirteen people from the Philippines Bureau of Fisheries and Aquatic Resources, three universities, the South East Asian Fisheries Development Center, the National Museum of the Philippines and the Project Seahorse/Haribon Foundation conservation team was presented with the options devised by the biologists in (1) and similarly asked to indicate and explain their level of support.

4. Aquarium professionals in the USA. Forty-eight participants at the Regional Aquarium Workshop of the American Zoo and Aquarium Association were presented with a reduced list of six management options applicable to acquisition of aquarium specimens and asked to indicate and explain their level of support.

5. Traditional Chinese medicine community in Hong Kong. Fifty questionnaires were distributed to members of a TCM trade association with detailed questions on a reduced list of management options that would impact on syngnathid trade. Additional informal discussions were held on minimum and maximum size limits.

6. CITES technical workshop. Thirty-six participants from a diverse range of backgrounds were involved in this workshop. Management options were considered in detail by a subset of 12 participants who reported back to a plenary session. Qualitative assessment of preferences was assigned from rapporteur notes.

Table 1: Preliminary summary of the biology of *Hippocampus comes*

Distribution	Central Philippines, Singapore, Vietnam, Malaysia
Maximum Recorded Size	205 mm standard length (SL); 21 g weight
Standard Length-height conversion	Standard length (mm) = 1.16 * Height (mm) + 1.2
Sexual dimorphism	Mature males with brood pouch; males have greater exponent in length/weight relationship
Habitat	Coral reefs, soft corals and sponges, seagrasses, soft sediments, Sargassum, mangroves??
Depth range	0 to >20 m
Estimated size at first reproduction	102 mm SL
Reproductive system	Male incubates brood, monogamous pair bonds, breeding year round with peaks in Sep-Oct, Dec-Feb in Philippines
Broodsize	Mean = 489 (range 223-758)
Gestation period	14-21 days
Estimated parameters of von Bertalanffy growth equation	L_{inf} = 26 cm k = 0.89 yr^{-1}
Estimated longevity	2.7-3.6 years
Estimated generation time	1.0-1.2 years
Estimated natural mortality	0.8-1.6 yr^{-1}

Sources: Lourie *et al.,* 1999; Perante *et al.,* 2002; Meeuwig *et al.,* in prep

Stakeholder Input

At a broad scale, the four stakeholder groups that we have already consulted agreed on priority management options (Fig. 2, Table 3). Marine Protected Areas and minimum size limits were highly preferred by all groups, while tenurial systems, sex-selective fishing and caging pregnant males were highly preferred by one or more groups. Only one option (slot sizes) elicited widely divergent responses. Four groups of options (high, moderate-high, moderate and low-moderate preference) were identified (Fig. 2, Table 3).

These composite rankings were obtained by using the frequency of each group response given in Table 3.

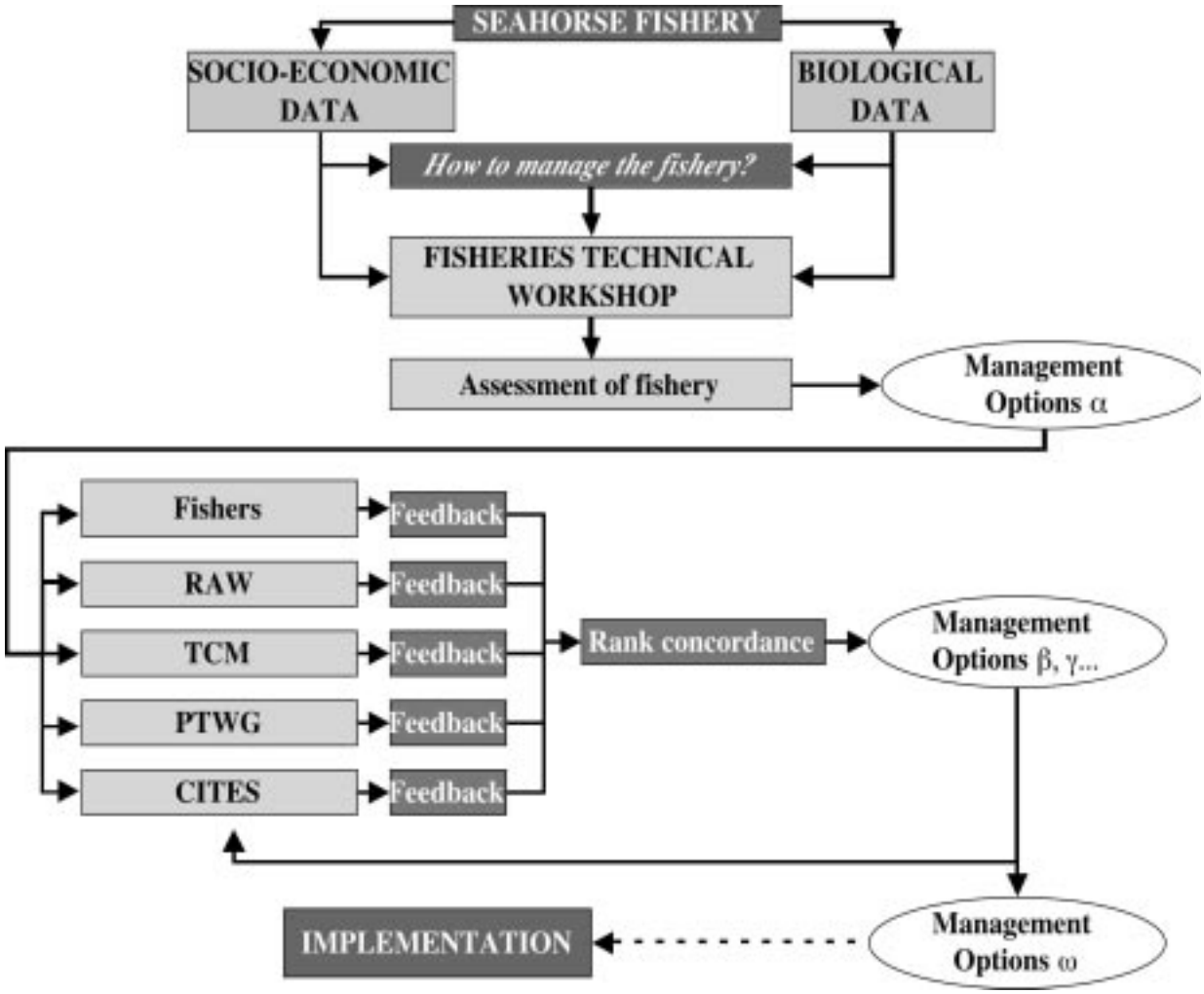


Figure 1. Flow diagram showing consultative process for developing management options for a seahorse fishery. Solid arrows indicate passage of information, dotted arrow the final phase in translating the recommended options to implementation in the fishery. Abbreviations for groups consulted: RAW – Regional Aquarium Workshop of the American Zoo and Aquarium Association, TCM – Traditional Chinese Medicine traders association, PTWG – Philippines Technical Working Group on syngnathids, CITES – workshop on syngnathids mandated by the Convention on International Trade in Endangered Species.

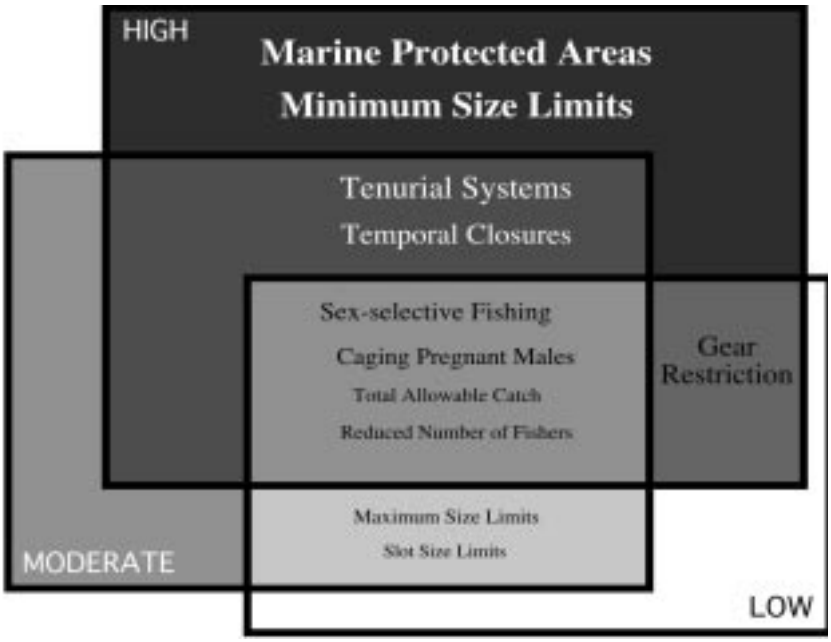


Figure 2. Graphical representation of preferences for management options in a seahorse fishery by stakeholder groups. Each large shaded box represents one of three preference levels: High, Moderate or Low. Areas of overlap indicate different preferences levels by different groups e.g. Temporal closures lie in an area of overlap between High and Moderate preference (see Table 3). Deeper shading represents higher preference levels. Font size for each option is proportional its level of support with maximum size indicating High preference from all stakeholder groups consulted for that option.

A. Options ranked universally High by all stakeholders

A (1). Marine Protected Areas (MPAs)

All stakeholder groups identified no-take MPAs as offering a refuge from exploitation, thus helping to providing an 'insurance policy' for seahorse populations in heavily-fished areas. Mosquera *et al.* (2000) used meta-analyses to review the use of MPAs as conservation tools and concluded that they offered significant protection for fish populations; overall abundance was 3.7 times greater within MPAs compared with adjacent areas. MPAs have been demonstrated to provide spatial refuges for fish populations in many coral reef fisheries around the world including the Philippines (Russ and Alcala, 1996; 1999), Tanzania (McClanahan *et al.,* 1999) and the Caribbean (Chapman and Kramer, 1999).

It would appear difficult to be confident about the population response of seahorses to MPAs. Although it seems clear that no-take zones are very valuable conservation tools, response of individual species to protection can be difficult to predict (Mosquera *et al.,* 2000). For example, target species showed greater increases in abundance in MPAs than non-target species, with a significant positive correlation between body size and increase in abundance (Mosquera *et al.,* 2000). Furthermore, there were significant differences among species within the same family or feeding guild (Mosquera *et al.,* 2000). The size, shape and location of protected areas may well influence their effectiveness for particular species (Chiappone and Sealey, 2000; Dahlgren and Sobel, 2000; Hyrenbach *et al.,* 2000).

Despite uncertainties about specific responses, MPAs are considered to be particularly useful for managing fisheries that lack data, as with *H. comes* and most other seahorses. For example, where the intrinsic rate of population increase (*r*) is unknown, as, then rates of population recovery in MPAs might be predicted from maximum body size or age-at-maturity instead (Jennings, 2001).

Some life history parameters for seahorses (Table 1) suggest that they should show a reasonably quick response to the creation of MPAs. Other species that, like seahorses, are site-attached and have small home ranges have shown rapid rates of recovery (deMartini, 1993; Russ and Alcala, 1998; Kramer and Chapman, 1999). The probable dispersal of newborn young (currently under study) suggests that this may be the stage that replenishes depleted populations.

Tentative evidence to date indicates that seahorses can respond well to the elimination of fishing pressure. A population of *H. comes* showed good recovery in one MPA facilitated by Project

Seahorse in the central Philippines: after an isolated poaching event, for example, the number of adults rose from three to >30 individuals within 6 months (Project Seahorse, unpublished data).

If they are to persist, MPAs need to enhance nearby fisheries sufficiently to compensate for the fishing area lost in the creation of the no-take zone; compensation probably need not come from seahorses *per se* in this multi-species fishery. The efficacy of MPAs as fisheries management tools has been the subject of considerable debate. There has been conflicting evidence over the 'spillover' or export of fish from MPAs to surrounding exploited areas (Russ and Alcala, 1996; Chapman and Kramer, 1999; McClanahan and Mangi, 2000; Jennings, 2001) and the effect of concentrating fishing effort into a smaller total area (Beverton and Holt, 1957; Guénette *et al.,* 1998; Sutinen, 1999; Nowlis, 2000). The amount of spillover to adjacent, exploited areas will depend on attributes of the MPA (e.g. shape and habitat availability within and outside) and attributes of particular species (e.g. rates of movement and density-dependent responses, Jennings, 2001). Although Guénette *et al.* (1998) found that theoretic models predicted increased yield with MPAs, a review in Chapman and Kramer (1999) found only weak evidence of coral reef fishes spilling into areas outside the MPA.

MPAs must have broad acceptance to work as conservation or fishery management measures. Local support of the MPAs is crucial to effective enforcement of protected areas (Russ and Alcala, 1999). Where local support breaks down, benefits of MPAs may be rapidly lost (Russ and Alcala, 1999). In the Philippines, MPAs have had considerable public acceptance and may be more readily adopted than other management measures (Pajaro *et al.,* 2000; Gulayan *et al.,* 2000). Nevertheless, economic issues will be important: a model presented by Nowlis (2000) suggested that income initially declined less with the establishment of an MPA is less than with the introduction of other management measures, although it took longer before income increased (Nowlis, 2000).

A (2). Minimum Size Limit

All groups recognised that that a minimum size limit would help address the evident recruitment overfishing in *H. comes* (where animals are caught before they have the opportunity to start reproducing). Minimum size limits are common in a many different fisheries (Pitcher and Hart, 1983; King, 1995), although often established in conjunction with other measures (e.g. Kruse *et al.,* 2000; Hutton *et al.,* 2001).

As fishing mortality for *H. comes* in the central Philippines is estimated to be very high (Table 1), minimum size limits may have a high probability of increasing stock size: a yield-per-recruit model by Lowe *et al.* (1991) suggested that minimum size limits are most effective when fishing mortality is greater than 0.2, with little effect at lower values.

Fishers suggested limiting *H. comes* catches to greater than about 10 cm in standard length, which is approximately the mean length at which they start to breed. This idea accords well with research showing that minimum size limits need to be set at sizes greater than mean size at first reproduction if they are prevent recruitment overfishing (Nowlis, 2000). Bohnsack (2000) suggested that acceptance of minimum size limits was greatest when they were introduced gradually over a number of years, thus effectively reducing short-term losses (Nowlis, 2000; Bohnsack, 2000).

The Philippines policy group suggested that minimum size limits could prove very difficult to implement if each seahorse species required a different size limit: other fisheries in the Philippines catch primarily *H. barbouri*, *H. kelloggi*, *H. kuda* and/or *H. spinosissimus*. A general minimum size limit could probably be applied as all of these species except *H. kelloggi* are similarly sized (Lourie *et al.,* 1999). This problem of devising minimum size limits for many species caught in the same fishery has already been tackled in the coral trout fishery on Australia's Great Barrier Reef: all species were managed under one size limit. Recent recognition that one species matures at a substantially larger size than the others has led to a new and specific size limit: fortunately, this species is easily recognised by fishers (QDPI, 2002).

B. Management options with general support – ranked Moderate-High preference by stakeholders

B (1) Temporal closures

Stakeholders considered this management option to be potentially useful, although reservations were expressed by some groups. Little evidence suggests that seahorses are vulnerable at particular life-history stages although dieback of *Sargassum* in Mar-Apr may increase visibility and thus catches of *H. comes* (Vincent *et al.,* in prep). In addition, temporal closures are generally complicated and require a high level of knowledge of the biology of the target species (Sutinen, 1999). Furthermore, temporal closures have been insufficient to prevent the collapse of fish stocks even where the biology was well understood (Orensanz *et al.,* 1998; Sutinen, 1999). Models of different management measures indicated that temporal closures did not ensure long-term sustainability of populations (Nowlis 2000).

Given the subsistence nature of the seahorse fishery, temporal closures for seahorses may prove extremely difficult to enforce. Nevertheless, the national policy group recommended that if the fishery is critically overexploited there should be a temporary moratorium (total closure for 1-2 years), an option also recommended by seahorse fishers during interviews across northern Bohol (Meeuwig *et al.*, 2003). Temporal closures have been generally used as fishery management tools to protect certain life-history stages of the population, such as aggregations of spawning adults (Beets and Friedlander, 1999; Sala *et al.,* 2001). These fisheries are extremely vulnerable to overfishing as a large proportion of the population is concentrated in a small area at certain times of the year.

B (2). Tenurial Systems

Tenurial Systems, offering stewardship or ownership of local marine resources to local resource users, were considered essential for effective management of seahorses by the biologists and the Philippines policy group. Indeed Johannes (1978, 1998a) has argued that sustainability has only been achieved in systems with customary tenure. Similarly, Mantjoro (1996) considered tenure of local fisheries resources to be crucial to the success of management in Indonesia. Interestingly, however, seahorse fishers did not consider tenurial systems important, perhaps because of open-access traditions for exploiting marine resources or because of skepticism about the feasibility of local ownership.

Tenurial Systems should generally be used in conjunction with other forms of management. Some of these may not be explicitly stated but if, for example, fishing rights are only granted to resource owners, these will result in de facto reductions in fishing effort (Johannes, 1978).

Tenure may be difficult to implement in areas that lack social tradition for ownership or that have experienced significant breakdown of social structures from population growth or migration. Moreover, tenurial systems take longer to become effective than MPAs and minimum size limits.

C. Management options producing divergent responses.

C (1). Reduction in total number of fishers

This management option was ranked low by most groups for its unworkability and probable negative social effects (i.e. creating unemployment among fishers). A reduction in the number of fishers would decrease total fishing effort if, and only if, remaining fishers maintained or decreased their rate of fishing. However, the fishery is open-access and there are few alternative livelihoods for fishers. Even if some fishers did leave the fishery, those remaining would expect greater catches as fishers left the fishery and the population of seahorses increased. Restriction in total effort requires strong enforcement capability and only appears to have been successfully achieved with community ownership of resources (Johannes, 1978). One hopeful (and surprising) sign is that the fishers themselves ranked this option as being of moderate interest, suggesting receptivity to alternative means of earning income that neither the biologists nor the policy group had expected.

C (2). Gear restriction (ban or reduction of 'hookah' surface supplied breathing apparatus)

Only limited gear restriction is possible in the *H. comes* fishery, but it might be helpful. In the central Philippines, seahorses are caught by hand while spearfishing for food and marketable commodities. Most fishers free dive holding their breath but a small proportion use compressed air supply from the surface (hookah) to work in deeper waters. The reduction or elimination of such hookah rigs would provide a spatial refuge for seahorses.

Gear restriction might produce similar results to the implementation of a maximum size limit (see below). Length-based analysis suggests that *H. comes* may show an ontogenetic habitat shift from shallow to deep water at larger adult sizes, where hookah is used (Meeuwig *et al.,* in prep). If so, then the restriction of hookah would leave larger seahorses in situ, with potential benefits for reproductive output and recruitment to shallow areas.

Alternatively, restricting hookah rigs could have an effect similar to that produced by spatial closures (see above). If, as an alternative hypothesis suggests, seahorses in deeper water represent self-recruiting populations, then gear restrictions on deeper fishing would merely leave those populations intact without much benefit for neighbouring areas. Clearly, more research is needed on the abundance, distribution, and recruitment of seahorses in deeper water before the potential impacts of hookah restrictions can be predicted.

Enforcement of a gear restriction would be difficult. Fishers that were interviewed were moderately supportive of gear restriction but few (if any) of those present have used hookah. Hookah divers have invested enough in their equipment to reduce options for alternative livelihoods.

C (3). Total Allowable Catch (TAC)

Fishers were the only group that showed high preference for this option, although their support was by no means unanimous. It is unclear why TACs should have higher levels of support among the fishers when compared with reduction in the number of fishers, but perhaps it was perceived as more equitable. All the other groups consulted showed lower preference because of the potential to restrict fishers' income if TACs could be enforced and associated scepticism about the possibility of enforcement. Although TACs are designed to reduce the overall fishing mortality, they lead to scramble competition between fishers to exploit the resource as rapidly as possible (Sutinen, 1999). If enforcement breaks down after a TAC is reached, then overall fishing effort actually increases. It appears very unlikely that TACs could be successfully enforced in the seahorse fishery, given the resources available, their spatial distribution and the ease of hiding small animals. Furthermore, TACs lead to market gluts which could depress prices and lead to lower income for fishers (Sutinen, 1999).

C (3). Sex-selective fishing (leaving pregnant males)

Fishers were strongly supportive of this management option while the TCM community was recorded as being strongly opposed. Such an apparent difference may represent a real divergence of opinion may between these groups. Alternately, however, our phrasing of the question in the present tense may mean that the TCM community saw it as reasonable to sell pregnant males under current trade practice. The latter is more likely:

(a) pregnant males have the same economic value as females or non-pregnant males in TCM;

(b) three representative Hong Kong importers called on Philippines fishers and exporters not to take pregnant male seahorses during a November 2000 workshop in Cebu (B. Kwan in litt. Nov. 2000); and

(c) seven TCM trade associations in Hong Kong called for colleagues "*not to purchase seahorses during their breeding seasons, so that their resources can be sustainable*" on 25 March 2002 (S. Lee in litt. 13 Apr. 2002). We need to explore the response of TCM community to sex-selective fishing further before we can fully gauge the efficacy of this management option

Fishers tacitly acknowledge recruitment overfishing by favouring the conservation option of leaving pregnant males in the sea. It is unclear whether they realised that such a policy would result in a substantial catch reduction: the sex ratio is 1:1 and males are pregnant approximately 50% of the time. An alternative option to achieve the same ends without this cost would be to cage pregnant males (see below).

The biological and economic consequences of sex-selective fishing on seahorses will be dependent on the frequency of fishing effort, the rate at which they repair, and the frequency of pregnant animals in the population (Martin-Smith, unpublished data). If most seahorses are pair-bonded and males are pregnant for the majority of each reproductive cycle (Vincent and Sadler, 1995; Perante *et al.,* in press), then leaving pregnant males in the sea might significantly enhance total reproduction, and also increase short-term economic losses. If, however, overall population densities are so low that males have difficulty finding a partner, then leaving the pregnant males may not help much, although it would still cause economic loss.

The unusual nature of seahorse reproduction makes it difficult to predict the impact of protecting one sex rather than the other. In seahorses, although the male bears the young, the female makes a significant contribution through her eggs, to the extent that female size is a key determinant in reproductive output (Vincent, 1990; Vincent and Giles, unpublished data). Removing either sex will skew the population sex

ratio, perhaps problematically given the apparently monogamous pairing in *H. comes* (Perante *et al.,* in press). Given the open access nature of the seahorse fishery, it may not be very easy to ensure that fishers do leave pregnant males. Certainly, the race to fish in large industrialised fisheries in developed countries did not diminish with sex-selective fishing, despite high enforcement costs (Sutinen, 1999).

C (4). Caging pregnant males

This is the management option most specific to seahorses. Rather than leaving a pregnant male in situ, the fisher takes him back to his village and puts him in a holding pen in the sea until he releases young. The young escape through the cage to the sea, and fisher then sells the empty male. The biological effect of caging pregnant males is to allow males to release one more brood of young before they are removed from the sea. In theory, the fisher gets virtually the full price for the male seahorse, and thus suffers no economic loss.

Some of the seahorse fishers had already been involved in a project to cage pregnant males prior to sale (Vincent and Pajaro, 1997). Somewhat surprisingly, fishers with previous experience were more supportive of the option than those without. Biological difficulties included the need to site the cages near the village, where water quality and environmental parameters were often poor, and the lack of certainty as to the fate of the newly released young. Economic issues included capital costs of cage construction, deferred realisation of the money for the male, potential (albeit low) mortality in the cage, and the loss of weight when the young were released (with consequent drop in income if buyers purchased the seahorses by weight). Social difficulties arose from the from the fishers' inexperience with self-organisation: they found it difficult to co-ordinate action to construct the cages, check them regularly, and arrange sale of the empty males. All of these factors suggest high uncertainty about the utility of this option, although organisational capacity has certainly improved.

D. Management options of lowest preference

D (1/2). Maximum size limit and slot sizes

The benefits of maximum size limits for seahorse management, as for other fisheries (McCann and Shuter, 1997), depend on the relationship between fecundity and body size. In theory, maximum or slot sizes allow larger and more fecund animals to survive to reproduce. Large individuals contribute disproportionately to spawning success in some species (Plan Development Team, 1990; Roff, 1992). In seahorses, however, this relationship is unlikely because of (a) extended parental care, and (b) small maximum body size (Lourie *et al.,* 1999). Brood size was not related to size in *H. comes* over the size range of animals caught in the fishery (Meeuwig *et al.,* in prep). The proportion of pregnant males did show a strong relationship with body size over the range 105-200 mm SL (Vincent *et al.,* in prep), but increased total reproductive gain from this relationship was likely to be modest (Vincent *et al.,* in prep).

It appears very unlikely that any form of maximum size limit could be enforced for *H. comes* except through trade bans. Above 12 cm standard length, seahorses become more valuable as they get larger, with payment varying by weight or length. Fishers thus feared considerable decline in income if maximum size limits were implemented. The same argument was presented by fishers for opposition to slot sizes, with the additional handicap that smaller catches of smaller individuals further reducing their income. A summary of the discussion on each of the management options is provided in Table 4.

Conclusions

The collaborative process described in this paper has produced clear suggestions as to management options for this seahorse fishery. We recommend that a combination of the highly preferred options (MPAs, minimum size limits and a tenurial system) is instituted to ensure the management objectives for the fishery are achieved. Use of multiple management measures should help to spread the risk if some of the biological or economic assumptions are invalid. In addition, the three most highly preferred options have different temporal scales for their implementation and subsequent effects.

There appears to be consensus that MPAs are an important precautionary measure for conservation in general, with MPAs having significant effects on the whole ecosystem (Mosquera *et al.,* 2000; Jennings, 2001). Certainly, MPAs enhance protection and habitat for other fished species (Rogers-Bennett and Pearse, 2001), for which spillover and export of larvae may be greater than for seahorses. Such gains can help seahorses, which are just one part of a multi-species fishery. The introduction of a tenurial system would be another important contribution to long-term sustainability of seahorse populations and other marine fauna too. However, implementation would take time and would not of itself create security for seahorse populations. Minimum size limits would be very specific to one or a few seahorse species but might operate more quickly than MPAs in re-building seahorse populations (Bohnsack, 2000; Nowlis, 2000), and potential loss of income could be mitigated by gradual introduction (Bohnsack, 2000).

Equivalence of Management Options to CITES Trade Controls

A number of output controls suggested in this paper would lead to a reduction in the total number of seahorses caught in the fishery, in sympathy with the intent of trade controls. Within the list of management options we explored, reduction in TACs most closely approximated trade controls.

However, TACs were not seen as promising options by the biologists or the policy group, largely because of concerns about feasibility and enforcement issues. Fishers and aquarium dealers were slightly more receptive to the idea, but the fishers would want other livelihood options to be available if TACs were to be reduced.

Given that mandatory reduction in TACs would probably not be effective by itself, any plan to reduce seahorse catches (with or instead of trade controls) will have to explore and promote other options that are ranked more highly by stakeholders, such as minimum size limits. The same management outcomes (sustainability of exploitation) may be attained through different mechanisms that are more or less socially, economically or legally acceptable and feasible. It should be remembered that the traditional Chinese medicine community is, for example, receptive to minimum size limits, as articulated in a joint statement issued by seven TCM trade associations on 25 Mar 2002 (Samuel Lee, TRAFFIC East Asia, in litt, 13 Apr 2002).

Application to Other Syngnathid Fisheries

This paper has explored management options for one seahorse species, *H. comes*, but similar approaches should be useful for other target fisheries, if modified with respect to such parameters as size limits. Managing bycatch of syngnathids will, by comparison, be very problematic. Marine Protected Areas can be used for both target and bycatch species and have been advocated for both fisheries management and conservation purposes (Bohnsack, 1998; Mosquero *et al.,* 2000). Other input controls such as the number of fishers, or temporal and spatial closures, are also often part of management regimes for non-selective gear types. Technical changes to fishing gear might also allow escapement of certain sizes and/or sex, although they would work where the target species were similar in size or exhibited similar behaviour to the bycatch species. The non-selective nature of bycatch means that output controls such as

Table 2: List of management options presented to stakeholder groups

Management Option	Description, in the context of the H. comes fishery	Examples of this approach for other fisheries
1. Reduction in number of fishers	Fishers exit the fishery leading to reduction of total effort. Necessitates alternative livelihoods.	Valentini *et al.*, 1991; McManus *et al.*, 1992; Muller *et al.*, 1997
2. Restriction of gear type	Reduction or ban on compressor divers who catch seahorses in deeper waters than breathhold divers.	Karpov *et al.*, 1998
3. Spatial closures: No-take Marine Protected Areas (MPAs)	Permanent ban on fishing in specified areas.	Roberts and Polunin, 1991; Rowley, 1994; Roberts, 1995; Russ and Alcala, 1996; 1999; Wantiez *et al.*, 1997; Bohnsack, 1998; Guénette *et al.*, 1998; Chapman and Kramer, 1999; McClanahan *et al.*, 1999; Mosquera *et al.*, 2000; Jennings, 2001
4. Temporal closures	Temporary ban on fishing in particular areas for specified period of time.	Attwood and Bennett, 1990; Beets and Friedlander, 1999; Sala *et al.*, 2001
5. Tenurial systems	Local ownership of marine resources. Normally used in conjunction with other options.	Johannes, 1978; 1998a; Adams, 1998; Cooke *et al.*, 2000
6.Total Allowable Catch	Quota on total number of seahorses that can be caught.	Sissenwine and Mace, 1992; Nakken, 1998
7. Minimum size limit	Restriction on landings and sales of seahorses smaller than specified size.	Foale and Day, 1997; Kruse *et al.,* 2000; Hutton *et al.,* 2001
8. Maximum size limit	Restriction on landings and sales of seahorses larger than specified size.	Eckert *et al.,* 1992; QFMA, 1999
9. Slot size	Restriction on landings and sales of seahorses to a specified size range.	Alam *et al.,* 1993; Power and Power, 1996; Hicks *et al.,* 1995; Williams, 1997; QFMA, 1999
10. Sex-selective fishing	Restriction or ban on landing pregnant male seahorses, although could also apply to egg-bearing females.	[leaving females] Vaughan *et al.,* 1995; Orensanz *et al.,* 1998
11. Caging pregnant males	Pregnant male seahorses held in sea cages until they give birth	M. Pajaro (unpub. data)

Table 3: Possible management options for an artisanal seahorse fishery in the central Philippines. Preference for each option was assessed as described in the text. N/a indicates that the option was not applicable or not assessed by a stakeholder group. Abbreviations: FTW – Fisheries Technical Workshop; RAW – Regional Aquarium Workshop (North America); TCM – Traditional Chinese Medicine traders (Hong Kong); PTWG – Philippines Technical Working Group; CITES – international policy workshop held to discuss potential listing of seahorses under the Conventional on International Trade in Endangered Species.

	Preference assessment by stakeholder group						Recent examples of application
Management Option	FTW	Fishers	RAW	TCM	PTWG	CITES	
Input Controls (acting to regulate fishing effort)							
Reduction in the number of fishers	Low	Moderate	High	N/a	Low	Low	[38,39]
Restriction of gear type (reduction or ban on compressor divers)	Low	High	N/a	N/a	High	N/a	[40]
No-take Marine Protected Areas	High	High	N/a	N/a	High	High	[20,32,41-46]
Temporal closures	Moderate	High	N/a	High	Moderate	Moderate	[47,48,49]
Tenurial systems (village/barangay ownership)	High	Moderate	N/a	N/a	High	N/a	[50,51,52]
Output Controls (acting to regulate catches)							
Total Allowable Catch	Low	High	Moderate	Moderate	Low	Low	[53,54]
Min. size limit	High	High	High	High[a]	High	High	[55,56,57]
Max. size limit	Moderate	Low	Moderate	Low	Moderate	Moderate	[58,59]
Slot size (combo of min. and max. size limits)	Moderate	Low	Moderate	Low	Moderate	Low	[59,60,61]
Sex-selective fishing (restriction on capture of pregnant males)	Moderate	High	High	Low[a]	Moderate	Moderate	[62.63]
Caging pregnant males to allow them to release brood before being sold	Moderate	High	n/a	n/a	Moderate	Low	-

[a] Translation errors mean that questions on both of these options were phrased in terms of current practice. Whilst future minimum size limits appear to be acceptable to the TCM community, opposition to sex-selective fishing is at odds with our longer-term understanding of TCM receptiveness to management change (see Synthesis).

Table 4: Summary of pros and cons for seahorse management options

Management Option	Pros	Cons
1. Reduction in number of fishers	• Reduced total catch of seahorses • Reduced catch of other organisms • May increase income for remaining fishers	• Loss of livelihood for some fishers • Problems of enforcement • May increase effort by remaining fishers • Low level of support
2. Restriction of gear type	• Deep-water refuge for some seahorses • May protect larger, reproductive individuals	• Problem of enforcement – hookah divers unlikely to give up their gear • Smaller seahorses still vulnerable to breathhold divers
3. Spatial closures: No-take Marine Protected Areas (MPAs)	• Permanent protection of some seahorse populations • High level of support from all stakeholders • General benefits for other species	• Cannot predict response of seahorses to MPAs • Level of 'spillover' to areas outside MPAs unknown • Potential increase in effort outside MPAs • 'Lag' period before effect of MPA observed
4. Temporal closures	• Protection during certain periods of increased vulnerability – reproduction, recruitment of juveniles	• Difficult to determine appropriate period for closure • Loss of income during closure – cannot be sustained by subsistence fishers
5. Tenurial systems	• Local ownership provides vested interest in sustainability • Promotes local involvement in management process	• Political implications of re-allocating ownership • No tradition of tenure • Variable responses by different tenure-holders
6.Total Allowable Catch	• Total (sustainable) quota can be set	• Problem of enforcement • 'Scramble' competition for resources • Market gluts with reduced income
7. Minimum size limit	• Protection of juveniles, allowing them to reach reproductive size • High level of support from all stakeholders • Most effective method of rebuilding populations suffering recruitment overfishing	• Loss of income • Determination of minimum size limit • 'Lag' period before effect of minimum size limit observed
8. Maximum size limit	• Protection of reproductive adults • Increased reproductive output per pair because larger individuals have larger broods and shorter inter-brood interval?	• Substantial loss of income because large seahorses most valuable • Low level of support • Determination of maximum size limit
9. Slot size	• Protection of juveniles and reproductive adults • Increased reproductive output	• Substantial loss of income from large and small seahorses • Low level of support
10. Sex-selective fishing	• Pregnant males allowed to release brood in natural habitat • High level of fisher support	• Produces skewed sex ratio in adult population • Reproduction may be reduced if males cannot find new partner
11. Caging pregnant males	• Pregnant males allowed to release brood • No loss of income for fisher	• Location of cages may not be optimal for juvenile survival or recruitment • Mortality of males in cages • Logistic and organization requirements for successful operation of cages

size limits or sex-selective fishing would be extremely difficult to implement, and might not even serve a conservation goal, if the fish were landed dead anyway. Other and innovative management options of particular utility to bycatch fisheries, such as mandatory use of sorting hoppers, will need to be considered.

In all protocols, we need to avoid managing seahorses in a way that deflects fishing pressure onto other vulnerable species. Marine conservation must be holistic even as it addresses specific issues.

For more information, we refer you to the following analysis: Full citation is Martin-Smith, K.M., Samoilys, M.A., Meeuwig, J.J. & Vincent, A.C.J. (2004) Collaborative development of management options for an artisanal fishery for seahorses in the central Philippines. Ocean & Coastal Management 47: 165-193.

REFERENCES

Adams, T. 1998. *The interface between traditional and modern methods of fishery management in the Pacific Islands*. Ocean Coastal Manage. 40: 127-142.

Alam, M.K., P.L. Wagner, D.F. Mosley, and N.L. Vucinich. 1993. *Harvest slot limit rationale for Lahontan cutthroat trout at Pyramid Lake, Nevada*. Calif. Fish. Game. 79: 76-81.

Attwood, CG and B.A. Bennett. 1990. *A simulation model of the sport-fishery for galjoen Coracinus capensis: An evaluation of minimum size limit and closed season.* S. Afr. J. Mar. Sci. 9: 359-369.

Beets, J and A. Friedlander. 1999. *Evaluation of a conservation strategy: a spawning aggregation closure for red hind, Epinephelus guttatus, in the US Virgin Islands*. Env. Biol. Fishes 55: 91-98.

Beverton, R.J.H. and S.J. Holt. 1957. *On the Dynamics of Exploited Fish Populations*. Chapman and Hall, London. 533 pp.

Bimbo, A.P. 2000. *Fish meal and oil*. *In* R.E. Martin, E.P. Carter, G.J. Flick, and L.M. Davis, eds. *Marine and Freshwater Products Handbook*. CRC Press, New York, pp. 541-582.

Bohnsack, J.A. 1998. *Application of marine reserves to reef fisheries management*. Aust. J. Ecol. 23: 298-304.

Bohnsack J.A. 2000. *A comparison of the short-term impacts of no-take marine reserves and minimum size limits*. Bull. Mar. Sci. 66: 635-650.

Botsford L.W., J.C. Castilla and C.H. Peterson. 1997. *The management of fisheries and marine ecosystems*. Science 277: 509-515.

Chapman, M.R. and D.L. Kramer. 1999. *Gradients in coral reef fish density and size across the Barbados Marine Reserve boundary: effects of reserve protection and habitat characteristics*. Mar. Ecol. Prog. Ser. 181: 81-96.

Chiappone, M. and K.M.S. Sealey. 2000. *Marine reserve design criteria and measures of success: Lessons learned from the Exuma Cays Land and Sea Park, Bahamas*. Bull. Mar. Sci. 66: 691-705.

Cochrane, K.L. 2000. *Reconciling sustainability, economic efficiency and equity in fisheries: the one that got away?* Fish Fisheries 1: 3-21.

Cooke, A.J., N.V.C. Polunin and K. Moce. 2000. *Comparative assessment of stakeholder management in traditional Fijian fishing-grounds*. Env. Cons. 27: 291-293.

Dahlgren, C.P. and J. Sobel. 2000. *Designing a Dry Tortugas ecological reserve: How big is big enough? ... To do what?* Bull. Mar. Sci. 66: 707-719.

DeMartini, E.E. 1993. *Modeling the potential of fishery reserves for managing Pacific coral reef fishes.* Fish. Bull. 91: 414-427.

Eckert, K.L., J.A. Overing and B.B. Lettsome. 1992. *Sea turtle recovery action plan for the British Virgin Islands*. UNEP Caribbean Environment Programme, Kingston, Jamaica, 131 pp.

FAO. 2002. *The State of World Fisheries and Aquaculture 2002*. Food and Agriculture Organization, Rome.

·Foale, S. and R. Day. 1997. *Stock assessment of trochus (Trochus niloticus) (Gastropoda: Trochidae) fisheries at West Nggela, Solomon Islands*. Fish. Res. 33: 1-16.

Green, E. and F. Shirley. 1999. *The Global Trade in Coral*. World Conservation Monitoring Centre. World Conservation Press, Cambridge, UK. 70pp.

Guénette, S., T. Lauck and C. Clark. 1998. *Marine reserves: from Beverton and Holt to the present*. Rev. Fish Biol. Fish. 8: 251-272.

Gulayan, S., I. Ancog, M.G. Pajaro and E. Brunio. 2000. *Management of marine sanctuaries in Bohol, central Philippines*. 9th Int'l. Coral Reef Symp. Bali, Indonesia. Program Abstracts p. 169.

Hicks, F., B. Monroe, R. Hawkins, R.W. Bachmann, J.R. Jones, R.H. Peters and D.M. Soballe. 1995. *Early response of lake trout to a slot size limit*. Lake Reserv. Manage. 11:149.

Hutton, T., M.H. Griffiths, U.R. Sumaila and T.J. Pitcher. 2001. *Cooperative versus non-cooperative management of shared linefish stocks in South Africa: an assessment of alternative management strategies for geelbek (Atractoscion aequidens)*. Fish. Res. 51: 53-68.

Hyrenbach, K.D., K.A. Forney and P.K. Dayton. 2000. *Marine protected areas and ocean basin management*. Aquat. Cons. Mar. Freshw. Ecosyst. 10: 437-458.

Jennings, S. 2001. *Patterns and predictions of population recovery in marine reserves*. Rev. Fish Biol. Fish. 10: 209-231.

Jennings, S. and N.V.C. Polunin. 1997. *Impacts of predator depletion by fishing on the biomass and diversity of non-target reef fish communities*. Coral Reefs 16: 71-82.

Johannes, R.E. 1978. *Traditional marine conservation methods in Oceania and their demise*. Ann. Rev. Ecol. Syst. 9: 349-364.

Johannes, R.E. 1998a. *Government-supported, village-based management of marine resources in Vanuatu*. Ocean Coastal Manage. 40: 165-186.

Johannes, R.E. 1998b. *The case for data-less marine resource management: examples from tropical nearshore fin-fisheries*. Tr. Ecol. Evol. 13: 243-246.

Karpov, K.A., P.L. Haaker, D. Albin, I.K. Taniguchi and D. Kushner. 1998. *The red abalone, Haliotis rufescens, in California: Importance of depth refuge to abalone management*. J. Shellfish Res. 17: 863-870.

Katon, B.M., R.S. Pomeroy, L.R. Garces and A.M. Salamanca. 1999. *Fisheries management of San Salvador Island, Philippines: A shared responsibility*. Soc. Nat. Resources 12: 777-795.

King, M. 1995. *Fisheries Biology, Assessment and Management*. Fishing News Books, Oxford 341pp.

Kramer, D.L. and M.R. Chapman. 1999. *Implications of fish home range size and relocation for marine reserve function*. Env. Biol. Fishes 55: 65-79.

Kruse, G.H., L.C. Byrne, F.C. Funk, S.C. Matulich and J. Zheng. 2000. A*nalysis of minimum size limit for the red king crab fishery in Bristol Bay, Alaska*. N. Am. J. Fish. Manage. 20: 307-319.

Lourie, S.A., A.C.J. Vincent and H.J. Hall. 1999. *Seahorses: an identification guide to the world's species and their conservation*. Project Seahorse, London. 214 pp.

Lowe, S.A., J.T. Fujioka and J.M. Terry. 1991. *Bioeconomic analysis of a minimum size limit for Gulf of Alaska sablefish using a yield per recruit model*. Fish. Res. 11: 307-320.

Mantjoro, E. 1996. *Management of traditional common fishing grounds: The experience of the Para community, Indonesia*. Coast. Manage. 24: 229-250.

McCann, K. and B. Shuter. 1997. *Bioenergetics of life history strategies and the comparative allometry of reproduction.* Can. J. Fish. Aquat. Sci. 54: 1289-1298.

McClanahan, T.R. and S. Mangi. 2000. *Spillover of exploitable fishes from a marine park and its effect on the adjacent fishery*. Ecol. App. 10: 1792-1805.

McClanahan, T.R., N.A. Muthiga, A.T. Kamukuru, H. Machano and R.W. Kiambo. 1999. *The effects of marine parks and fishing on coral reefs of northern Tanzania*. Biol. Cons. 89:161-182.

McManus, J.W., C.L. Nonola, R.B. Reyes and K.N. Kesner. 1992. *Resource ecology of the Bolinao coral reef system*. ICLARM, Manila. 117 pp.

Meeuwig, J.J., M.A. Samoilys, J. Erediano and H. Hall. 2003. *Fishers' perceptions on the seahorse fishery in the central Philippines: interactive approaches and an evaluation of results*. In: Proceedings of the Putting Fishers' Knowledge to Work Conference.

Mosquera, I., I.M. Côte, S. Jennings and J.D. Reynolds. 2000. *Conservation benefits of marine reserves for fish populations*. Anim. Cons. 4: 321-332.

Muller, R.G., J.H. Hunt, T.R. Matthews and W.C. Sharp. 1997. *Evaluation of effort reduction in the Florida Keys spiny lobster, Panulirus argus, fishery using an age-structured population analysis*. Mar. Freshw. Res. 48: 1045-1058.

Nakken, O. 1998. *Past, present and future exploitation and management of marine resources in the Barents Sea and adjacent areas*. Fish. Res. 37: 23-35.

Nowlis, J.S. 2000. *Short- and long-term effects of three fishery-management tools on depleted fisheries.* Bull. Mar. Sci. 66: 651-662.

Orensanz, J.M.L., J. Armstrong, D. Armstrong and R. Hilborn. 1998. *Crustacean resources are vulnerable to serial depletion - the multifaceted decline of crab and shrimp fisheries in the Greater Gulf of Alaska*. Rev. Fish Biol. Fisheries 8: 117-176.

Pajaro, M.G., C.M. Nozawa, M. Lavides and S. Gutierrez. 2001. *Status of Marine Protected Areas in the Philippines: Better management of coral reefs and the coastal areas in the tropics*. 9th Int'l. Coral Reef Symp. Bali, Indonesia. Program Abstracts p. 171.

Pauly, D. 1997. *Small-scale fisheries in the tropics: marginality, marginalization and some implications for fisheries management*. *In* E.K. Pikitch, D.D. Huppert and M.P. Sissenwine, eds. *Global Trends: Fisheries Management* American Fisheries Society, Bethseda, Maryland. American Fisheries Society Symposium 20: 40-49.

Perante, N.C., M.G. Pajaro, J.J. Meeuwig and A.C.J. Vincent. 2002. *Biology of a seahorse species, Hippocampus comes in the central Philippines*. J. Fish Biol. 60:821-827.

Pitcher T.J. and P.J.B. Hart. 1983. *Fisheries Ecology*. Croon Helm, London 414pp.

· Plan Development Team. 1990. *The potential of marine fishery reserves for reef fish management in the U.S. southern Atlantic*. (ed. Bohnsack JA). NOAA Technical Memorandum NMFS-SEFC-261.

Power, M. and G. Power. 1996. *Comparing minimum-size and slot limits for brook trout management.* N. Am. J. Fish. Manage. 16:49-62.

QDPI (Queensland Department of Primary Industries). 2002. F*isheries (Coral Reef Fin Fish) Management Plan 2002: Consultation Version*. QDPI: Brisbane.

Roberts, C.M. 1995. *Rapid buildup of fish biomass in a Caribbean marine reserve*. Cons. Biol. 9: 815-826.

Roberts, C.M. and N.V.C. Polunin. 1991. *Are marine reserves effective in management of reef fisheries?* Rev. Fish Biol. Fish. 1: 65-91.

Roff, D.A. 1992. *The Evolution of Life Histories*. Chapman and Hall, New York.

Rogers-Bennett, L. and J.S. Pearse. 2001. *Indirect benefits of marine protected areas for juvenile abalone*. Cons. Biol. 15:642-647.

Rowley, R.J. 1994. *Marine reserves in fisheries management.* Aquatic Cons: Mar. Freshw. Ecosyst. 4: 233-254.

Russ, G.R. and A.C. Alcala. 1996. *Do marine reserves export adult fish biomass? Evidence from Apo Island, central Philippines*. Mar. Ecol. Prog. Ser. 132: 1-9.

Russ, G.R. and A.C. Alcala. 1998. *Natural fishing experiments in marine reserves 1983-1993: roles of life history and fishing intensity in family responses*. Coral Reefs 17: 399-416.

Russ, G.R. and A.C. Alcala. 1999. *Management histories of Sumilon and Apo Marine Reserves, Philippines, and their influence on national marine resource policy*. Coral Reefs 18: 307-319.

Sala E., E. Ballesteros and R.M. Starr. 2001. *Rapid decline of Nassau grouper spawning aggregations in Belize: Fishery management and conservation needs*. Fisheries 26 (10): 23-30.

Sissenwine, M.P. and P.M. Mace. 1992. *ITQs in New-Zealand - the era of fixed quota in perpetuity*. Fishery Bull. 90: 147-160.

Sutinen, J.G. 1999. *What works well and why: evidence from fishery-management experiences in OECD countries*. ICES J. mar. Sci. 56: 1051-1058.

Valentini, H., P.M.G. de Castro, G.J.M. Servo and L.A.B. de Castro. 1991. *Evolucao da pesca des principais especies demersais da costa sudeste do Brasil, pela frota de arrastreiros de parelha baseada em Sao Paulo, de 1968 a 1987*. Atlantica 13: 87-95 [in Portuguese].

Vaughan, D.S., M.R. Collins and D.J. Schmidt. 1995. *Population characteristics of the Black Sea bass Centropristis striata from the southeastern US*. Bull. Mar. Sci. 56: 250-267.

Vincent, A.C.J. 1990. *Reproductive Ecology of Seahorses*. Ph.D. Thesis, University of Cambridge, UK.

Vincent, A.C.J. and M.G. Pajaro. 1997. *Community-based management for a sustainable seahorse fishery*. *In* D.A. Hancock, D.C. Smith, A. Grant and J.P. Beumer, eds. *The 2nd World Fisheries Congress*. Brisbane, Australia, pp 761-766.

Vincent, A.C.J. and L.M. Sadler. 1995. *Faithful pair bonds in wild seahorses, Hippocampus whitei*. Anim. Behav. 50:1557-1569.

Wantiez, L., P. Thollot and M. Kulbicki. 1997. *Effects of marine reserves on coral reef fish communities from five islands in New Caledonia*. Coral Reefs 16: 215-224.

Watson, R. and D. Pauly. 2001. *Systematic distortions in world fisheries catch trends*. Nature 414: 534-536.

Westmacott, S. 2002. *Where should the focus be in tropical integrated coastal management?* Coast. Manage. 30: 67-84.

Williams, L.E., ed. 1997. *Queensland's fisheries resources: current condition and recent trends 1988-1995*. Queensland, Department of Primary Industries, Information Series QI97007. 101pp.

Wood, E.M. 2001. *Collection of coral reef fish for aquaria: global trade, conservation issues and management strategies*. Marine Conservation Society, UK. 80 pp.

Wood, E.M. and S.M. Wells. 1988. *The marine curio trade: conservation issues*. A report for the Marine Conservation Society. Sponsoring organisation World Wide Fund for Nature, UK.

Wood, E.M. and S.M. Wells. 1995. *The shell trade: a case for sustainable utilization*. Chapter 4: Sustainable utilization. *In* E. Alison Kay (ed.). *The conservation biology of molluscs*. Occasional paper of the IUCN Species Survival Commission No.9. Proceedings of a Symposium held at the 9th International Malacological Congress, Edinburgh, Scotland, 1986. Switzerland, p. 41-52.

Zacharias, M.A. and J.C. Roff. 2001. *Use of focal species in marine conservation and management: a review and critique*. Aquatic Conserv: Mar. Freshw. Ecosyst. 11: 59-76.

Assessing A Seahorse Fishery For Overfishing

Keith Martin-Smith, Project Seahorse
Keith.MartinSmith@utas.edu.au

This document was originally prepared by Project Seahorse for the CITES Secretariat for the Technical workshop on seahorses and other members of the family Syngnathidae (Cebu, Philippines), 27-29 May 2002), and has been revised by Project Seahorse for the CITES Secretariat for the International workshop on seahorse fishery management (Mazatlán, Mexico), 3-5 February 2004).

Determining whether a fishery is overfished is the first step before any management decision can be made. The following document prepared by Project Seahorse represents the summary of a discussion at a Fisheries Technical Workshop (see Briefing Document on Fisheries Management), at which a particular seahorse fishery in the Central Philippines was assessed qualitatively and semi-quantitatively for evidence of overfishing.

Seahorses may be particularly vulnerable to heavy exploitation due to the low potential reproductive rate, small home range, and limited swimming abilities observed in many species (Lourie *et al*., 1999). At least 20 million dried seahorses were traded annually by 1995, and local fishers and buyers reported substantial declines in catches of *Hippocampus comes*, in the order of 70% over ten years to 1995 (Vincent, 1996; Vincent and Pajaro, in prep.). The fishery for *H. comes* described in the document Summary of the Central Philippines Seahorse Fishery was assessed against various qualitative and semi-quantitative definitions of overfishing.

At least six different qualitative categories of overfishing have been proposed in the literature (Table 1). For all categories, there was some evidence that the fishery was overexploited (Table 2). A semi-quantitative assessment of the fishery was also conducted using catch data from the fishery (Vincent *et al.,* in prep), fishery-independent biological data (Perante *et al*., in press), and estimates of fisheries parameters from a yield-per-recruit model. There was direct and indirect evidence of overfishing in all of the criteria used (Table 2).

There were considerably more data available for this fishery than many other nearshore, coral reef fisheries. In line with the conclusions of Johannes (1998), who advocated precautionary management in data-poor or data-less situations, we considered that there was a high probability that the seahorse fishery in the central Philippines was overfished, and that management action should be taken on this basis.

For more information, we refer you to the following analysis: Full citation is Martin-Smith, K.M., Samoilys, M.A., Meeuwig, J.J. & Vincent, A.C.J. (2004) Collaborative development of management options for an artisanal fishery for seahorses in the central Philippines. Ocean & Coastal Management 47: 165-193

Table 1: Qualitative assessment of a central Philippines seahorse fishery for evidence of overfishing

Type of overfishing	Definition	Assessment of seahorse fishery	Conclusion
Economic	"fishing at levels beyond an economically optimal level. The latter optimum usually occurs at levels of fishing effort below those based on the other types of overfishing" (McManus, 1997)	Economic optimum for seahorse fishery is unknown. Reported historical declines in CPUE leading to decreased income	Almost certainly overfished
Growth	"harvesting of individual organisms at sizes which are sub-optimal with respect to potential yield" (McManus, 1997)	High proportion of juveniles taken and strong size-dependent value	Almost certainly overfished
Recruitment	"refers to fishery-induced reduct number of young fish entering fi ground." (Pauly, 1994). "a level of fishing in which the adult stock is reduced to the extent that recruits produced are insufficient to maintain the population" (King, 1995)	Level of recruitment required to maintain population is unknown. Adult standing stock v. low (640 km^{-2}) and high proportion of catch is juveniles (Vincent et al., unpub.; Samoilys et al., unpub.)	Probably overfished
Biological	"a combination of growth and recruitment overfishing which leads to a decline in catch as fishing effort increases." (McManus, 1997)	Time series (1996-2001) for CPUE not really sufficient to evaluate biological overfishing. Although CPUE was stable for 3 years and then increased, fishers report declines from historical CPUE (Vincent et al., unpub.)	Probably overfished as both growth & recruitment overfishing appear to be taking place
Ecosystem	"Ecosystem overfishing causes a shift in community structure from a fishery dominated by valuable species to one dominated by species of less economic value or utility" (Pauly, 1979)	Historical declines in proportion of species from higher trophic levels. Declines in catches of piscivores (McManus, 1997).	Total fishery suffering ecosystem overfishing. Effects on seahorse component unknown
Malthusian	"overfishing occurs at when poor fishermen, faced with declining catches and lacking any other alternative, initiate wholesale resource destruction in their effort to maintain their incomes." (Pauly et al., 1989)	Seahorses are not caught with gears that are destructive. However there is abundant evident that these gears are being used for other species in the same fishery (McManus, 1997). Effects of degraded habitat on seahorse populations are unknown	Total fishery suffering Malthusian overfishing. Effects on seahorse component unknown

Table 2: Semi-quantitative assessment of seahorse fishery for evidence of overfishing (Unpublished criteria developed by Carl Walters, Fisheries Centre, U.B.C.)

Criterion	Direct Evidence	Indirect (Inferred) Evidence
1. High proportion of individuals of at least one life-history stage must be accessible to fishery.	High levels of fishing effort across known seahorse habitat	Fishers' knowledge of habitat preferences of *H. comes*. Reported historical declines in CPUE
2. Age/size at recruitment to fishery substantially less than age/size at first maturity.	Calculated size at 50% maturity = 102 mm Smallest individual recorded in fishery = 52 mm 18% of catch recorded as juveniles (Vincent *et al.*, unpub.)	N o n e
3. Current biomass substantially less than virgin biomass	None (no surveys of virgin biomass were undertaken)	Reported declines of 15-50% over 5 years to 1995 from fishers and traders (Vincent, 1996; Perante *et al.*, 1998) Population densities of only ~640 km^{-2} in 2000 very low, even for rare coral reef species (Samoilys *et al.*, unpub.)
4. Fishing mortality (F) greater than approx. 0.6x natural mortality (M)	None (estimates of F and M from catch data only)	Estimates of F range from 1.7-2.5 yr^{-1} from catch data Estimates of M range from 0.8-1.6 yr^{-1} (Meeuwig *et al.*, unpub.)
5. Population biomass will increase in response to lower F.	Increases in population size within Marine Protected Areas	Increased CPUE in 1999 following period of reduced fishing pressure (seaweed farming).

REFERENCES

Johannes, R.E. 1998. *The case for data-less marine resource management: examples from tropical nearshore finfisheries*. Tr. Ecol. Evol. 13:243-246.

King, M. 1995. *Fisheries Biology, Assessment and Management*. Fishing News Books, Oxford 341pp.

Lourie, S.A., A.C.J. Vincent and H.J. Hall. 1999. *Seahorses: an identification guide to the world's species and their conservation*. Project Seahorse, London. 214 pp.

McManus, J.W. 1997. *Tropical marine fisheries and the future of coral reefs: a brief review with emphasis on Southeast Asia*. Coral Reefs 16, Suppl.: S121-S127.

Pauly, D. 1979. *Theory and management of tropical multispecies stocks: a review, with emphasis on the Southeast Asian demersal fisheries*. ICLARM Stud. Rev. 1:35.

Pauly, D. 1994. *From growth to Malthusian overfishing: stages of fisheries resources misuse*. SPC Trad. Mar. Resour. Manage. Knowl. Bull. 3:7-14.

Pauly, D., G. Silvestre and I.R. Smith. 1989. *On development, fisheries and dynamite: a brief review of tropical fisheries management*. Nat Resour Model 3: 307-329.

Perante, N.C., M.G. Pajaro, J.J. Meuwig and A.C.J. Vincent. in press. *Biology of a seahorse species Hippocampus comes in the central Philippines*. J. Fish Biol.

Vincent, A.C.J. 1996. *The International Trade in Seahorses*. TRAFFIC International, Cambridge, UK. 163 pp.

APPENDIX I

Prop. 12.37

CONSIDERATION OF PROPOSALS FOR AMENDMENT OF APPENDICES I AND II

A. Proposal

Inclusion of all species of the genus *Hippocampus* (*Hippocampus* spp.) in Appendix II of CITES. *H. comes*, *H. spinosissimus*, *H. barbouri*, *H. reidi*, *H. erectus*, and *H. ingens* qualify for listing in Appendix II in accordance with Article II, paragraph 2 (a) of the Convention, and satisfy Criterion Bi) in Annex 2a of Resolution Conf. 9.24.

The other 26 described species qualify for listing in Appendix II in accordance with Article II, paragraph 2 (b) of the Convention, and satisfy Criterion A. in Annex 2b of Resolution Conf. 9.24.

B. Proponent

The United States of America.

C. Supporting statement

1. Taxonomy

1.1 Class: Actinopterygii
1.2 Order: Syngnathiformes (Gasterosteiformes)
1.3 Family: Syngnathidae
1.4 Genus and species: *Hippocampus* spp. See Appendix A
1.5 Scientific synonyms: See Appendix B
1.6 Common names: English: Seahorse, sea pony, horsefish
French: Hippocampe, Cheval de mer
Spanish: Caballito de mar
1.7 Code numbers: None

Seahorses are listed in the UNEP-WCMC *Animals of the World Database*. http://www.unepwcmc.org /species/animals/animal_redlist.html and are included on the 2000 IUCN Red List. However, there have been several recent taxonomic revisions described in Lourie et al., 1999 and changes regarding the global status of seahorses included in the 2000 IUCN Red List. The species nomenclature used throughout this proposal is based on Lourie et al., 1999, and includes recent revisions that will appear in the 2002 IUCN Red List.

2. Biological parameters

2.1 Distribution

Seahorses inhabit marine or brackish water, occurring primarily in shallow temperate, subtropical and tropical coastal environments between 52° north and 45° south latitude (Lourie et al., 1999). Of 32 species described by Lourie et al. (1999), the highest diversity occurs in the Indo-Pacific region. Australia is a range state for thirteen described species (and possibly a number of additional endemic species described in Kuiter, 2001) and Southeast Asia and Japan have at least seven seahorse species living in their waters (Lourie et al, 1999). By contrast, only four species are known to inhabit the coastal waters of the Western hemisphere. The range states for individual seahorse species are summarized in Appendix A.

Most seahorses are found in coastal areas, typically at depths of 1-15 meters, occurring in relatively protected environments among sea grasses, kelp beds, algal and rocky reefs, mangrove prop roots and coral reefs. A few species prefer open sand or muddy bottoms, as well as areas influenced by strong currents and tidal flow, and deeper reef environments (15-60m depth) (Kuiter, 2001). Seahorses are also found in estuaries exposed to varying salinities, although they do not tolerate extended periods of low salinity (freshwater); others have been identified in the open ocean associated with floating *Sargassum* weed, and at least two species have been identified in trawls from 80-100m depth off Australia and New Zealand (Froese and Pauly, 2002). Certain seahorses utilize different habitats depending on their life stage or size class, with larger animals occurring in deeper water (45 to 60 meters); some exhibit short-range seasonal migrations, retreating to deeper and warmer waters in the winter months (Vincent, 1996).

Most seahorse species examined to date show high site fidelity, with males having smaller home ranges than females, especially during the breeding season. For instance, *H. whitei* had home ranges averaging 8-12 m^2, while the home ranges of *H. guttulatus* on average was less than 30 m^2 (Vincent, 1996). In *H. comes*, males often ranged only 1 m^2 on coral reefs in the Philippines. In contrast, *H. abdominalis* does not show site fidelity, and often ranged over an area of several hundred meters (Vincent, 1990).

Low mobility, limited home range, and certain other life history traits may reduce the potential for re-colonization in locations where they are heavily fished. Dispersal is reported to occur during storms or through transport on floating debris and detached marine algae. In addition, young seahorses may have a planktonic stage that lasts up to eight weeks, allowing them to be carried to new locations by tidal currents, especially when attached to floating debris and algae. Recent work from the Philippines has identified a number of potential barriers to dispersal, including deep water channels, unusual current patterns and large expanses of unsuitable habitat (Casey, 1999).

2.2 Habitat availability

Because of their worldwide distribution and occurrence throughout most coastal environments, potential seahorse habitat is extensive. However, seahorse populations may exhibit a high degree of fragmentation due to the patchy nature of suitable habitat, and extensive habitat loss resulting from human activities such as coastal development, dredging, infilling, and removal of mangroves and seagrasses. In addition, seahorses exhibit microhabitat preferences, occupying only the edges of particular habitat types such as that observed in certain seagrass beds; thus, large areas of seemingly suitable habitat are unoccupied (Vincent, 1996).

Pollution, shoreline development and alteration, and destructive fishing methods such as trawling, dynamite fishing and cyanide fishing are contributing to the worldwide degradation of shallow, coastal habitats that support seahorses populations. For example, mangroves formerly occupied an estimated area of 1.7x105 km^2, occurring from 25° N to 30° S latitude; close to 3000 km^2 of this habitat has been lost each year since the early 1980s, representing roughly 35% of the total aerial world-wide coverage of mangroves (Valiela et al., 2001). Mangroves continue to disappear at a rate of 2.1% each year as a result of clearcutting for shrimp farming, building materials, firewood and other uses. Mangrove loss is a major concern in Asia, Bangladesh, Brazil, Ecuador, Kenya and other locations. Coral reefs represent another important habitat for seahorses that have declined substantially over the last two decades. The Global Coral Reef Monitoring Network reports that an estimated 11% of the world's coral reefs had been lost by 1992, and another 16% are no longer fully functional due to widespread coral mortality during the 1997-1998 El Niño-La Niña events (GCRMN, 2000).

An additional 14% of all remaining coral reefs are predicted to disappear in the next 2-10 years unless fishing pressure, pollution, and other human pressures affecting reef ecosystems are reduced and sustainable management approaches are implemented. Southeast Asia and India have some of the most expansive and suitable seahorse habitat, supporting diverse and abundant *Hippocampus* populations, but these habitats are being lost at an accelerated rate (Table 1). Heavy fishing pressure in this region generates the majority of global seahorse landings (see below), and exacerbates the threat of habitat loss for seahorses in the Indo-Pacific.

2.3 Population status

Seahorses are characterized by sparse distributions and low population density, which may be related to their limited mobility, small home ranges, mate fidelity and other life history traits. Lifespans for seahorses are estimated to range from about one year in small species to about 3-5 years for the larger species. Seahorses reach sexual maturity between six months and one year of age; however, fecundity is orders of magnitude lower than that of most fishes taken by large-scale fisheries (Froese and Pauly, 2002). Males produce from 5 to1572 offspring per pregnancy, depending on the species and size of the animal, with most species releasing an average 100-200 young during each pregnancy (Vincent, 1996). The ability to compensate for exploitation pressure through increased juvenile survivorship is limited in seahorses because of their low fecundity, short lifespan and considerable investment of energy and parental care, especially when adult males are removed.

In most populations for which transect data are available, densities are reported to range from 0.002 to 0.1 per square meter, although densities may be as high as 10-15 seahorses per square meter in localized patches of seagrass (Table 2). The low densities recorded in some areas may be an artifact of heavy fishing pressure and overexploitation, as historic abundance data are unavailable and certain unfished species are locally abundant (Vincent, 1996). For example, *H. bargibanti* are found in clusters of up to 28 pairs on a single gorgonian. Also, *H. breviceps*, a species endemic to southwest Australia, often occurs in aggregations of hundreds of animals (Lourie et al., 1999).

2.4 Population trends

Based on fishery-dependent data and interviews with fishers and traders, seahorses have declined in abundance in many range states that have seahorse fisheries. There are reports and strong circumstantial evidence of both recruitment overfishing (declining numbers) and growth overfishing (diminishing size) among a number of the commonly traded species. Three species (*H. comes*, *H. spinosissimus* and *H. barbouri*) are reported to have experienced substantial declines in heavily fished areas. Fishers, exporters, and buyers interviewed during 1995 in the five largest known seahorse-exporting countries all reported declines in seahorse catch of 15-75% over a period of 3 – 10 years. This includes: 1) 15-50% decline since 1990 in Indonesia; 2) 69% decrease in *H. comes* seahorse catch between 1985-1995 in northern Bohol, Philippines; 3) 50% decline between 1993 – 1995 in Thailand; 4) 30-60% decline between 1990 1995 in Viet Nam; and 5) declines of up to 75% between 1992-1995 in India (Vincent, 1996). These landings are largely believed to encompass the three species described above, and possibly *H. fuscus*, *H. kelloggi*, *H. kuda* and *H. trimaculatus* (A. Perry, pers. comm.). In addition, changes in the length frequency distribution of catch data indicate that populations are over-exploited; sizes of individuals in the trade have declined, and fishers are targeting juveniles and less preferred species to meet an increasing international demand (Perante et al., 1998).

Seahorse numbers in the wild appear to have declined in the Western Atlantic and Eastern Pacific, with fishers reporting decreases in catch of *H.reidi*, *H. ingens* and *H. erectus*. For *H. erectus* and *H. reidi* in the Western Atlantic this includes 1) estimated declines of between 75 -90% in Mexico in the past 10-20 years; 2) a decrease in catch in Honduras; 3) a decrease in catch in Brazil; and for *H. ingens* in the Eastern Pacific 1) estimated declines of 95% in the past 20-30 years in Mexico; 2) estimated declines in catch in Guatemala from 100-150 animals per trip to 4-15 seahorses per trip in 2000; 3) a decline in numbers within the Gulf of Papagayo, Costa Rica; 4) a decrease in catch in Panama during 1985-1990; and 5) a decline during the 1990s in Ecuador (Baum and Rosa, in prep).

The Knysna seahorse, *Hippocampus capensis*, is endemic to South Africa, occurring in four estuaries on the southern coast. This species is believed to be threatened with extinction due to its limited dist ribution, habitat degradation and mass mortalities that have occurred in the Swartvlei estuary (Lockyear, 1999). Between 1985 and 1994, three mass mortalities of *H. capensis* were recorded, the largest of which occurred in 1991 when 3000 dead specimens were collected following the flooding and subsequent breaching of the estuary mouth (Russell, 1994). In addition, pollution and other anthropogenic disturbances may indirectly impact seahorse populations by affecting the seagrass beds inhabited by *H. capensis*. This species is listed as Endangered on the IUCN Red List (Hilton-Taylor, C. (compiler) 2000), but it is not currently in international trade due to national protection in Africa (Table 10).

2.5 Geographic trends

While evidence suggests that localized extirpations and fragmentation of populations have occurred as a result of heavy fishing pressure and loss of habitat, there are no reported losses of seahorse species on a national, regional or global scale. Currently, it is difficult to determine whether the distribution of individual seahorse species has been reduced in extent within individual range states, due to:

1) the existence of only very general information on the regional distribution of most species;
2) few temporal and spatial field assessments;
3) taxonomic difficulties and recent species revisions; and
4) a high probability of species misidentifications in fishery catch and trade data.

For instance, Kuiter (2001) revised the list of extant Australian seahorses, including the addition of several new presumed species that were previously reported by some other name. In most cases, the newly described species are endemic or highly restricted in their range, and splitting of species may have resulted in a restriction of the former range of a previously described species.

2.6 Role of the species in its ecosystem

Seahorses are carnivorous, preying upon small crustacea such as copepods, amphipods and shrimp, as well as larval fishes and other types of zooplankton. The few studies on their feeding ecology suggest that they may play a substantial role in structuring at least some benthic faunal communities (Tipton and Bell, 1988). Young seahorses are prey for tuna, cod, skates, rays, sea perch, and crabs as well as penguins and other marine birds. Rates of predation on adult seahorses are low probably because they are highly cryptic and heavily armored (Vincent, 1995).

2.7 Threats

Threats to seahorses include over-harvest for commercial trade, bycatch in fisheries, and degradation and loss of habitat due to coastal development, destructive fishing practices and pollution. A rapidly growing trade in *Hippocampu* s spp. for traditional medicines (TM), as well as trade for aquarium pets, souvenirs

and curios is resulting in overexploitation of wild populations. At least 20 million seahorses were captured annually from the wild in the early 1990s, and the trade is estimated to be growing by 8-10% per year (Vincent, 1996). Based on reports from seahorse fishers and traders, seahorse populations in are estimated to have declined by 25-75% between 1990 and1995 in India, Indonesia, the Philippines, Thailand and possibly other Indo-Pacific countries where these animals are under heavy fishing pressure to supply international markets (Vincent, 1996). Seahorse numbers in the wild appear to have also declined in the western Atlantic and eastern Pacific Oceans, with fishers reporting decreases in catch of *H. reidi*, *H. ingens* and *H. erectus*. See Section 2.4 for details. Global trade and demand is apparently growing despite localized stock depletions. In Asia alone, annual consumption was estimated at 45 metric tons (16 million seahorses) in the 1980s and early 1990s (Vincent, 1996). Demand for medicinal purposes increased 10-fold during the 1980s and continued to grow by 8 to 10 percent per year in China alone. Trade is thought to have declined in 1998 and 1999 due to the Asian economic crisis, and then increased to as much as 70 metric tons in 2000 (Vincent and Perry, in prep).

Due to a growing trade and heavy fishing pressure in many range states, seahorse supply no longer meets international demand. *H. comes*, *H. barbouri* and *H. spinosissimus*, *H. ingens, H. erectus,* and *H. reidi* are apparently under the greatest threat from unsustainable levels of harvest and international trade to supply TM, curios and pet trades, but at least 20 other species are also in trade. In addition to the large, highly prized specimens that were exclusively harvested in past decades, a substantial proportion of the trade today consists of previously undesirable, small seahorses. For instance, in Bohol, Philippines, seahorse populations have declined by a factor of 5-10 between 1985 and 1995. Fishers noted that only seahorses longer than 100mm vertical length were collected in the 1970s, while anything over 50mm was accepted by 1995. In addition, the numbers of dried seahorses per kg increased from 200-350 in 1993 to 300-450 in 1995 due to a continuing decline in size frequency distributions of local populations (Vincent, 1996). This indicates that juveniles and adults, as well as other previously unexploited species (of smaller adult size) are now vulnerable to harvest pressures.

Seahorse populations are particularly vulnerable to over-exploitation due to their social and spatial organization and life history characteristics: a) seahorses brood their young, thus pregnant seahorses must survive if the young are to survive; b) reproductive rates are limited by lengthy parental care combined with a small brood size; c) sparse distribution, low mobility, small home ranges, and mate fidelity of most species limit replacement of lost partners and the ability for juveniles to recolonize depleted areas; d) juvenile seahorses experience high mortality rates as a result of predation; and e) low natural rates of adult mortality are offset by heavy fishing pressure, which exerts selective pressure on populations (Vincent, 1996). Furthermore, because seahorses have low mobility and small ranges, and they may require considerable time to re-colonize an area from which they have been eliminated, localized extirpations are very likely in areas affected by heavy fishing pressure.

In Indonesia, Philippines, Thailand, and Viet Nam, four of the largest seahorse exporting countries, overexploitation of fishes and the use of poison, dynamite and fine mesh nets were identified as the most serious cause of reef degradation, followed by sedimentation associated with clear-cutting and removal of mangroves, pollution and coastal development (Chou, 2000). These countries have on average lost about half of their mangroves and less than 50% of their coral reefs remain in good to excellent condition (Table 1).

Bycatch of syngnathids occurs in commercial trawl fisheries directed at food fish, scallops or shrimp/prawns. This type of non-selective fishing gear has been shown to cause considerable habitat damage, and it may seriously impact populations of non-target species such as seahorses by removing all life stages, including juveniles and small seahorses that may have little commercial or medicinal value. In addition, non-selective trawls are not conducive to the survival of syngnathids due to long net deployment times, abrasion and compression, and decompression when animals are brought up quickly from deepwater. The combined effects of an increased demand and heavy fishing pressure, the vulnerable nature of the species due to their biology, and the reduction in available seahorse habitat is having severe consequences on population dynamics and abundance of some of the dominant seahorse species in commercial trade.

3. Utilization and trade

3.1 National utilization

Approximately 23 of the 32 described seahorse species are harvested through directed fisheries, and also as bycatch in non-selective trawl fisheries to supply local and international markets. Bycatch currently accounts for the majority of specimens intended for the TM and curio markets, whereas directed fisheries are usually the source of live specimens for the pet trade, as well as a portion of the dried specimen trade. India, Indonesia, the Philippines, Thailand, and Viet Nam exhibit significant bycatch for seahorses in trawl fisheries, while other exporting countries like Australia, Ecuador, Mexico, the United States, and possibly Nicaragua and Honduras also trade in seahorses from bycatch (Vincent and Perry, in prep). To meet international demand, and possibly because other marine resources are declining, subsistence and small-scale fishers in Asia are increasingly targeting seahorses by hand, scoop net or small seine, and many obtain the majority of their seasonal income from these fishes (Vincent, 1996). Seahorses are also collected by subsistence fishers throughout other parts of the Indo-Pacific and a growing number of countries in Latin America. Florida has a small directed trawl fishery in shallow grass beds off the west coast for *H. zosterae* and *H. erectus* where they are landed in a live bait trawl fishery. Non-selective push nets and seine nets also catch seahorses in Australia, Mexico, Kenya, Peru, Tazmania and Thailand. Individual seahorse fisheries are small, but collectively they are very large and have the potential to detrimentally affect wild populations. See Section 2.7 for details on global trade.

3.2 Legal international trade

Export sources

Seahorses are traded internationally as dried specimens for use in traditional medicines (TM), for curios, and as live specimens to supply the aquarium trade.

During the mid 1990s, the largest known exporters were India, Indonesia, the Philippines, Thailand and Viet Nam, with annual exports for each country estimated at 3 to 15 tons of dried seahorses (Vincent, 1996). Furthermore, seahorses comprise 80 to 100 percent of the seasonal income of some fishers in the Philippines and India, and are among the most valuable export fisheries by weight from Viet Nam and the Philippines (Vincent 1995). Based on new trade data from 1998-2000, the largest exporters in descending order are Thailand, India, Mexico, the Philippines and Viet Nam (Vincent and Perry, in prep). Over the last several years a number of new countries have entered the TM trade, including at least 9 countries in Africa and 9 countries in Latin America, possibly in response to declining supplies in southeast Asia (Table 3). At

least 75 countries are now known to trade in seahorses, including 42 nations that export seahorses (Vincent and Perry, in prep). Global harvest, export and import of seahorses are summarized in Tables 4-8.

Transshipment points

Twelve jurisdictions have been identified as trade intermediaries, including Costa Rica, Hong Kong, Japan, Kenya, Laos, Macau, Mali, Norway, Singapore, Switzerland, Chinese Taipei, and Zimbabwe (Vincent and Perry, in prep).

Import destinations

The largest importers for dried seahorses are China, Hong Kong (SAR), Chinese Taipei, and Singapore, respectively. In Asia alone, annual consumption was estimated at 45 metric tons (16 million seahorses) in the 1980s and early 1990s (Vincent, 1996). Demand for medicinal purposes increased 10-fold during the 1980's and continued to grow by 8 to 10 percent per year in China alone. Trade is thought to have declined in 1998 and 1999 due to the Asian economic crisis, and then increased to as much as 70 metric tons in 2000 (Vincent and Perry, in prep). Seahorses are also used in traditional medicines in Indonesia, Japan, Korea, and in Traditional Indian Jamu Medicine, Philippine Folk Medicine, European Alternative Medicine and the rapidly expanding American Alternative Medicine. At least eight medicines prepared from seahorses are now sold in North America (Fratkin 1986). There are currently seven main species that are sold as whole, dried animals (in Hong Kong they are often bleached) for preparation into tonics, and at least six other species traded at lower volumes (Table 9). In the mid 1990s, there was an increased availability of prepared medicines (pills) in Asia possibly in response to decreases in size of individuals obtained in fisheries catch. In China alone, as many as 30-50 medicines are reported to contain seahorse as an active ingredient (Vincent, 1996).

Dried seahorses are also utilized as curios with a high availability in beach resorts and shell shops around the world. Trade surveys and Customs reports indicate that at least 17 species are available as curios, including many species that are unsuitable for TM or aquarium organisms (Table 9). The total global volume of trade in dried seahorses for curios is unknown.

Live specimens for aquaria are imported primarily by North America, Europe, Japan, and Chinese Taipei, with live seahorses also destined for Australia, Hong Kong, and Mexico. The largest exporters of live animals are the Philippines, Indonesia, and Brazil; other exporters include Belize, Egypt and Kenya. Vincent (1996) suggested that up to 1 million seahorses enter the aquarium trade each year, but this is probably an overestimate. More recently, Vincent and Perry (in prep) identified Indonesia and the Philippines as the largest exporters of live seahorses, with several hundred thousand animals exported from each country annually, and some of the primary buyers reporting an annual trade of up to 854,000 animals.

Available global import data indicate that numbers may be much lower, although the large discrepancies are probably due to the limited recording of imports. At least 18 species are traded live for aquaria including four Indo-Pacific species in the *H. histrix* complex and *H. kuda* complex, and two North American species, *H. erectus* and *H. zosterae*. Many of the species in the live trade are also valued for TM (Table 9).

Virtually all seahorses for home aquaria come from the wild, although some captive-bred specimens are now available. Wild seahorses are highly unsuitable aquarium fishes, due to their difficult dietary requirements, high susceptibility to disease, injury during collection and transport, and poor aquarium management at all levels of the trade (Vincent 1996). Although captive-bred seahorses are reported to exhibit better rates of survival in home aquaria, the high cost of these animals (USD 30 - USD 150 for one animal in U.S. markets) may limit their demand and marketability.

Overall, the increased trade in the late 1990s appears to be supported by new source countries entering the trade, as well as increased fishing effort, higher retention of bycatch and greater sale of incidental landings (Vincent and Perry, in prep).

3.3 Illegal trade

Illegal, unreported, and unregulated (IUU) fisheries pose a significant threat to many species of fish, compromise attempts at stock assessment, and have prompted new policies within bodies such as the United Nations Food and Agriculture Organization (FAO). In seahorse fisheries, "illegal trade" has limited meaning because most trading countries do not specifically regulate seahorse harvest or shipment. A number of countries have established specific legislation and regulations affecting the harvest, export and/or import of selected seahorse species (Table 10). However, unreported landings, complicated trade routes, and poorly documented imports in major consuming countries (see below) confound analyses of how successful these measures are in conserving seahorses. For instance, Thailand reported exports to mainland China of 300 kg in 2000 and 4300 kg in 2001, while China import data for Thailand was 1690 kg in 2000 and 1568 kg in 2001 (Table 5; 8). The current understanding of trade volumes, patterns, and participating countries has arisen almost entirely because of independent research by non-governmental organizations (Vincent, 1996). These organizations are likely to cease such efforts because of financial considerations (A. Vincent, pers. comm.), and there is no apparent avenue for documenting illegal or unreported trade in the future.

3.4 Actual or potential trade impacts

A CITES Appendix-II listing for seahorses will contribute to a more accurate understanding of the global trade in seahorses due to permitting and reporting requirements. In addition, a CITES listing will improve the ability to obtain global trade data on a species level, which is critical for understanding the impact of fisheries on local and regional seahorse populations. The listing will clarify and should improve fishery management mechanisms undertaken by exporting countries, and could lead to potential revision of appropriate fishery legislation. Since source countries would have to justify non-detriment findings and show that their export volumes are sustainable, an Appendix-II listing should result in more thorough field monitoring of the resource, collection of fishery-independent and fishery dependent data, and development of conservation programs at local and national levels. This would theoretically include by-catch fishery management to protect seahorses as non-targeted species.

Given that many seahorse fisheries appear to be unsustainable (see Section 2.4), such improved management measures may result in reduced seahorse trade volumes in the near term. However, national and local catches are already declining because of overexploitation and better management practices should lead to sustainable and profitable fisheries over the long-term.

Any significant improvements to seahorse management in developing countries will require continued technical and financial assistance from developed countries. Listing could also help promote certification schemes for environmentally sound collection practices, such as that being implemented by the Marine Aquarium Council.

3.5 Captive breeding for commercial purposes (outside country of origin)

Large-scale captive breeding programs designed to reduce pressure on wild populations have been mostly unsuccessful, due to difficulties in rearing young and the need for repeated removal of adults from the wild to maintain brood stock. Syngnathid culturing has included wild-caught pregnant males that

give birth in captivity and syngnathids mating in captivity, with subsequent births, both of which are relatively easily to achieve. The difficulty comes in rearing large portions of the brood to market size, which usually takes many months to a year, but often results in high mortality due to disease and nutritional problems (Vincent, 1996).

Captive breeding programs existed from the 1950's to the 1980's in China, but economic failure (mainly due to high mortality rates and low productivity) forced closure of many facilities (Vincent 1996). Seahorse culturing was also attempted in the Philippines because indiscriminate fishing was depleting populations, but activities have also been abandoned. Currently some Filipino fishers are placing males into pens, to allow them to give birth prior to export, but survival rates for juveniles are unknown. The Seafarming Development Centre in Sumatra, Indonesia reports success in seahorse culturing (53 percent survival of young), although this facility needs to be critically assessed. Captive breeding operations are underway in Viet Nam, New Zealand, the United States, and Australia, and it appears these are capable of supplying at least limited numbers of live specimens for the pet trade. Fry production technology for *Hippocampus kuda* has been preliminarily established by The Taiwan Fisheries Research Institute (Sheu et al., 2002).

Overall, most seahorse culturing programs have found that breeding seahorses in captivity is relatively simple, but rearing the young is highly problematic due to nutritional problems and disease. Common clinical problems encountered include diseases caused by bacteria, ciliates, fungi, trematodes and other microorganisms and parasites.

4. Conservation and Management

4.1 Legal status

4.1.1 National

Seahorses are included in the French, Portuguese and Viet Namese Red Lists of Threatened Animals; however, trade is still legal. Israel, South Africa and the Australian national jurisdictions of Tasmania and Victoria fully protect all syngnathid species, including seahorses. Other countries, such as China and Slovenia, protect particular species (Table 10).

4.1.2 International

Currently there is no international body or organization responsible for the conservation or management of seahorse fisheries, or international regulation through trade controls.

Recommendations of fishery management options were developed at a recent seahorse workshop and are summarized in Martin-Smith and Vincent (in prep), but these have been tested and implemented only on a small local scale.

4.2 Species management

4.2.1 Population monitoring

There are few long-term scientific survey programs in place in range states to monitor populations of seahorses and the impacts of the seahorse fishery. However, a number of countries have established monitoring programs for coral reef fishes over the last 10 years, and some of these record seahorse abundance. For example, in Hawaii, ornamental fishes including seahorses have been monitored since 1998 in an area targeted by collectors (Tissot and Hallacher, 1999). The Florida Marine Research Institute has also collected fishery dependent and fishery-independent data for seahorses for the last 12 years. This

includes extensive trawl and seine surveys conducted in nine survey areas along the Gulf of Mexico, Caribbean, and Atlantic coasts of Florida. The sampling protocol covers all habitat types utilized by seahorses including seven major estuary systems (Stu Kennedy, Florida Fish and Wildlife Commission, pers. comm). Both of these Florida datasets show abundance and harvest data that vary with no apparent trend (no increase or decrease) since 1991 (http://www.floridamarine.org/features/view_article.asp?id=5063). Reef Check, in collaboration with the Marine Aquarium Council (MAC), developed a monitoring protocol for marine ornamentals (including seahorses) in November 2000 and it is being tested and implemented in countries with aquarium fisheries.

In Australia, the Philippines, Portugal, South Africa and Tasmania, biologists have conducted assessments of seahorse density and population dynamics using transect surveys or grids, but they are limited in spatial and temporal scale (Table 2). In the central Philippines, researchers from Project Seahorse and the Haribon Foundation have studied the seahorse fishery since 1995, and extensive field assessments have been conducted, in particular for the most commonly collected species, *H. comes* (Perante et al., in press).

4.2.2 Habitat conservation

In most jurisdictions with large seahorse fisheries there are few conservation measures in place to protect seahorse habitat. Inshore trawling is banned in Indonesia, Chinese Taipei, and Thailand, and possibly other locations, which may provide protection for seahorses in soft bottom habitats such as grassbeds. In the Philippines, Marine Protected Areas (MPAs) have been found to be an effective strategy for protecting seahorse populations and limited data suggest that heavily fished areas will recover through elimination of heavy fishing pressure but this requires considerable time (Project Seahorse, unpubl. data). An increasing number of MPAs are being established throughout southeast Asia, including Indonesia, Malaysia, the Philippines, Singapore, and Thailand. Nonetheless, there are often conflicting responsibilities for the resources, a lack of coordination among different agencies, limited funding and technical expertise, and/or lack of enforcement (Chou, 2000).

4.2.3 Management measures

Management of syngnathid fisheries is not well developed in most range states because of a lack of information on the biology and population dynamics of most species, and limited reporting of catch data by fishers. In addition, the majority of the harvest and export occurs in developing countries in the tropical Indo-Pacific. Many of these countries lack capacity and financial resources necessary for the development and implementation of sustainable harvest schemes. Human pressures affecting coastal habitats throughout Southeast Asia and the South Pacific need to be addressed through integrated coastal management strategies that are largely lacking throughout the region. Some countries have targeted conservation strategies or management measures, although many occur only on paper, with limited government staffing, operational funding and enforcement capabilities (GCRMN, 2000).

Community-based management systems are having increasing success at conserving and sustainably managing coastal resources and different models are being applied to suit local situations. For example, small-scale community -based seahorse management projects exist in Viet Nam, the Philippines, Australia and other locations. These include (a) no-take Marine Protected Areas (MPAs), (b) holding pens for

pregnant males, to allow them to release young into the sea prior to export, (c) education and outreach, and (d) alternative livelihood programs including low-technology captive breeding (Vincent and Pajaro, 1997). In addition, Project Seahorse has been involved in socio-economic and fisheries research and monitoring, seahorse fishery management, habitat research, and MPA implementation in the Philippines (Project Seahorse, 2001).

While certain initiatives, such as those being undertaken in the Philippines by Project Seahorse are assisting in the conservation of seahorse populations, these are small scale and are limited to few communities. These programs are unlikely to address the growing world-wide seahorse trade due to the scale of the trade, including 1) the large number of range states and locations within individual countries where harvest occurs; 2) the large number of fishers that participate in a seahorse fishery; 3) the prevalence of non-selective trawl fisheries and relative importance of bycatch as a source of TM specimens; and 4) lack of manpower and funding for training, capacity building and enforcement. In particular, the largest exporters of seahorses have few management measures that are designed to protect seahorses at a national level, and unless international regulations are implemented there will be little impetus for these countries to sustainably manage seahorse fisheries.

4.3 Control measures

4.3.1 International trade

Relatively few political entities currently provide measures to limit trade in seahorses at an international level. For example, although export of dried seahorses is banned in India, Mexico and Slovenia and capture and trade of live seahorses are prohibited in India, Mexico, Panama, Slovenia and Thailand (for 3 of 5 native species), it appears that India, Mexico, and Thailand are among the world's largest suppliers of seahorses.

4.3.2 Domestic measures

A recent analysis by Project Seahorse identified 20 countries that control capture and/or trade to varying degrees for dried and/or live seahorses. These measures range from full prohibitions on the take or export to various permitting and licensing schemes (Table 10). In addition, trade is monitored in Australia, China, Hong Kong (SAR), India, Peru, South Korea, Chinese Taipei and USA, although some of this is dependent on voluntary trader declarations (Vincent and Perry, in prep). On January 1, 1998, Australia became the first country requiring permits specifically for exports of syngnathids; permits are only issued for animals derived from approved captive breeding programs, or from the wild under an approved management regime (Moreau, 1997).

5. Information on Similar Species

The taxonomy of seahorses requires additional clarification due to the large numbers of synonyms, several multi-species complexes, and some unnamed species. Four North American, two European and eleven Australian species are well defined, but many Indo-Pacific species are problematic (Lourie et al., 1999). The most heavily fished Indo-Pacific seahorses are often lumped under one of four species (*H. kuda*, *H. histrix*, *H. kelloggi* and *H. trimaculatus*); however, *H. kuda* is a complex of ten species; *H.*

histrix consists of at least four separate species; *H. trimaculatus* may be two separate species; and *H. kelloggi* is not well described (Vincent, 1996).

Morphological characters used to separate seahorses include the number of rays on the dorsal, pectoral and anal fin; presence or absence of spines; snout length; coronet shape; and occasionally, the color pattern. Nevertheless, identification to species based on morphological features alone is difficult, as individual species may exhibit sexual dimorphism and separate reproductively or geographically isolated species may look similar. Species identification may require a combination of genetic data, environmental data, geographic ranges, and habitat information. Two taxonomic references are available to assist in species identification (Lourie et al., 1999; Kuiter, 2000) and FishBase also includes a discussion of diagnostic features (Froese and Pauly, 2000). The proponents have used Lourie et al. (1999) as a standard taxonomic reference for this proposal.

6. Other Comments

6.1 Range State Consultations

(Note: the proponents consulted range states on the concept of listing the entire family Syngnathidae in Appendix II. The results below, and independent advice obtained at the CITES Technical Workshop on Syngnathid Conservation (May 27-29, 2002; Cebu, Philippines), led to the current proposal to list only the genus *Hippocampus*).

Australia: Australia exported 1294 *H. abdominalis*, 32 *H. angustus* and 29 *H. breviceps* in 200-2001 to six countries. Syngnathids are listed as protected marine species under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), which requires that fishers obtain authorization from the Minister of Environment and Heritage to trade or catch these species in Commonwealth waters. No syngnathid species are classified as threatened under the EPBC Act, but five species are listed on the IUCN Red List. Australia does not feel that listing of the whole family can be justified because the vulnerability and status varies between species. However, they do not object to an Appendix II Listing if research shows that an International initiative will aid in their survival, and the CITES Workshop in the Philippines supports protection of particular species under CITES.

Bermuda: There is no significant trade (export or import) of seahorses. However, the Bermuda CITES Authorities support an Appendix II listing. This was independent of and subordinate to the EU position.

Canada: One species of seahorse, *H. erectus* occurs in the North Atlantic. There is no known commercial, recreational or subsistence fishery, and the species is not regulated by the Federal Government. No information is available on abundance, population size, habitat preference, or ecological significance of this species in Canadian waters.

Cayman Islands: There is no local harvesting of syngnathids. Marine Conservation Law prohibits take of any fish less than 8 inches in length. The Cayman Islands CITES Scientific Authority supports an Appendix II listing.

China: Seahorses are harvested in three provinces, with an estimated annual catch of 20 metric tons. China also reports successful seahorse culturing. The government recognizes the importance of conserving seahorses but pointed out that 1) only a few of all syngnathids are in international trade for TM;

2) some species are being successfully bred on farms; and 3) they are unclear how CITES will address bycatch. A decision on the proposal will be made after the CITES Syngnathid workshop.

Cuba: The CITES Management Authority provided a summary of the habitat preference and life history of three species of seahorses that are found in Cuban waters, *H. erectus*, *H. reidi* and *H. zosterae.* They did not indicate whether these species are commercially exploited. They recommend that a separate proposal is developed for each species of concern as the situation for each species may differ.

Hong Kong (SAR): The Agriculture, Fisheries and Conservation Department stated that updated biological and trade information are necessary before determining a suitable and workable conservation plan for seahorses. They state that by-catch in trawling fisheries and loss of habitat are the major threats to syngnathids, and not international trade, and they feel a CITES listing is not the appropriate way to address these threats. Hong Kong Customs and Statistics Department has monitored syngnathid trade since January 1998.

Mauritius: The Ministry of fisheries reports that seahorses are not common, but they occur in lagoon, algal beds and rocky/rubble substrates. They state that seahorses need protection and can be considered for listing in CITES Appendix II.

Norway: The Directorate for Nature Management commented that they had not received any information on Syngnathids, possibly because the taxon is either rare in Norwegian waters, or does not occur there.

Singapore: One species, *H. kuda*, is recognized as being threatened by habitat destruction and harvesting for medicinal use and the aquarium trade and harvest is not allowed except by permit. Singapore would consider supporting a proposal for listing in the Appendices of CITES if there is sufficient scientific evidence to show that they are globally endangered.

Spain: The inclusion of the entire family Syngnathidae in Appendix II of CITES is not appropriate, but Spain would consider the inclusion of some taxa, pending recommendations of the Seahorse workshop.

Sweden: No seahorses are reported to occur in Swedish waters and trade in these species is thought to be minimal, although they do not have any recent documentation. Sweden considers it reasonable to list the entire genus *Hippocampus*, rather than individual species, but does not support a listing for the entire family.

Chinese Taipei: There is no fishery targeting syngnathids, but they are harvested as bycatch. Seahorses are not listed as protected under Chinese Taipei's Wildlife Conservation Law; some of their major habitats are established as protected areas of fisheries resource, however. The Council of Agriculture indicates that seahorses are "not so abundant" and they feel the price of these species would increase if they were listed on Appendix II. An importers business license is required to import dried seahorses.

Thailand: Exports from Thailand to Asian countries tripled between 2000 and 2001; origins of these seahorses are unknown, although they are thought to represent by-catch from trawl fisheries operating outside Thai waters. Thailand states that an increase in exports may be affecting the availability of seahorses in local waters, and they support a CITES Appendix II listing.

Togo: The government feels that the protection of wildlife is of critical importance and they support an Appendix II listing for seahorses.

United Kingdom: The UK supports any Appendix II listing proposal endorsed by the Seahorse Workshop, held in May 2002 in the Philippines.

United States of America: Seahorses occur in a number of states, but the only existing trawl fisheries are in Florida. Florida has established extensive fishery regulations for seahorses and population status is monitored. Seahorses may be harvested for ornamental purposes in Hawaii, but catch data do not indicate landings in the last 6 years. Hawaii monitors populations of ornamental species, including seahorses, off Kona, in an area targeted by ornamental fishers. Seahorses are not currently harvested in U.S. territories on a commercial scale. The USA imports and exports seahorses, with 18 species reported in trade at U.S. ports since 1996. Seahorses have been imported from 24 countries, with most coming from the Philippines, Mexico, Australia and China. Between 1996-2002 a total of 664 kg and 408,219 dried seahorses and 16,341 live seahorses are listed in import records; however, the trade may be largely unreported as shipments are often classified as "tropical fish" only.

Vanuatu: The Environment Unit of Vanuatu indicates that there is no commercial fishery or trade in seahorses. Stock assessments have not been conducted, but the general feeling is that seahorse populations are stable and unexploited. Due to the small size of populations, they feel that seahorses could not support a commercial fishery.

Yugoslavia: Two species of seahorses occur in Yugoslavian waters (*H. antiquorum* and *H. guttulatus*), but both are rare and not reported in commerce. Yugoslavia supports an Appendix II listing for these species.

7. Additional Remarks

Attendees at the CITES Technical Workshop on seahorses and other members of the family Syngnathidae (Cebu, Philippines; 27-29 May 2002) reviewed a working draft of this proposal and discussed it in the context of other potential conservation strategies for seahorses. Attendees included Syngnathid researchers, NGO's, industry representatives, Traditional Chinese Medicine traders, and country representatives. The workshop final report to the Animals Committee recommended listing the entire genus *Hippocampus* in Appendix II of CITES, and made several concomitant recommendations to the Parties and the CITES Secretariat. There were three attendees representing China, Indonesia, and the Hong Kong Chinese medicinal traders who voiced objection to the listing because of poor data on population status, potential increases in illegal harvest, and potential socioeconomic impacts. The workshop recommendations, which addressed such things as capacity building, delayed implementation, and legislative action, were subsequently considered by the Animals Committee and shall be addressed in the Chairman's report prior to COP12.

REFERENCES

Baum, J.K. and I.L. Rosa. *The trade in seahorses in Latin America*. In: Global Trade in Seahorses. Vincent, ACJ and A Perry Eds. *International trade in syngnathids*. Technical workshop on seahorses and other members of the family Syngnathidae Cebu (Philippines), 27-29 May 2002. CITES Doc. 4.1. 34 pp.

Bell, E.M., J.F. Lockyear, J.M. Schulz, A.D.M. Marsden and A.C.J. Vincent. In review. *First field studies of an Endangered South African seahorse, Hippocampus capensis*.

Casey, P.S. 1999. *Conservation genetics of seahorse* (*Hippocampus* species). PhD Thesis, University of London, Queen Mary and Westfield College, England. 190 pp.

Chou, L.K. 2000. *Southeast Asian Reefs- Status update: Cambodia, Indonesia, Malaysia, Philippines, Singapore, Thailand and Viet Nam*. In: Wilkinson C. editor *Status of coral reefs of the world*. 1998. Global Coral Reef Monitoring Network, Australian Institute of Marine Science, Cape Ferguson, Australia, pp. 117-140.

Fratkin, J. 1986. *Chinese herbal patent formulas: A practical guide*. SHYA Publications, Colorado.

Froese, R. and D. Pauly. Editors. 2002. *FishBase*. World Wide Web electronic publication. http://www.fishbase.org

GCRMN. 2000. *Global Coral Reef Monitoring Network's Status of coral reefs of the world: 2000* (C. Wilkinson, ed.), Australian Institute of Marine Science, Cape Ferguson, Australia, 363 pp.

Hilton-Taylor, C. (compiler) 2000. *2000 IUCN Red List of Threatened Species*. IUCN, Gland, Switzerland and Cambridge, UK. xviii + 61pp.

Hilton-Taylor, C. (compiler). In prep. *2002 IUCN Red List of Threatened Species*. IUCN/SSC, Gland, Switzerland and Cambridge, UK.

Kuiter, R.H. 2000. *Seahorses, pipefish and their relatives: A comprehensive guide to Syngnathiformes*. TMC Publishing, UK. 240 pp.

Kuiter, R.H. 2001. *Revision of the Australian seahorses of the genus Hippocampus (Syngnathioformes: Syngnathidae) with a description of nine new species*. Records of the Australian museum. 53:293-340.

Larkin, S.L., C.M. Adams, R.L.Degner, D.J. Lee, J.W. Milon, 2001. *An economic profile of Florida's Marine Life Industry*. Sea Grant Technical Paper N. 113, University of Florida Gainsville, 61 pp.

Lockyear, J.F. 1999. *Proposal to upgrade the threatened status of the Knysna Seahorse, Hippocampus capensis, according to the IUCN Red List criteria*. Submitted to the World Conservation Monitoring Centre (Cambridge, UK). Unpublished report.

Lourie, S.A., A.C.J. Vincent and H.J. Hall. 1999. *Seahorses: an identification guide to the world's species and their conservation*. Project Seahorse, London, UK. x + 214 pp.

Martin-Smith, K and Vincent A.C. J. In prep. *Information requirements for assessing fishery status*. Technical workshop on seahorses and other members of the family syngnathidae Cebu (Philippines), 27-29 May 2002. CITES Doc. 3.1. 21 pp.

Moreau, M. December. 1997. *Australia bans exports of wild-caught seahorses*. SPC Live Reef Fish Information Bulletin #3. Pp. 45-46.

Perante, N.C., A.C.J. Vincent and M.G. Pajaro. 1998. *Demographics of the seahorse Hippocampus comes in the central Philippines*. 3rd International Conference on the Marine Biology of the South China Sea, Hong Kong. Pp. 439-448.

Perante, N.C., M.G. Pajaro, J.J. Meeuwig, and A.C.J. Vincent. In press. *Biology of a seahorse species Hippocampus comes in the central Philippines*. J. Fish. Biol.

Pollard, D.A. 1984. *A review of ecological studies on seagrass-fish communities, with particular reference to recent studies in Australia*. Aquat. Bot. 18:3-42.

Project Seahorse. 2001. *Philippines annual report*. 10 pp.

Sheu et al., 2002. *The propagation techniques on Kuda seahorse, Hippocampus kuda*. The annual report of Taiwan Fisheries Research Institute.

Spalding, M.D., C. Ravilious and E.P. Green. 2001. *World Atlas of Coral Reefs*. University of California Press, Berkeley, 424 pp.

Teixeira, RL; Musick, JA, 2001. *Reproduction and food habits of the lined seahorse, Hippocampus erectus (Teleostei: Syngnathidae) of Chesapeake Bay, Virginia*. Brazilian Journal of Biology [Brazilian J. Biol.], 61 (1): 79-90.

Tipton, K.K. and S. Bell. 1988. *Foraging patterns of two syngnathid fishes: importance of harpacticoid copepods*. Mar. Ecol. Prog. Ser. 47: 31-43.

Tissot, B.N. and L.E. Hallacher. 1999. *Impacts of aquarium collectors on reef fishes in Kona, Hawaii*. Final report, Dept. of Land and Natural resources, Honolulu HI. 32 pp.

Valiela, I. J. L. Bowen and J.K. York. 2001. *Mangrove forests: one of the world's threatened major tropical environments*. Bioscience. 51:807-815.

Vincent, A.C.J. 1990. *Reproductive Ecology of Seahorses*. Ph.D thesis, Cambridge University, England. 101 pp.

Vincent, A.C.J. 1995. *Trade in seahorses for traditional Chinese medicines, aquarium fishes and curios*. TRAFFIC Bulletin. 15(3): 125-128.

Vincent, A.C.J. 1996. *International trade in seahorses*. TRAFFIC International. Cambridge, UK. 163 pp.

Vincent, A.C.J. 1997. *Sustainability of seahorse fisheries*. Proc. 8th Intl. Coral Reef Symp. 2:2045-2050.

Vincent, A.C.J., K.L. Evans and A.D.M. Marsden. *in review*. *A. Home range behavior of the monogamous Australian seahorse, Hippocampus whitei*.

Vincent, A.C.J. and Perry in prep. *International trade in syngnathids*. Technical workshop on seahorses and other members of the family syngnathidae Cebu (Philippines), 27-29 May 2002. CITES Doc. 4.1. 34 pp.

Table 1. Examples of the condition of seahorse habitat in tropical and subtropical countries with large seahorse fisheries. Mangrove data are from Valiela et al., 2001 and * Wolanski et al., 2000). Estimates of reef area are from Spalding et al., 2001 and coral data are from GCRMN, 2000.

Country	% Loss of mangroves (time)	Remaining area of Mangroves (km^2) (year of observation)	Total Area and Condition of Coral Reefs
India	47% (29 years)	3,565 (1992)	5790 km^2. Four major coral reef areas associated with offshore islands. In three areas, 5-45% of reefs destroyed prior to 1998 and 50-90% of coral died in 1998. Only one area remains in good condition (Andaman and Nicobar Islands).
Philippines	70.5% (70 years)	1,325 (1990)	25,060 km^2. 40% of reefs are in poor condition and 29% are good to excellent.
Viet Nam	62% (50 years)	1,520 (1995)	1270 km^2, including 3260 km of coastline and 3000 offshore islands. 1.4% of reefs are excellent, 31% good, 48.6% fair and 37.3% poor. The healthiest reefs are remote form human population centers.
Indonesia*	local losses of 50-80%*	42,500 (2000)	50,000 km^2. 29% of reefs are good to excellent, 31% fair and 40% poor.
Thailand	55% (32 years)	1,687 (1993)	2130 km^2. Reefs primarily in two locations. 1) Gulf of Thailand: 16.4% of reefs are excellent, 29% good, 30.8% fair and 23.8% poor: 2) Andaman Sea: 4.6% excellent, 12% good, 33.6% fair and 49.8% poor.
Malaysia	12% (10 years)	6,424 (1990)	3600 km^2. Best reefs are oceanic reefs at far east coast and the southern Spratleys. Reefs in other locations have experienced considerable declines in coral cover, and an alarming amount of recently dead and shattered corals from blast fishing. In Tunku Abdul Park coral cover declined from 30% in 1994 to 5% in 2000.
Australia	14% (7 years)	10,000 (1990)	50,000 km^2. The Great Barrier Reef in general is in good condition due to relatively low human pressures and remote, offshore location of the reef system. Some nearshore reefs have been degraded from human impacts.
Brazil	46% (14 years)	13,400 (1997)	1200 km^2. Five major coral reef areas. Nearshore reefs degraded as a result of sedimentation, nutrients, and heavy fishing pressure.
Ecuador	21% (12 years)	1,620 (1991)	<50 km^2. No information identified.
China	73% (15 years)	178 (1995)	1510 km^2 (China), 940 km^2 (Chinese Taipei). Reefs have been degraded over the last 10 years from coastal development and pollution, dynamite fishing, trawling. Some species of reef fish, gastropods and crustaceans are becoming locally extinct.
Singapore	66% (7 years)	6 (1990)	< 100 km^2. Most reefs have lost up to 65% of live coral cover since 1986; the best reef, furthest from the mainland, has lost 37% of its coral.

Table 2. Population densities of seahorses determined from field surveys using transects or grids.

Species	Location	Density (#/m^2)	Source
H. guttulatus	Ria Formosa Lagoon, Portugal	0.002-0.383; max 10	J. Curtis, unpubl. Data
H. capensis	South Africa	0.0089-0.22	Bell et al, in review
H whitei	Sydney, Australia	0.08-0.215	Vincent et al., in review
H. comes	Philippines	0.02	Perante et al., 2002
H. abdominalis	Tasmania	0.007	K. Martin-Smith, unpublished data

Table 3. Countries known to catch and/or export seahorses. Codes for each country are as follows: 1) Yes: known catch and/or export; volume unknown; 2) (x) low volume of harvest/trade: < 10 kg (dried) or < 1000 (live) 3) x minor: tens of kg (dried) or thousands (live); 4) xx medium: hundreds of kg (dried) or tens of thousands; 5) xxx major: tonnes (dried) or > 100,000; 6) xxxx dominant: > 10 tonnes (dried). Adapted from Vincent and Perry, in prep.

Country	Catches	Exports	Jurisdiction	Catches	Exports
Argentina	Yes		Nicaragua	Yes	?
Australia	x	x	Nigeria	Yes	x
Bangladesh	Yes	(x)	Pakistan	Yes	
Belize	x	x	Panama	x	
Brazil	xx	xx	Peru	x	xx
China	Yes		Philippines	xxxx	xxx
Costa Rica	Yes	live only	Portugal	Yes	
Croatia	Yes		Senegal	Yes	xx
Ecuador	xx	xx	Seychelles	Yes	Yes
Egypt	Yes	live only	Singapore	?	?
France	Yes		South Korea	Yes	(x)
Gambia	Yes	x	Spain	Yes	
Guatemala	xx	(x)	Sri Lanka	Yes	
Guinea	?	xx	Chinese Taipei	Yes	?
Honduras	xx	xx(past) (x)(now)	Tanzania	xxx	xxx
Hong Kong SAR	(x)	(x)	Thailand	xxxx	xxxx
India	xxxxx	xxxxx	Togo	Yes	x
Indonesia	Yes	Yes	USA	xx	x
Japan	Yes	xxx	Venezuela		Yes
Kenya	x	live only	Viet Nam	xxxx	xxxx
Madagascar	Yes	Yes			
Malaysia	xxx	xx			
Mexico	xxxx	xxx			
Mozambique	Yes	Yes			
Myanmar	Yes	?			
New Zealand	x	Yes			

Table. 4. Number of seahorses landed by commercial fishers in the United States (thousands of animals). Data are from Larkin et al., 2001.

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Florida, USA	5.97	13.98	83.72	71.82	110.95	23.34	19.1	90.1	16.98

Table 5. Seahorse exports from Thailand (kg dried). Data were provided to USFWS by the Department of Fisheries, Thailand.

Importing area	Chinese Taipei	Malaysia	Hong Kong	China	Total
2000	1630	100	1600	300	3630
2001	3848	720	1670	4300	10538

Table 6. Recorded imports of dried seahorses to Hong Kong from 1998-2000.

All data are in kg.

Country of origin	1998	1999	2000
Thailand	4 894	3 608	9 115
Philippines	6 520	7 189	5 874
India	750	1 354	5 536
Indonesia			728
Malaysia		104	659
Senegal	94	270	605
Mainland China			163
Singapore R	414	178	153
Australia	292	132	100
Peru	321	332	96
Guinea	146	158	30
Mexico		140	23
Togo		19	3
USA		60	
Gambia		66	
Total	13 413	13 610	23 085

Table 7. Recorded imports of dried seahorses to Chinese Taipei (1983-2000) with origin, value and volume (kg) per annum.

Origin	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	20
China									1271	1500	823	806	538	455	810	587	7	13
Japan	20	15						75										
Hong Kong	1688	2376	2634	499	788	1346	1121		130	179								
Indonesia						43	168	3	14		50	39		34		22	32	2
Malaysia	120	213	144	100	41	127	506	597	469	350	129	236		194	64	302		
Singapore	96	297	186	16	140	271	45	36	145	22		136	32			113	49	
Philippines	115			480	1050	1191	1297	640	1258	1858	1770	1830	1575	290	136	196	321	8
Thailand	2844	2909	1948	3043	2796	4120	5854	4046	5703	7903	8150	8069	7322	9399	8886	6144	6043	86
Viet Nam							10	258		20	384	140	39	27			81	1
Other Asian							1317	1564	1369									
Italy		30																
USA		123	160	76		5		18		111								
Ecuador				7														
Surinam																		2
Other	746							35										
Total (kg)	5629	5963	5072	4221	4815	7103	10318	7272	10359	11943	11306	11256	9506	10399	9896	7364	6533	115
Total Value (USD1000)	637.2	742.3	621.1	459.6	449.6	463.9	585.5	355.3	562.3	644.9	831.3	697.7	669.2	466.8	580.7	513.7	344.9	4
Mean Price (USD/kg)	113	124.5	147.1	108.9	93.4	65.3	56.7	48.9	54.3	54.0	73.5	62.0	70.4	44.9	58.7	69.8	52.8	3

Source: Chinese Taipei trade statistics

Table 8. Import data of dried seahorses and pipehorses for mainland China

Year	Source	Quantity (kg dried)
1992	Hong Kong, Japan, Philippines, Thailand Australia, other	15,333
1993	Hong Kong, India, Indonesia, Singapore, Thailand	7,708
1994	Hong Kong, Macao, Indonesia, Singapore, Thailand, Australia	14,545
1995	Hong Kong, Indonesia, Thailand, Singapore	3,815
1996	Indonesia, Japan, Singapore, Thailand	4,904
1997	India, Indonesia, Japan, Thailand, Chinese Taipei	2,290
1998	No data	
1999	Indonesia	184
2000	Thailand	1690
2001	Thailand	1568

Table 9. List of Syngnathid species observed or reported to be traded, dried for traditional medicine (TM), dried as curios or live for aquariums. Trade from those countries listed with an * may consist of a complex of these species. Compiled from Vincent and Perry, in prep; Vincent, 1996; and Lourie et al., 1999.

Species	TM	Curio	Live	Important exporting countries
H. abdominalis		x	x	Australia
H. algiricus?	x			West Africa (Gambia and Senegal)
H. angustus			x	Australia
H. barbouri	x	x	x	Philippines, Malaysia
H. borboniensis	x	x		Africa
H. breviceps			x	Australia
H. camelopardalis	x	x	x	South Africa
H. comes	x	x	x	Philippines
H. erectus		x	x	USA; Mexico and Brazil; Western Atlantic
H. fuscus	x	x	x	India
H. guttulatus		x	x	Senegal, Portugal, Croatia
H. hippocampus		x		Guinea, France?,Portugal? Spain?
H. histrix	x	x	x	Thailand*, Philippines*
H. ingens	x	x	x	Pacific coast of Latin America; Mexico and Ecuador
H. kelloggi	x	x		Southeast Asia
H. kuda	x	x	x	India, Thailand*, Indonesia*, Sri Lanka
H. mohnikei	x		x	Japan, Viet Nam
H. reidi		x	x	USA, Mexico and Brazil; Western Atlantic
H. spinosissimus	x	x	x	Indonesia, Viet Nam, Philippines
H. subelongatus			x	Australia
H. trimaculatus	x			Viet Nam, Philippines, China
H. whitei	x			Australia
H. zosterae			x	USA
Total	14	15	17	

Table 10. Summary of regulations affecting *Hippocampus* spp. Data are compiled from Range State Consultations submitted to the US FWS in 1999 and 2002, a review of fishery management plans available electronically, and Vincent and Perry (in prep).

Country	Conservation measures
Australia	Seahorses are listed as protected marine species under the *Environment Protection and Biodiversity Conservation Act (1999)* and permits are required for exports of syngnathids derived from approved captive breeding programs, or from the wild under an approved management regime. Seahorses are currently exported from Victoria, Queensland, South Australia, Western Australia, and Northern territory. Several syngnathids are listed as endangered.
Bermuda	Non- specific harvest regulations that affect seahorses, including a ban on the aquarium fish trade.
Canada	Seahorses are not regulated by licenses or quotas and no import data are collected.
Cayman Islands	No harvest of any fish under 8 inches allowed.
China	*H. kelloggi* is listed as threatened and permits are required for trade.
Ecuador	Export permits required.
European Union	The genus *Hippocampus* is listed in EC regulation 338/97 Appendix D.
France	Illegal to import tropical species under the name *H. kuda*; *H. guttulatus* is listed as threatened.
Hong Kong	The Traditional Chines Medicine community is adopting voluntary conservation measures for the long-term sustainable use, including 1) minimum sizes; 2) seasons; and 3) using substitutes in prescriptions when possible.
India	All seahorses listed on schedule 1 of the Wildlife Protection Act in July 2001, which prohibits capture of seahorses; export permits required.
Indonesia	Inshore trawling is banned. Permits for harvest and trade issued by local governments; exporters have an Ornamental Fishery Permit issued by the Ministry of Marine and Fishery for 5 year duration. No limit on harvest level; no special fishing methods and no monitoring has been undertaken.
Israel	Trade in Red Sea seahorses forbidden; the entire family syngnathidae is proposed for full listing protection.
Mexico	Export is banned; targeted capture of live animals prohibited.
Portugal	*H. hippocampus* and *H. ramulosus* are listed as threatened.
Panama	Collection of seahorses is banned.
Singapore	*Hippocampus kuda* is classified as vulnerable under the Singapore Red Data Book. This species is protected under national legislation and collection is only allowed by permit.
Slovenia	*H. guttulatus* protected under Government Order on the Protection of Threatened Animals Species (October 1993), which prohibits trade and prohibits keeping them in captivity.
South Africa	Harvest of *H. capensis* is illegal without permit from Cape Nature Conservation (CNC) under CNC Ordinance 19, 1974. All syngnathids protected from harvest and disturbance except with permit (Draft Regulations of the Marine Living Resources Bill and Sea Fisheries Act 1988). *H. capensis* is listed as threatened. Export permits required for all seahorses.

Chinese Taipei	Inshore trawling is banned. Seahorses are not listed as protected species, but some of their habitats (Kenting and Green Island) are established as protected areas of fisheries resource.
Thailand	Inshore trawling within 3 km of the shore is banned. Export of live marine ornamentals including 3 species of seahorses is banned.
Ukraine	*H. guttulatus microstephanus* is listed as threatened.
U.S.A.	Managed fishery for *H. zosterae* and *H. erectus* in Florida. Take of seahorses for the aquarium trade is prohibited in the USVI and Puerto Rico.
Viet Nam	*H. histrix*, *H. japonicus*, *H. kelloggi*, *H. kuda* and *H. trimaculatus* listed as vulnerable in National Red Data Book. Seahorse fishery began in 1998; Annually, Viet Nam exports at least 5 metric tonnes of dried seahorses (one kilogramme of seahorses comprises about 300-400 individuals) and there is also a domestic seahorse tonic trade. Current supply does not meet demand and the heavy exploitation has resulted in catch consisting of fewer and smaller seahorses.

APPENDICES

A. Species of *Hippocampus*

There are 32 recognized species in the genus *Hippocampus*, as determined from morphometric and genetic analyses (Lourie et al., 1999). 2002 IUCN Status for seahorses is included (Hilton-Taylor in prep.)

Taxa	Range and comments	IUCN Red List Category
Hippocampus abdominalis Lesson, 1827	Southwest Pacific: Australia and New Zealand	VU A2cd
Hippocampus algiricus Kaup, 1856	Mediterranean and Eastern Atlantic: Algeria, Benin, Côte d'Ivoire, Gambia, Ghana, Guinea, Liberia, Nigeria, Sao Tome and Principe, Senegal, Sierra Leone.	DD
Hippocampus angustus Günther, 1870	Australia.	DD
Hippocampus barbouri Jordan and Richardson, 1908	Southeast Asia including the Philippines, Malaysia.	VU A4cd
Hippocampus bargibanti Whitley, 1970	Southeast Asia and western Pacific including: Australia Indonesia, New Caledonia, Papua New Guinea; found only on gorgonians of the genus *Muricella* from 10 to 60m depth.	DD
Hippocampus borboniensis Duméril, 1870	Red Sea and Indian Ocean: Madagascar, Mauritius, Mozambique, Réunion, South Africa, Tanzania.	VU A2cd
Hippocampus breviceps Peters, 1869	Australia, west and south coast.	DD
Hippocampus camelopardalis Bianconi, 1854	Red Sea and Indian Ocean: Mozambique, South Africa, Tanzania.	VU A2cd
Hippocampus capensis Boulenger, 1900	Indian Ocean: South Africa. The species has a restricted and fragmented distribution, only occurring in a few estuaries.	EN B1+2c+3d
Hippocampus comes Cantor, 1850.	Southeast Asia: Malaysia, Singapore, Viet Nam and Philippines.	VU A2cd
Hippocampus coronatus Temminck & Schlegel, 1850	Japan, Viet Nam.	VU A2cd
Hippocampus erectus Perry, 1810	Caribbean, western Atlantic, Nova Scotia to Brazil: Anguilla, Antigua and Barbuda, Argentina, Aruba, Bahamas, Barbados, Belize, Bermuda, Brazil, Canada, Cape Verde, Cayman Islands, Colombia, Cuba, Dominica, Dominican Republic, Grenada, Guadeloupe, Guatemala, Haiti, Martinique, Mexico, Montserrat, Netherlands Antilles, Panama, Puerto Rico, Saint Helena, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Sao Tome and Principe, Suriname, Trinidad and Tobago, Turks and Caicos Islands, United States, Uruguay, Venezuela.	VU A2cd

Hippocampus fisheri Jordan and Evermann, 1903	Australia, Hawaii, New Caledonia.	DD
Hippocampus fuscus Rüppell, 1838	Indian Ocean and Red Sea: Saudi Arabia, Djibouti, and Sri Lanka. *Records from South Africa, Madagascar, Mauritius and Réunion are questionable.*	VU A2cd
H. guttulatus Cuvier, 1829	Mediterranean and Eastern Atlantic: Netherlands, England, France, Spain, Portugal, Senegal, Morocco, Italy, Malta, Croatia, Greece, Cyprus.	VU A2cd
Hippocampus hippocampus Linnaeus, 1758	Mediterranean and Eastern Atlantic: Albania, Algeria, Benin, Bosnia and Herzegovina, Bulgaria, Cameroon, Canary Islands, Côte d'Ivoire, Croatia, Cyprus, Egypt, Equatorial Guinea, France, Gambia, Georgia, Ghana, Gibraltar, Greece, Guinea, Guinea-Bissau, Israel, Italy, Lebanon, Liberia, Libyan Arab Jamahiriya, Mauritania, Monaco, Morocco, Netherlands, Nigeria, Portugal, Russian Federation, Senegal, Sierra Leone, Slovenia, Spain, Syrian Arab Republic, Togo, Tunisia, Turkey, Ukraine, United Kingdom, Western Sahara, Yugoslavia	VU A2cd
Hippocampus histrix Kaup, 1856	Indo-Pacific: Tanzania and South Africa to Hawaii and Tahiti, north to Japan, south to New Caledonia, including China, Egypt, French Polynesia, Guam, Indonesia, Japan, Malaysia, Mauritius, Micronesia (Federated States of), Mozambique, New Caledonia, Papua New Guinea, Philippines, Réunion, Samoa, Seychelles, South Africa, Chinese Taipei, Tanzania, Tonga, United States: Hawaii, Viet Nam. Reported from the Arafura Sea.	DD
Hippocampus ingens Girard, 1858	Eastern Pacific from California to Peru: Colombia, Costa Rica, Ecuador: Ecuador, Galapagos, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru, United States	VU A2cd
Hippocampus jayakari Boulenger, 1900	Red Sea and Indian Ocean: Israel, Oman, Pakistan	VU A2cd
Hippocampus kelloggi Jordan & Snyder, 1901	Red Sea, Indian Ocean, Southeast Asia and Australia: from East Africa and the Red Sea to Japan and Lord Howe Island, Australia. *Deep water species.*	DD
Hippocampus kuda Bleeker, 1852	Indo-Pacific: Pakistan and India to southern Japan, Hawaii, and the Society Islands, including American Samoa, Australia, Cambodia, China, Egypt, Fiji, French Polynesia, Hong Kong, India, Indonesia, Japan, Kenya, Korea, Republic of, Madagascar, Malaysia, Maldives, Mauritius, Micronesia (Federated States of), Mozambique, New Caledonia, Pakistan, Palau, Papua New Guinea, Philippines, Samoa, Singapore, Solomon Islands, South Africa, Chinese Taipei, Thailand, Tonga, United States: Hawaiian Is, Viet Nam. This name is used for maybe 10 distinct species in the Indo-Pacific.	VU A2cd
Hippocampus lichtensteinii Kaup, 1856	Red Sea and Western Indian Ocean: Little known species *(if type locality is in error it may be synonymous with H. zosterae).*	DD
Hippocampus minotaur Gomon, 1997	Only known from southeastern Australia; prefers deepwater (64-110 m depth).	DD

Hippocampus mohnikei Bleeker, 1854	Southeast Asia: Japan and Viet Nam; occurrence along Chinese coast needs confirmation.	VU A2cd
Hippocampus reidi Ginsburg, 1933	Western Atlantic: from Cape Hatteras, North Carolina and Florida (USA) to Rio de Janeiro, Brazil, including Bahamas, Barbados, Bermuda, Columbia, Cuba, Grenada, Haiti, Jamaica, Uruguay, Venezuela.	VU A2cd
Hippocampus sindonis Jordan & Snyder, 1901	Japan	VU A2cd
Hippocampus spinosissimus Weber, 1913	Indo-Pacific: from Sri Lanka to Chinese Taipei, including Australia, Malaysia, Philippines, Indonesia, Singapore, Viet Nam.	VU A2cd
Hippocampus subelongatus Castelnau, 1873	Southwest Australia.	DD
Hippocampus trimaculatus Leach, 1814	Indo-Pacific, from southern India to Japan, Australia and Tahiti: China, Indonesia, Malaysia, Philippines, Singapore, Thailand, Viet Nam.	VU A1cd+2cd
Hippocampus whitei Bleeker, 1855	Southwest Pacific: Solomon Islands and southeast Australia. Records from southern Mozambique and Natal, South Africa are misidentifications of *H. camelopardalis*.	VU A2cde
Hippocampus zebra Whitley, 1964	Northwestern Australia	DD
Hippocampus zosterae Jordan & Gilbert, 1882	Western Atlantic: Bermuda, southern Florida (USA), Bahamas and the entire Gulf of Mexico, Cuba.	VU A2cd

B. Scientific Synonyms

Taxonomy is particularly problematic for some species when identification is based solely on morphological characteristics. The North American (*Hippocampus erectus*, *H. ingens*, *H. reidi*, *H. zosterae*), European (*H. hippocampus*, *H. guttulatus*) and most Australian (*H. abdominalis*, *H. angustus*, *H. bargibanti*, *H. breviceps*, *H. minotaur*, *H. spinossissimus*, *H. whitei*, *H. zebra*) seahorses are moderately well defined but the Indo-Pacific species are difficult to classify. Trade data for a number of smooth and spiny seahorses from the Indo-Pacific are often lumped under the species *H. kuda* and *H. histrix* (respectively); *H. kuda* includes a complex of at least six species and another four species are closely related based on genetic data, and at least five geographically restricted spiny seahorses may be reported as *H. histrix* (Lourie et al., 1999).

APPENDIX II

International Workshop On Seahorse Fishery Management
Mazatlan, Mexico

WORKING PROGRAM

Tuesday February 3, 2003

Opening ceremony 8:30 – 9:15

1. Welcome and opening remarks (Francisco Giner de los Ríos or Georgita Ruiz, SEMARNAT)
2. Background to the workshop – CITES and seahorses (John Field, U.S. Fish and Wildlife Service)
3. Adoption of the Agenda and working programme (Oscar Ramírez, SEMARNAT)

Background presentations (Chair: Andy Bruckner)

4. Biology and fisheries 9:15 – 10:00
    - 4.1. Taxonomy and distribution (Sarah Foster, Project Seahorse)
    - 4.2. Seahorse biology and vulnerability (Sarah Foster, Project Seahorse)
5. Seahorse fisheries and by-catch (Keith Martin-Smith, Project Seahorse) 10:00 – 10:30
6. Trade in seahorses (Amanda Vincent, Project Seahorse) 10:30 – 11:15

Break 11:15 – 11:30

7. CITES requirements for Appendix-II trade (Tom de Meulenaer, CITES Secretariat) 11:30 – 12:30
    - 7.1. Role of CITES authorities
    - 7.2. Application of CITES Article IV (legal acquisition and non-detriment findings)
    - 7.3. Information needs
    - 7.4. Enforcement
    - 7.5. Signficant Trade Review

Lunch 12:30 – 13:30

Practical application of CITES to seahorse trade (Chair: Hesiquio Benitez)

8. Determining if trade is non-detrimental under CITES
    - 8.1. Universal minimum sizes (Amanda Vincent, Project Seahorse) 13:30 – 14:00
        - CITES decisions regarding minimum sizes and their utility
        - Refining the recommended universal minimum size limit.
        - Factors for natural height to trade height conversions.
    - 8.2. Monitoring seahorse populations for sustainable export fisheries 14:00 – 14:30 (Andy Bruckner, U.S. National Marine Fisheries Service)

9. Identification manual (Ernie Cooper, TRAFFIC North America) 14:30 – 15:00

Break 15:00 - 15:15

10. National reports on seahorse fisheries (15 min. each) 15:15 – 17:45
    - 10.1. Philippines
    - 10.2. Indonesia
    - 10.3. Thailand
    - 10.4. Australia
    - 10.5. Viet Nam

Break 16:30 – 16:45

    - 10.6. India
    - 10.7. Mexico
    - 10.8. Brazil
    - 10.9. United States
    - 10.10. China

Assignment to Working Groups 18:00 – 18:15

End of activities for the day 18:30

Wednesday February 4, 2003

11. Working Group sessions (Chair: Oscar Ramírez)

Working Group 1: Elements of a functional national management program and ensuring adequate information for non-detriment findings
- Assessing *Hippocampus* bycatch and directed fisheries, in order to recognise detriment and identify management actions.
- Fishery-independent population surveys (design, gear, execution)
- Collecting information on fishermen, exporters, and other traders

Working Group 2: Enforcement of a CITES listing (Chair: Ernie Cooper)
- Tracking, labelling and monitoring to distinguish captive-bred from wild-caught animals.
- Sampling procedures for enforcement officers handling large volumes of *Hippocampus*.

Working Group 3: Non-detriment findings (NDFs) (Chair: John Field)
- Making NDFs for *Hippocampus* aquaculture and captive breeding operations.
- Making NDFs for smaller species, with maximum adult size below the recommended universal minimum size.
- Making NDFs for *Hippocampus* populations caught in non-selective fishing gear.

Working Groups meet 9:00 – 13:00

Lunch	13:00 – 14:00
Working Groups meet	14:00 – 18:00
End of activities for the day	18:00

Thursday February 5, 2003

Working Groups meet	9:00 – 13:00
Lunch	13:00 – 14:00
12. Working group reports (aprox. 30 min. each WG)	14:00 – 15:30
Break	15:30 – 16:00
13. Conclusions	16:00 – 17:00
13.1. Summary of workshop recommendations (Hesiquio Benitez)	
13.2. National priorities after the workshop (1 delegate from each country to summarize how workshop will apply to their national priorities for seahorses)	
14. Closure of the workshop	17:00 – 17:15

APPENDIX III

List of Participants

AUSTRALIA

Keith Martin-Smith
School of Zoology, University of Tasmania,
Private Bag 05
Hobart, Tasmania 7001
Australia.
T: (613) 6226-2522
F: (613) 6226-2745
keith.martinsmith@utas.edu.au

BRAZIL

Ierece Rosa
Universida de Federal de Paraiba,
CCEN, Departmento de Sistematica e Ecologia,
CIDADE Universitaria,
58058-800 Joao Pessoa, PB
Brazil
T: 55-83-216-7472
F: 55-83-216-7775 / 7768
ierece@dse.ufpb.br

CANADA

Julia Baum
Department of Biology, Dalhousie University,
Halifax, NS, B3H 4J1,
Canada
T: 1-902-494-3910
F: 1-902-494-3736
juliabaum@hotmail.com

Ernie Cooper
Canadian Representative of TRAFFIC North America.
Apt. 707 1050 Harwood St.
Vancouver, BC,
Canada
T: (604) 682-7077
ecooper@wwfcanada.org

Sarah Foster
Project Seahorse
University of British Columbia, Fisheries Center
2204 Main Mall
Vancouver, BC V6T 1Z4
Canada
T: 604 827 5141
F: (604) 827-5199
s.foster@fisheries.ubc.ca

Amanda Vincent
Project Seahorse
University of British Columbia Fisheries Center
2204 Main Mall,
Vancouver, BC V6T 1Z4
Canada
T: (604) 827 5139
F: (604) 827-5199
a.vincent@fisheries.ubc.ca

CHINA

Zhi Yong Fan (sent national report)
CNMA, State Forestry Administration,
18 Hepingli Dongjie
Beijing 100714,
China
T: 86-10-8423-9001
F: 86-10-6421-4180
zhiyongfan@21cn.com

INDIA

Shekhar Kumar Niraj
Regional Deputy Director & Assistant Mgt.
Authority - C I T E S
Western Region
Ministry of Environment & Forests
11 Air Cargo Complex Sahar
Mumbai 400099. India
T: 91-22-26828184 (OFF.)
91-22-23677052 (RES.)
F: 91-22-26828184
skniraj@vsnl.com
niraj@md4.vsnl.net.in

MEXICO

Serafin Almenara Roldan
AZOO Mexico, S. A. De C. V.
Pedro Luis Ogazón #9, Col. Vallejo,
Mexico, 07870 D. F.
T: (5255) 2123-4040
F: (5255) 5574-6410
azoomexico@prodigy.net.mx

Jorge Alvarez Romero
CONABIO.
Liga Periférico-Insurgentes Sur 4903
Parques del Pedregal Tlalpan 14010,
Mexico D.F.
T: (5255) 5528-9145
F: (5255) 5528-9170
jalvarez@xolo.conabio.gob.mx

Benjamín Barón Sevilla
CICESE Km. 107 Carretera Tijuana – Ensenada,
Baja California, Mexico
T: (646) 175-0500
F: (646) 175-0534
bbaron@cicese.mx

Ricardo Belmontes Acosta
Comisión Nacional de Acuacultura y Pesca.
Av. Camarón Sábalo s/n esq. Tiburón, col. Sabalo
Coutry, Mazatlan, Sinaloa, Mexico.
T: (669) 913-0940
F: (669) 913-0935
rbelmontes@conapesca.sagarpa.gob.mx

Hesiquio Benítez Díaz
CONABIO.
Liga Periférico-Insurgentes Sur 4903
Parques del Pedregal Tlalpan 14010,
Mexico D. F.
T: (5255) 5528-9125
F: (5255) 5528-9170
hbenitez@xolo.conabio.gob.mx

Paloma Carton de Grammont Lara
Instituto Nacional de Ecología. Periférico Sur #
5000, Col. Insurgentes Cuicuilco, Mexico, D.F.
T: (5255) 5424-6448
palomac@ine.gob.mx

Lilia Durán Salguero
Instituto Nacional de Pesca.
Pitagoras # 1320 Col. Santa Cruz Atoyac,
Mexico 03310 D.F.
T: (5255) 0155-5604
F: (5255) 0155-2352
lilydusa@yahoo.com.mx

Martha Aurea Estrada Jimenez
Dirección de Asuntos Pesqueros Internacionales,
CONAPESCA. Av. Camarón Sabalo s/n esq.
Tiburón, Col. Sabalo Coutry, Mazatlan, Sinaloa,
Mexico.
T: (669) 913-0940
F: (669) 913-0935
mestradaj@conapescasagarpa.gob.mx

Patricia Fuentes Mata
Instituto Nacional de Pesca.
Pitagoras # 1320 Col. Santa Cruz Atoyac,
Mexico 03310 D.F.
T: (01 55) 5422-3064
F: (01 55) 5604-2352
pfmata@yahoo.com.mx

Norma Eréndira García Núñez
Dirección General de Vida Silvestre SEMANART.
Av. Revolución # 1425 5° Nivel Col. Tlacopac San
Angel. México 01040 D. F.
T: (5255) 5624-3509
F: (5255) 5624-3642
erendira.garcia@semarnat.gob.mx

José Antonio Martínez Hernández
Acuario de Veracruz. Blvd. Avila Camacho s/n
Playon de Hornos Veracruz,
Veracruz. Mexico.
T: (01-229) 932-8006 ext. 110
F: (01-229) 931-1020
especies@acuariodeveracruz.com

Paola Mosig Reidl
CONABIO.
Liga Periférico-Insurgentes Sur 4903 Parques del
Pedregal Tlalpan 14010, Mexico D. F.
T: (5255) 5528-9125
F: (5255) 5528-9170
pmosig@xolo.conabio.gob.mx

Judith Núñez Lecuanda
Cerro de Jesus # 118 Fraccionamiento Lomas de Mazatlán, Mazatlán, Sinaloa. Mexico.
T: (01-669) 983-8699
judith_mazatlan@yahoo.com

Arturo Peralta Delgado
Comisión Nacional de Pesca y Acuacultura (CONAPESCA),
Dirección General de Ordenamiento Pesquero y Acuícola, Av. Camarón Sabalo s/n esq. Tiburón, col. Sabalo Coutry, Mazatlan, Sinaloa, Mexico.
T: (01-669) 913-0926
F: (01-669) 913-0921
aperaltad@conapesca.sagarpa.gob.mx

Vladimir Pliego Moreno
Procuraduria Federal de Protección al Ambiente,
Ajusco 200 Jardines de la Montaña
Mexico, D. F.
T: (5255) 5449-6324
F: (5255) 2615-2093
vpliego@correo.profepa.gob.mx

Oscar Manuel Ramirez Flores
Dirección General de Vida Silvestre
SEMANART,
Av. Revolución # 1425 4° Nivel
Col. Tlacopac San Angel. Mexico 01040 D. F.
T: (5255) 5624-3509
F: (5255) 5624-3642
oscar.ramirez@semarnat.gob.mx

Samuel Ramos Carrillo
CONAPESCA
Av. Camarón Sabalo s/n esq. Tiburón, col. Sabalo Coutry, Mazatlan, Sinaloa, Mexico.
T: (669) 913-0922
F: (669) 913-0935
sramosc@conapesca@sagarpa.gob.mx

Marcela Romero
IFAW Latin America.
Prolongación Angelina 10, Guadalupe Inn, 01020, Mexico, D.F.
T: (5255) 5661-0166
F: (5255) 5662-9205
mromero@ifaw.org

Georgita Ruíz Michael
Dirección General de Vida Silvestre, SEMANART,
Av. Revolución # 1425 1° Nivel,
Col. Tlacopac San Angel,
Mexico 01040 D. F.
T: (5255) 5624-3310
F: (5255) 5624-3642
georgita.ruiz@semarnat.gob.mx

Liliana Urbina
IFAW Latin America.
Prolongación Angelina 10,
Guadalupe Inn, 01020,
Mexico, D.F.
T: (5255) 5661-0166
F: (5255) 5662-9205
lurbina@ifaw.org

José Francisco Zamora Carmona
Secretaria de Relaciones Exteriores
Dirección General de Temas Globales,
Av. Reforma 255 6° Piso,
Col. Cuauhtémoc,
Mexico 06500 D.F.
T: (5255) 5063-3000 ext. 2087
F: (5255) 9157-4251
jzamora@ser.gob.mx

Eliezer Armando Zúñiga Villarreal
Cerro de Jesus # 121 Fraccionamiento Lomas de Mazatlán,
Mazatlán, Sinaloa. Mexico.
T: (01-669) 983-1024
F: (01-669) 986-8411
zea79@yahoo.com

PHILIPPINES

Noel Barut
National Fisheries Research and Development Institute,
940 Quezon Ave., Quezon City, 1103,
Philippines
T: 63-2-372-5063, 373-6336
F: 63-2-372-5063
nbarat@nfrdi.da.gov.ph