CASE STUDY: *HIPPOCAMPUS* SPP. PROJECT SEAHORSE

AUTHOR:
Sarah Foster
Project Seahorse. The University of British Columbia.

I. Background information on the taxa

1. BIOLOGICAL DATA

1.1 Scientific and common names

Seahorses comprise one genus (*Hippocampus*) of the family Syngnathidae, which consists of about 52 genera of pipefishes, pipehorses and seadragons.The CITES Nomenclature committee currently recognizes about 39 species of seahorse, based on morphometric and genetic analysis, although a few more species may emerge from further taxonomic research. The vast majority of seahorse species, and certainly populations, have not been studied adequately in the wild.

Although easily recognised as a group, many seahorse species are superficially similar in appearance. The problems regarding species identification and the large number of names in the literature (over 130) means that seahorse names are often unreliable. It is imperative to employ taxonomies that are precise and unambiguous about features that distinguish species, and that use original (type) specimens for their source data, as significant overlap among characters or dependency on photographic sources is problematic.

Effective implementation of the CITES listing will require that government authorities and other stakeholders be able to identify seahorse species that are utilized in international trade. Project Seahorse and Traffic North America developed an ID guide for seahor-

[1] The complete guide can be found at http://seahorse.fisheries.ubc.ca/pdfs/IDguide/Seahorse_ID_Guide_2004.pdf

ses to help meet this need. It is recommended that individuals use *A Guide to the Identification of Seahorses*[1] when identifying seahorses (Lourie et al. 2004).

1.2. Distribution

Seahorses occupy both temperate and tropical coastal waters, with a distribution from about 50 degrees north to 50 degrees south. Distribution maps by species can be found in the Project Seahorse and Traffic North America publication *A Guide to the Identification of Seahorses* (Lourie et al. 2004).

1.3 Biological characteristics

1.3.1 *General biological and life history characteristics of the species*
The following is drawn from a published review of the biology and ecology of seahorses (Foster & Vincent 2004). Primary references to all statements can be found therein.

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:

- Production of few young per breeding cycle limits the potential reproductive rate, although this may be offset by advanced development of the young when they leave the pouch
- Male pregnancy means that young seahorses depend on parental survival for far longer than is the case among most fish
- Monogamy in most species studied means that widowed animals stop reproducing until they find a new partner
- Low population density means that lost partners are not quickly replaced
- Monitoring of known individuals suggests that natural rates of adult mortality may be low, making fishing a new pressure
- Low adult mobility and small home ranges in many species may restrict the recolonisation of depleted areas, although juveniles may be the primary dispersers

Seahorse research has made great advances, but much more needs to be learned about key life history parameters such as natural mortality, growth rates and juvenile dispersal.

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.

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. 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.

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).

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.

Movement
Most seahorse species studied to date exhibit high site-fidelity and small home range sizes, at least during the breeding season.

1.3.2 *Habitat types*
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.

1.3.3 *Role of the species in its ecosystem*
Seahorses are a group of charismatic fishes that serve as flagship species for marine conservation. Little is known, however, regarding their functional role in the ecosystem. In order to increase understanding of seahorses role in marine food webs, Project Seahorse has begun to document reports of seahorses and other syngnathids as prey (Blight & Vincent in prep). In some places, the importance of syngnathids as food for marine animals seems to be increasing – for example, in recent years there has been a change in diet of nesting seabirds from forage fish to pipefish, likely in response to environmental change/disappearance of preferred prey species (Harris et al. 2007).

1.4 Population

1.4.1 *Global Population size*
Current population sizes for most, if not all, seahorse species are unknown.

1.4.2 *Current global population trends*
___increasing _X_decreasing ____ stable _X_unknown

See details in Section 1.5.1 "Global Population Size"

1.5 Conservation status

1.5.1 *Global conservation status (according to IUCN Red List)*

___Critically endangered
_X_Endangered
_X_Vulnerable
___Near Threatened
___Least concern
_X_ Data deficient

Globally, nine seahorses species are listed as Vulnerable on the IUCN Red List (World Conservation Union (IUCN) 2006), based on observed, estimated, inferred or suspected population declines of 30% (Tables 1 and 2). Each of these species is found in trade. These declines are attributed to changes in area of occupancy, occurrence, habitat and levels of exploitation.

The majority of seahorses species (23) are listed as Data Deficient, which means there exists inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status (Tables 1 and 2). 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.

Table 1. Summary table of the IUCN Status for seahorses.

Category	**# Species in category**	**# Species In Trade**	**Criteria**
EN B1+2c+3d	1	0	Extent of occurrence <5000 km^2 or area of occupancy <500 km^2; known to exist in <5 locations; decline in area, extent and/or quality of habitat; fluctuation in the number of locations or subpopulations
VU A2cd	2	2	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.
VU A4cd	7	7	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.
DD	23	15	Inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status.
na	6		not assessed
totals	39	24	

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

Species	IUCN Global Assessment	Assessment Year	Live Trade	Dried Trade	Comments
abdominalis	DD	2006	yes	yes	dried as curio
alatus	na				
algiricus	DD	2002	no	no	
angustus	DD	2002	yes	yes	
barbouri	VU A4cd	2002	yes	yes	common TM species
bargibanti	DD	2003	no	no	
biocellatus	na				
borboniensis	DD	2003	yes	yes	
breviceps	DD	2005	yes	no	
camelopardalis	DD	2003	yes	yes	
capensis	EN B1+2c+3d	2000	no	no	
comes	VU A2cd	2002	yes	yes	common TM species
coronatus	DD	2003	yes	no	
denise	DD	2003	no	no	
erectus	VU A4cd	2003	yes	yes	
fisheri	DD	2003	no	no	
fuscus	DD	2003	yes	yes	
guttulatus	DD	2003	yes	yes	
hippocampus	DD	2003	yes	yes	
histrix	DD	2002	yes	yes	common TM species
ingens	VU A4cd	2003	yes	yes	
jayakari	DD	2003	no	no	
jugumus	na				
kelloggi	DD	2002	yes	yes	common TM species
kuda	VU A4cd	2003	yes	yes	common TM species
lichensteinii	DD	2002	no	no	
minotaur	DD	2005	no	no	
mohnikei	VU A2cd	2005	yes	yes	
montebelloensis	na				
patagonicus	na				
procerus	na				
reidi	DD	2003	yes	yes	
sindonis	DD	2003	no	no	
spinosissimus	VU A4cd	2003	yes	yes	common TM Species
subelongatus	VU A4cd	2003	yes	no	
trimaculatus	VU A4cd	2003	no	yes	common TM Species
whitei	DD	2003	yes	no	
zebra	DD	2002	no	yes	
zosterae	DD	2003	yes	no	

1.5.2 *National conservation status for the case study country*
We have not prepared a country specific case study

1.5.3 *Main threats within the case study country*

___No Threats
_X_Habitat Loss/Degradation (human induced)
___Invasive alien species (directly affecting the species)
_X_Harvesting [hunting/gathering]
_X_Accidental mortality (e.g. Bycatch)
___Persecution (e.g. Pest control)
_X_Pollution (affecting habitat and/or species)
___Other_____
_X_Unknown

Much of the information presented here on trade and conservation is based on the report that first raised awareness of large scale trade in seahorses: The International Trade in Seahorses *(Vincent 1996). Additional supporting references are given.*

We have not prepared a country specific case study. Rather, we here address the threats faced by seahorse populations worldwide. Seahorses are threatened by direct exploitation, accidental capture in non-selective fishing gear (bycatch), and degradation of their habitats. Some of the world's poorest fishers make their living specifically targeting seahorses. Bycatch from trawlers, however, appears to be the largest source of seahorses in international trade, and the trawl gear also damages their coastal habitats (A.C.J. Vincent and A. Perry, Project Seahorse, unpublished data). More research needs to be done to assess loss of seahorse habitat, especially seagrasses, and its impact on wild populations.

Seahorses are sold dried for traditional medicines, tonic foods and curiosities, and live for ornamental display. Traditional medicines (TM), particularly traditional Chinese medicine (TCM) and its derivatives, account for the largest consumption of seahorses (approx 95% of the global trade). Large, pale and smooth seahorses are believed by some to have a higher medicinal value in TCM (Vincent 1996). Pre-packaged pharmaceuticals are also popular in TM, and offer industry a chance to absorb animals previously thought undesirable for use in conventional (whole) form, including juvenile seahorses (Vincent 1996, S.K.H. Lee, TRAFFIC East Asia, pers. comm.). Although globally the dried trade is larger, for some species and populations the live trade is the greatest pressure. A survey of the live trade suggest that all cultured seahorses are traded live (A. Mangera, Project Seahorse, unpublished data).

The available evidence showed that in 1995 at least 32 countries traded syngnathids (seahorses and their immediate relatives), and that trade in Asia alone exceeded 45 tonnes of dried seahorses (Vincent 1996). Further research showed that nearly 80 countries had traded syngnathids by 2000, with many new sources in Africa and Latin America (A.C.J. Vincent and A. Perry, Project Seahorse, unpublished data). Moreover, the few official data, trade surveys, and qualitative evidence all indicated that the Asian trade in dried seahorses exceeded 50 tonnes in 2000. Hundreds of thousands of live seahorses were traded internationally in both 1995 and 2000, with small specimens finding a ready market (A.C.J. Vincent and A. Perry, Project Seahorse, unpublished data).

The impacts on seahorse populations of this trade are considerable, especially when combined with the damage that is being inflicted on their vulnerable inshore marine habitats. It is impossible to determine exactly how many seahorses live in the wild and it is difficult to assess how individual species are coping with the exploitation that is taking place, but a combination of customs records, quantitative research and qualitative information indicates that seahorse catches and/or trades have declined markedly. This reflects a loss of population rather than a drawdown of the trade: estimated population declines of between 15 and 50 percent over five-year periods are common (A.C.J. Vincent and A. Perry, Project Seahorse, unpublished data).

2. SPECIES MANAGEMENT WITHIN THE COUNTRY FOR WHICH CASE STUDY IS BEING PRESENTED

We have not prepared a country specific case study. However, many countries have established their own domestic conservation assessments or have drawn up regulations that recognise the threat to seahorse populations. The list of jurisdictions undertaking direct seahorse conservation action is still quite short and patchy. We apologise in advance for any exclusions and/or mistakes, and encourage Parties to make Project Seahorse aware of any National legislation affecting seahorses.

- *Australia*: Seahorses and their relatives came under Wildlife Protection Act on 1 January 1998, and then placed under the Environment Protections and Biodiversity Act in 2001. Export permits are only granted for approved management plans or captive-bred animals. The states of Tasmania and Victoria explicitly ban seahorse collection without a special permit, under fisheries regulations.

- *China: H. kelloggi* is listed under Category II of the Law of Wild Animal Protection of the People's Republic of China, and as Priority Fish Species (Grade B) in a national biodiversity action plan.
- *India*: Indian seahorse populations were moved under Schedule-I of the Wildlife Protection Act (1972) in 2001 which bans and collection or trade.
- *Mexico*: Intentional capture and trade of wild seahorses prohibited, only the commercialization of cultured and incidentally caught seahorses is permitted.
- *Phillipines*: Section 97 of the Philippines Fisheries Code currently legislates that harvesting and trade of any species listed on any CITES appendix is illegal.
- *Portugal: H. hippocampus and H. ramulosus* [to be revised as *H. guttulatus*] are both included in its national Red Data book.
- *Slovenia: H. guttulatus* is protected under a Government Order on the Protection of Threatened Animal Species (October 1993), which prohibits trade and bans keeping them in captivity.
- *South Africa*: Harvest of *H. capensis* illegal without permit from Cape Nature Conservation (CNC) under CNC Ordinance 19, 1974. All Syngnathids are protected from harvest, and disturbance except with a permit (Draft Regulations of the Marine Living Resources Bill, and Sea Fisheries Act, 1988).
- *Vietnam*: Lists *H. histrix, H. japonicus, H. kelloggi, H. kuda* and *H. trimaculatus* as Vulnerable in its national Red Data book.

We will address possible management measures for seahorses, as well as monitoring, under Section II: Non-detrimental Finding procedure (NDFs) (see below).

2.1 Management measures

2.1.1 *Management history*

2.1.2 *Purpose of the management plan in place*

2.1.3 *General elements of the management plan*

2.1.4 *Restoration or alleviation measures*

2.2 Monitoring system

2.2.1 *Methods used to monitor harvest*

2.2.2 ***Confidence in the use of monitoring***

2.3. Legal framework and law enforcement: Provide details of national and international legislation relating to the conservation of the species

3. UTILIZATION AND TRADE FOR RANGE STATE FOR WHICH CASE STUDY IS BEING PRESENTED

We have not prepared a country specific case study, but see Section 1.5.3 "Main threats within the case study country".

3.1 Type of use (origin) and destinations (purposes)

3.2 Harvest

3.2.1 *Harvesting regime*

3.2.2 *Harvest management/ control*

3.3 Legal and illegal trade levels

II. Non-detriment finding procedure (NDFs)

Provide detailed information on the procedure used to make the non-detriment finding for the species evaluated.

This section, on Non-detrimental Finding procedure (NDFs) for seahorses (Hippocampus spp.) is largely based on the findings of the "International Workshop on CITES Implementation for Seahorse Conservation and Trade", February 3-5, 2004, Mazatlan, Mexico. In places the text is lifted directly from the proceedings of this workshop (Bruckner et al. 2005) – this text is in quotes. This workshop is hereafter referred to as the "CITES Implementation Workshop".

1. IS THE METHODOLOGY USED BASED ON THE IUCN CHECKLIST FOR NDFS?

__yes _X_no

An attempt was made at the *CITES Implementation Workshop* to use the IUCN methodology to make NDFs for some of the better known seahorse species and populations. Unfortunately, insufficient informa-

tion exists, for any species or population, to make use of the checklist. It was decided, therefore, to suggest interim measure for making NDFs for seahorses, while further information is gathered by Parties to allow for the development of more specific NDFs. These interim measures *(minimum export size, protect seahorse habitats*, and *enforce existing laws*), as well as lists of information required to make more specific NDFs, are outlined below.

2. CRITERIA, PARAMETERS AND/OR INDICATORS USED

The main criteria/indicators used to implement the three interim measures suggested by the participants of the *CITES Implementation Workshop* are: a) for *minimum export size* – an indication of whether the size of individual seahorses entering trade is at or above the recommended height for seahorse exports (currently 10 cm height); b) for *protecting seahorse habitats* – an idea of what percentage of seahorses habitats, or preferably populations, are within marine protected areas; and c) for *enforcing existing laws* – knowledge that seahorses entering trade from non-selective fishing practices are being sourced legally.

3. MAIN SOURCES OF DATA, INCLUDING FIELD EVALUATION OR SAMPLING METHODOLOGIES AND ANALYSIS USED

The main types of information needed to implement the three interim measures suggested by the participants of the *CITES Implementation Workshop* are: a) for *minimum export size* – a Party could choose to implement the current recommendation of 10 cm height, or obtain specific information on size at maturity for their seahorses populations in order to implement population specific size limits; b) for *protecting seahorse habitats* – information on the location of seahorse habitats, or preferably areas of seahorse occupancy, in a Parties waters, and the proportion of these habitats/locations that are currently protected; and c) for *enforcing existing laws* – information on whether trawlers are fishing in restricted waters, and whether these trawlers are a source of seahorses for export.

4. EVALUATION OF DATA QUANTITY AND QUALITY FOR THE ASSESSMENT

It is imperative that Parties do not feel restricted by the quantity and quality of the information currently available to form NDFs for their exported seahorses. Instead, interim NDFs, based on the best available information, should be implemented immediately. Then, in the spirit of adaptive management, Parties can begin to collect information needed to develop more accurate measures for forming their NDFs.

5. MAIN PROBLEMS, CHALLENGES OR DIFFICULTIES FOUND ON THE ELABORATION OF NDF

These are unknown to us at this time. We are hoping this workshop will uncover some of the problems, challenges or difficulties Parties are encountering when attempting to make NDFs for their seahorses.

6. RECOMMENDATIONS

Five Key Points to Remember

1. Parties are at liberty to do what they want to make NDFs under CITES – the following are *recommendations* of interim measures where Parties lack other options/opportunities:

a) Minimum export size – a 10 cm minimum size limit for specimens of all *Hippocampus* species in trade is one component of an adaptive management plan, and a simple precautionary means of making initial non-detriment findings.

b) Protect seahorse habitats – protecting seahorse habitats should help to protect seahorse populations, at least until more information is obtained and more accurate spatial management measures can be developed and implemented.

c) Enforce existing laws – seahorses sourced from trawlers fishing in areas closed to trawling violate CITES provisions for legal acquisition, and should not be traded.

d) Collect information to increase understanding – species and population specific information are needed in order to identity potential alternative management tools which could supplement or replace the suggested interim measures. We wish to emphasise that even basic types of data are useful, as long as they are presented with a corresponding metric of effort.

There are, at present, two levels of NDF recommendations for seahorses: 1) immediate measures, which should be implementable based on existing information and understanding, and 2) measures that will be feasible once information on individual seahorse populations, exploitation levels, and trade are made available. By considering immediate measures now, and then developing more accurate measures based on new information later, Parties will be managing their seahorse trade according to the principles of adaptive management. Applying the

principles of adaptive management to NDFs is emphasised in the IUCN guidelines for making NDFs for Appendix II species (Rosser & Haywood 2002).

What follows are: 1) recommendations of immediate measures for making NDFs for wild seahorses; 2) lists of data that are needed to make more accurate recommendations for NDFs by species, population and fishery; and 3) NDF recommendations for aquaculture and other captive breeding operations. Included under each section are the relevant summary recommendations of the *CITES Implementation Workshop*, and supporting information from the reports of Working Groups 1 and 3 (Bruckner et al. 2005). Finally, section 4) presents "Hippocampus Info", a web based tool being developed by Project Seahorse for assisting Parties to undertake NDFs for the *Hippocampus* genus.

1. Immediate measures

CITES Parties have recognised the challenges of setting quotas or undertaking many other management measures given the dearth of information on the state of existing wild populations and seahorse trade levels, and the considerable similarity in physical appearance of many species. There are, however, possible way Parties could overcome the immediate difficulties of making early NDFs as required by the Convention – a) minimum size limits, b) habitat protection, and c) the enforcement of existing laws. These measures are expressed in Recommendations 1, 3 and 4 of the *CITES Implementation Workshop*.

a) Minimum Size Limit

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"

Decision 12.54 of the CITES Animal Committee suggests a universal *"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"*. The currently recommended minimum height is 10 cm. Basis for this recommendation can be found in Foster & Vincent 2005. The Animal Committee suggests that this size limit be reviewed at a later date on the basis of further research.

A single minimum permissible height for all seahorse species in international trade appears to be both biologically appropriate and

socially acceptable as a means of making interim NDFs for seahorses, until Parties are able to define management tools more specifically. Currently, the number of juvenile seahorses in trade bodes poorly for population recovery from overexploitation. Project Seahorse consultation with multiple stakeholders and managers has revealed that most favour minimum permissible size limits as a means of regulating seahorse fisheries.

A 10 cm minimum size limit would permit both reproduction and continued trade in most species that are currently exported. It serves as an initial approach to making NDFs while Parties assess international trade levels, impacts on domestic species, and potential alternative management tools which could supplement or replace the minimum size limit. A minimum size limit of 10 cm should be sufficient to permit reproduction in most species, including all six of the species at which the CITES listing was primarily directed (*H. barbouri, H. comes, H. erectus, H. ingens, H. reidi and H. spinosissimus*). This minimum size limit is slightly above the currently inferred maximum size at onset of sexual maturity for most species, so should allow reproduction to occur.

There is concern that implementation of this recommendation could lead to undersized seahorses being ground down before export (for inclusion in medicines), thereby "hiding" detrimental trade. The source and volume of seahorses consumed in pre-packaged, patent medicines remains an unknown. However, Project Seahorse trade surveys do suggest that all primary exports are of whole animals – with processing for medicines occurring in the import countries (e.g. China). Should this change, and source countries begin processing seahorses before export, then monitoring the size of seahorses entering trade will have to move down the supply chain – to the processing plants, primary buyers, and/or catches.

b) Seahorse Habitat and Population Protection

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".

The premise behind this recommendation is that protecting seahorse habitat will help protect seahorse populations. If Parties can confirm that a decent proportion of seahorse habitats are closed to non-selective fishing practices, then this may be useful in making NDFs in

the short term. This recommendation should be particularly useful where the majority of seahorses are caught by non-selective fishing practices, such as trawling. By closing a percentage of seahorse habitats to these types of fishing, Parties may be creating seahorse refugia.

To this end, Working Group 1 recommended that maps illustrating, to the extent possible, the distribution of habitat types, seahorse populations and fishing areas, be used to as tools to implement spatial management approaches (e.g. zoning of fishing grounds). 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) can be used, but should be refined to the highest level of detail possible once more information becomes available.

For recommendation on what proportion of habitats to protect, Parties should first look the guidelines/goals set by their own countries (if such guidelines exist). Alternatively, they could look to the recommendations set by global organisations. The UN Convention on Biological Diversity (CBD) suggests that 10% of all marine and coastal ecological regions be conserved in MPAs by 2012. More ambitiously, The World Parks Congress set a target of a global system of MPA networks by 2012, which would include "strictly protected areas" amounting to at least 20-30% of each habitat.

Should a Party wish to formulate more specific NDFs for seahorses caught as bycatch, then research into the life history and ecology of seahorse populations is required. For example, a Party could implement seasonal closures of the trawl fishery based on reproductive peaks, or implement bycatch quotas based on an understanding of population size and intrinsic rates of population increase. Where the bycatch consists of more than one seahorse species, changes to fishing techniques could be used to formulate NDFs. For example, nets could be brought up more frequently thereby increasing the chances that individuals are landed live and undamaged, and small ones could be returned to the water. Indeed, this could be beneficial for many bycatch species other than seahorses. It would be useful to have a focused discussion about how to make NDFs for trawl caught seahorses at the workshop.

c) Enforcement of existing laws

Recommendation 4: "… Enforcement of existing laws (e.g., trawling bans in specific areas) is needed to improve the conservation of seahorses".

Parties should consider existing bans on non-selective fisheries/gear when assessing sources of seahorse specimens destined for export. The majority of dried seahorses in international trade come from the

bycatch of shrimp trawl fisheries. Many countries currently ban trawling in coastal waters, but have little or no enforcement of these bans. Seahorses collected from these illegal fisheries should not be exported under CITES provisions for legal acquisition. Implementing this recommendation will require close collaboration between national Management Authorities, Scientific Authorities, and law enforcement agencies to enforce trawling bans in real time and upon permit issuance.

d) Information needed to identify potential alternative management tools which could supplement or replace the suggested interim measures

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 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".

The previous suggestions, a minimum size limit, protecting habitat, and enforcing existing laws, are possible way Parties could overcome the immediate difficulties of making early non-detriment findings as required by the Convention. They are not, however, long term solutions. More accurate measures for making NDFs on species and population specific levels are needed.

The collection of basic data is required before Parties can identity potential alternative management tools for making species and population specific NDFs. Working Group 3 outlined the types of data necessary for defensible and adaptive management of wild seahorse populations. With these types of data available, NDFs such as quotas, population specific minimum size limits, and zoning of fishing grounds may be possible. Long-term monitoring of these data will also provide an indication of population health – important as an assessment of trade must be put in context of all other threats faced by a species/population.

It was agreed that two different types of data must be collected: a) population data and b) fisheries data. Project Seahorse has available a

number of Technical Reports for Research and Management, which will prove useful for Parties who want to develop and implement data collection and population monitoring programs (http://seahorse.fisheries.ubc.ca/tech-reports.html).

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

- Species composition (fisheries are often dealing with multiple species – and Parties have to segregate information by species to meet obligations)
- Presence/absence
- 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

In addition to these population data, the following types of fisheries data should be collected in order to understand the effects of fishing on wild populations:

- fishing locations
- catches (including discards)
- fishing effort (number of boats, number of trips, etc)

The latter is perhaps the most important fisheries information, as most population data is useless unless accompanied by a measure of effort. Also, we here wish to re-emphasise that any data is better than no data. Parties should not feel overwhelmed by the length of these data "wish" lists, but rather use them as starting points for which to design pragmatic programs for monitoring their populations, fisheries and trades.

Based on these data, it was greed that a Scientific Authority could recognize the signs of detrimental or unsustainable trade based on an unexpected change in any of the following parameters:

- Species composition
- Presence/absence
- Relative abundance
- Size/age structure
- Sex ratio
- Frequency of male brood pouch
- Catch rates (per unit effort)
- Trade rates (per unit effort)
- Habitat quality/quantity

Such indications of unsustainable populations/fisheries/trade would only be visible after longer-term monitoring. It is suggested that Parties set up specific "sentinel" or indicator fisheries that can be targeted to test and evaluate various management measures through an adaptive management process.

Recommendations for seahorse aquaculture operations
The *CITES Implementation Workshop* resulted in specific recommendations for making NDFs for seahorse aquaculture operations. These are summarised in *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".

Hippocampus Info
Hippocampus Info (www.hippocampusinfo.org) is a web-based tool to assist countries in preparing scientifically sound and defensible NDFs for seahorses. Hippocampus Info provides a central repository for seahorse data, generic resources and technical tools to support seahorse conservation by CITES Authorities and other interested parties. It was developed by Project Seahorse (www.projectseahorse.org), an organization with immense global experience in seahorse conservation and biology with original financial support from the Whitley Fund for Nature (www.whitley-award.org) and additional support from other partners, donors, and sponsors of Project Seahorse.

With CITES Notification No. 2006/069, the Secretariat invited Parties to support this Project Seahorse initiative, which could become a model for providing species-specific information and capacity-building resources.

The website currently provides simple and intuitive access to the following information:

- Seahorse identification – using a highly visual and interactive identification key.
- Seahorse trade statistics – though a relational database containing all official trade records, by country, for seahorses before and after 2004 (year of CITES listing implementation)
- Resources about seahorse distribution, biology and trade.

- Generic resources about marine conservation issues and solutions such as fisheries, bycatch and trade monitoring, biological population assessment and marine protected areas.
- Country-specific information on all aspects of seahorses for most major seahorse trading countries (Brazil, India, Indonesia, Malaysia, Mexico, Philippines, Thailand, Viet Nam, and the major trading hub, Hong Kong SAR).
- Interim suggestions to Parties for making NDFs for seahorses
- Suggestion of the types of information and data needed to formulate more specific NDFs for seahorses

The site will grow in the future to host more information and tools, such as:

- Advisory tools incorporating seahorse information and appropriate levels of uncertainty and risk.
- Expansion to include seahorse information for additional countries identified as emerging or growing participants in the international seahorse trade.

REFERENCES

BLIGHT, and Vincent. in prep. Syngnathid predators reveal ecology of prey.

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-27, Silver Spring, MD 174 pp.

FOSTER, S. J., and A. C. J. Vincent. 2004. Life history and ecology of seahorses: implications for conservation and management. Journal of fish biology *64*:1-61.

FOSTER, S. J., and A. C. J. Vincent. 2005. Enhancing sustainability of the international trade in seahorses with a single minimum size limit. Conservation Biology *19*:1044-1050.

HARRIS, M. P., D. Beare, and L. N. R. Toresen, M. Kloppmann, H. Dörner, K. Peach, D.R.A. Rushton, J. Foster-Smith, S. Wanless. 2007. A major increase in snake pipefish (*Entelurus aequoreus*) in northern European seas since 2003: potential implications for seabird breeding success. Marine Biology *151*:1432-1793.

LOURIE, S. A., S. J. Foster, E. W. T. Cooper, and A. C. J. Vincent 2004. A Guide to the Identification of Seahorses. University of British Columbia and World Wildlife Fund, Washington, D.C.

ROSSER, A. R., and M. J. C. Haywood 2002. Guidance for CITES Scientific Authorities: Checklist to Assist in Making Non-detriment Findings for Appendix II Exports. The World Conservation Union (IUCN).

VINCENT, A. C. J. 1996. The International Trade in Seahorses. TRAFFIC International, Cambridge, UK.

WORLD Conservation Union (IUCN). 2006. 2006 IUCN red list of threatened species. IUCN, Cambridge. Available from www.redlist.org.