Working group	*Co-chair*	*CS Presenter*	*Keynote Speaker*	*Expert*	*Rapporteaur*	*Attendance*
Fishes						
Glenn Sant	☑	☐	☐	☐	☐	YES
Marcelo Vasconcelos	☑	☐	☐	☑	☐	YES
Donald Stewart	☐	☑	☐	☐	☐	YES
Hakan Wickstrom	☐	☑	☐	☐	☐	YES
Javier Tovar Avila	☐	☐	☐	☐	☐	YES
Jill Hepp	☐	☐	☐	☐	☐	YES
Leandro Castello	☐	☑	☐	☐	☐	NO
Lilia Durán Salguero	☐	☐	☐	☐	☐	YES
Nancy Daves	☐	☐	☐	☐	☑	YES
Radu Suciu	☐	☑	☐	☐	☐	YES
Sarah Foster	☐	☑	☐	☐	☐	YES
Sasanti R. Suharti	☐	☑	☐	☐	☐	YES

Total Participants : 12

The Fish Working Group (WG) considered five case studies produced for the workshop: seahorses *Hippocampus* spp., humphead wrasse *Cheilinus undulates* from Indonesia, sturgeons from the North west Black Sea and lower Danube river, *Arapaima* spp. from Brazil and eel *Anguilla anguilla* from Sweden. An extra species group was considered for sharks given the presence of experts in the group. After examining case studies in detail the WG considered each case study against the areas of information on the species, harvest, management measures and monitoring methods (Annex 1). The group further considered the logical steps to be taken when making an NDF. A flowchart was constructed reflecting the group's view on how NDF would be made on the short term and on a rolling basis to review the integrity of management and information associated with a species (Annex 2). An attempt to prioritize the critical elements to be taken into account to complete a NDF for each species groups was made and is reported in Annex 1 and in Table 1 of Annex 2. In addition, the WG considered the main problems, challenges and difficulties found in the elaboration of NDF, and reviewed the available references for an NDF formulation (Annex 1).

In examining the way in which an NDF would be considered for fish species, the WG considered some underlying assumptions that would support the conclusion that the general guidelines constructed by the WG were true to life:

- Fisheries management has a long history of trying to understand how you can best manage the harvest of fish so it is not a new concept;
- Many training manuals and databases exist to support those making NDF;
- In terms of risk, fish listed on Appendix II of CITES have already been concluded by Parties to be vulnerable and trade is a particularly important threat;
- More uncertainty requires more caution and leads to more monitoring; and
- Experts, who understand the use of fisheries management tools, are available to Scientific Authorities.

The WG concluded the following were essential to enable the NDF process for fish:

- A need to consider all sources of significant mortality affecting species in trade
- A need to consider whether establishing harvest/export quota is enough to achieve conservation goals
- Collaboration between Scientific Authorities and fisheries experts
- Transboundary migrants and shared stocks require regional NDF cooperation
- Be cautious with fisheries dependent data, verify when possible
- When possible, base NDF on both fisheries independent and dependent information/data
- Need techniques and legislation to distinguish among farmed, captive bred and wild individuals
- Management on which NDF is based should employ principles of adaptive and participatory management
- Parties need to report to Secretariat methods by which NDFs are being made on an annual basis to enable transparency, learning between NDF processes and to ensure that fish species which range beyond the boundaries of one State are accounted for by all range States in there NDF processes.

Annex 1. Main outputs of the Fish WG

1. Information about the target species or related species. The minimal information considered essential to make a reliable NDF for each of the case studies is highlighted in bold. Also highlighted are the most commonly used management measures and monitoring methods.

	General	Humphead wrasse	Seahorse	Sturgeons	Eels	Arapaima	Sharks
Biological and species status:	Taxonomy clarified Time-series of abundance Historical abundance Temporal and spatial distribution Size distribution Age distribution Sex ratio Maturity schedule Maternity schedule Recruitment Fecundity Type of reproduction Natural mortality rates/schedule Gamete viability (health) Critical habitats (spawning, nursery, feeding, overwintering, etc)	**Abundance** **Size distribution in wild** **Maturity schedule (size at first reproduction)** Temporal and spatial distribution Sex ratio Critical habitats Recruitment (SR relationship) Type of reproduction	**Size at maturity** **Taxonomy** **Critical habitats** **Temporal and spatial distribution** **Size distribution** Type of reproduction Time-series of abundance	**Age distribution** **Sex ratio** **Recruitment** **Critical habitats** Taxonomy Time-series of abundance Historical abundance Temporal and spatial distribution Size distribution Maturity schedule Type of reproduction Natural mortality rates/schedule	**Time-series of abundance** **Stage distribution** **Size distribution** **Sex ratio** **Recruitment** Natural mortality Temporal and spatial distribution Historical abundance Age distribution Gamete viability (health)	**Time-series of abundance (in one area)** **Size distribution** **Maturity schedule** Taxonomy clarified Recruitment Type of reproduction Air breather	Temporal and spatial distribution Age distribution Maturity schedule Maternity schedule Fecundity Natural mortality rates/schedule Critical habitats

	General	Humphead wrasse	Seahorse	Sturgeons	Eels	Arapaima	Sharks
Takes/uses (e.g. harvest regime):	Direct legal harvest by sectors (commercial, recreational, ranching, subs, etc.) Bycatch (post-capture mortality) Illegal harvest Collateral mortality (e.g. catch/release) Gear selectivity and impacts Market chain Harvest method	**Direct legal harvest by sectors** **Size distribution in trade** **Illegal harvest** **Market chain** **Harvest methods**	**Direct legal harvest** **Bycatch** **Market chain** **Harvest method**	**Direct legal harvest by sectors** **Illegal harvest** **Market chain** **Harvest method**	**Direct legal harvest by sectors** **Illegal harvest** **Collateral mortality (dams, etc)** **Market chain** **Harvest method**	**Direct legal harvest by sectors** **Illegal harvest (in unmanaged communities)** **Harvest method** Gear selectivity and impacts Bycatch	Direct legal Bycatch (post-capture mortality) (Basking) Illegal harvest Non-harvest related mortality (e.g. catch/release) Gear selectivity and impacts Market chain Harvest method
Other impacts	Habitat degradation (fisheries related or not) Habitat loss (dams, coastal development, navigation, etc) Environmental change Pollution Invasive species Genetic disruption (e.g. stocking, translocation) Hydro-power related mortality Water diversion Predator-prey dynamics	**Habitat degredation**	**Habitat degradation and loss (fisheries related or not)** Pollution	**Habitat degradation** **Habitat loss (dams)** Pollution (heavy metals, etc) Genetic disruption (e.g. stocking, translocation)	**Habitat loss** **Pollution** **Invasive species (parasite)** Environmental change Genetic disruption (e.g. stocking)	**Genetic disruption (e.g. stocking, translocation)**	Habitat degradation

	General	Humphead wrasse	Seahorse	Sturgeons	Eels	Arapaima	Sharks
Management, conservation	Management history (formal and informal) Protected areas Seasonal closures Bag limits Size limits Gear restrictions Rights-based management Community-based management Environmental education Capacity building Transport regulations Quotas Labelling/certification Product form regulations Enforcement	**Quota** **Size Limits** **Product form regulations (shipped alone)** **Protected Areas** **Protection of spawning aggregations** **Gear Restrictions** **Transport regulations (only by air)** **Stakeholder involvement**	**Protected areas (because of bycatch)** **Size limits (target fishery)** **Community-based management** **Capacity building** **Stakeholder involvement**	**Seasonal closures** **Size limits** **Quotas** **Transparency (website)** **Management history** **Protected areas** **Gear restrictions** **Rights-based management (licences)** **Environmental education** **Capacity building** **Labelling/certification (tagging, caviar labelling)**	**Size limits** **Seasonal closures** **Rights-based management (licences – effort control)** Gear restrictions Management history (formal and informal)	**Quotas** **Size limits** **Rights-based management** **Community-based management** **Seasonal closures** **Protected areas** **Product form regulations (whole animal)** **Gear restrictions** **Labelling/certification (tagged)** **Environmental education** **Capacity building**	Management history (formal and informal) Protected areas Size limits Gear restrictions Rights-based management (licenses) Community-based management Environmental education Capacity building (observers ID sharks) Quotas Product form regulations (fins attached to body, or fins to BW ratio)

	General	Humphead wrasse	Seahorse	Sturgeons	Eels	Arapaima	Sharks
Monitoring	Population monitoring Harvest monitoring Trade (domestic and international) monitoring Compliance assessment Ecosystem assessment Participatory monitoring	**Population monitoring** **Harvest monitoring** **Trade (domestic and international) monitoring**	**Population monitoring** **Harvest monitoring** **Trade (domestic and international) monitoring**	**Population monitoring (juveniles)** **Harvest monitoring** **Trade (domestic and international) monitoring** **Participatory monitoring** **Ecosystem assessment**	**Population monitoring** **Harvest monitoring** **Trade (domestic and international) monitoring** **Participatory monitoring**	**Population monitoring** **Harvest monitoring** **Participatory monitoring**	Population monitoring Harvest monitoring Trade (domestic and international) monitoring Participatory monitoring (log books)

2. Field methodologies and other sources of information.

Biological and species status data:	
Basic biological information (taxonomy and life history) (spatial/temporal approach)	DNA sampling Voucher (museum) specimens Age and growth methods Gonad sampling Measuring/weighting Life stage characterization Info on similar species Mark re-capture
Abundance and distribution (spatial/temporal approach)	CPUE (Fisheries dependent sampling) Visual surveys Recruitment indices Mark-recapture Interviews Fisheries indepdent sampling (See monitoring methods)
Population structure (spatial/temporal approach)	Length frequency analysis Age frequency analysis Genetic analysis (metapopulations structure) Sex ratio
Habitat and other impacts	GIS Remote sensing Visual surveys Substrate sampling Sonar Water quality assessment Temperature, salinity, turbidity assessment Ecosystem assessment
Harvesting and trade data:	Catch (port sampling, observers, trade data) Effort Market sampling Interviews Rapid Rural Appraisals Genetic analysis Catch and trade document schemes Databases Customs codes and Harmonized Systems (HS)

3. Types of approaches for data integration for NDF elaboration

- Analysis of time trends in biological/harvest data
- Analysis of spatial patterns in biological/harvest data
- Stock assessment methods
- Demographic analyses (e.g. life tables, matrix methods, etc)
- Rapid assessment methods

4. Approaches to assess data quantity and quality

- Transparency through peer review, stakeholder consultation, public communication, etc.
- Expert consultation/agreement[1]
- Statistical methods (e.g., power analyses, Bayesian methods)

5. Common problems, error, challenges or difficulties found on the elaboration of NDF

- Access to information - scattered, restricted, low level resolution
- Existing information very site/population specific
- Taxonomic uncertainty
- Challenge to monitor oceanic, large bodied, and low density animals in wild/harvest (e.g. sharks in wild, seahorses in bycatch)
- Lack of consistency in use of units in trade data
- Collection of trade data inconsistent among countries
- Lack of taxonomic resolution in trade data
- Expense of accessing trade data
- Reliability of fisheries dependent data
- Harvest effort not quantified/reported
- Lack of consistency of data from all range states of shared/migratory resources
- Lack of requirement to report NDFs
- Lack of mandated cooperation among range states for transboundary, migratory and shared stocks
- Illegal, unreported, and unregulated fishing (IUU)
- Cost of monitoring
- Lack of fisheries independent data
- NDFs not considering all sources of mortality (being made in isolation of all pressures on species)
- Lack of information on post-capture mortality
- Products in trade do not allow for easy determination of species/ quantities (e.g.shark fins, shark cartilage supplements, seahorses in prepared traditional medicines, canned glass eels, processed products)
- Introduction from the sea - who does the NDF?

[1] Examples qualitative indicators to be used in the evaluation of the reliability of fish abundance data can be found in Table 1 of FAO. 2007. Report of the second FAO Ad Hoc Expert Advisory Panel for the Assessment of Proposals to Amend Appendices I and II of CITES Concerning Commercially-exploited Aquatic Species. Rome, 26–30 March 2007. FAO Fisheries Report. No. 833. Rome, FAO. 2007. 133 p.is

- Accounting for intra-specific variability in life history (e.g. eel)
- Integration of diverse data sources into one assessment (e.g. eel)
- Lack of theoretical basis for establishing quotas (especially for eels)

6. Main recommendations which could be considered when making an NDF for this taxonomic group

- Must consider all sources of significant mortality when making NDF
- Consider whether establishing harvest/export quota is enough to achieve conservation goals
- Collaboration between Scientific Authorities and fisheries experts
- Transboundary migrants and shared stocks require regional NDF cooperation
- Be cautious with fisheries dependent data, verify when possible
- When possible, base NDF on both fisheries independent and dependent information/data
- Need techniques and legislation to distinguish among farmed, captive bred and wild individuals
- Management on which NDF is based should employ principles of adaptive and participatory management
- Report to the CITES Secretariat the methods by which NDFs are being made in order to improve transparency

7. Useful references for future NDF formulation.

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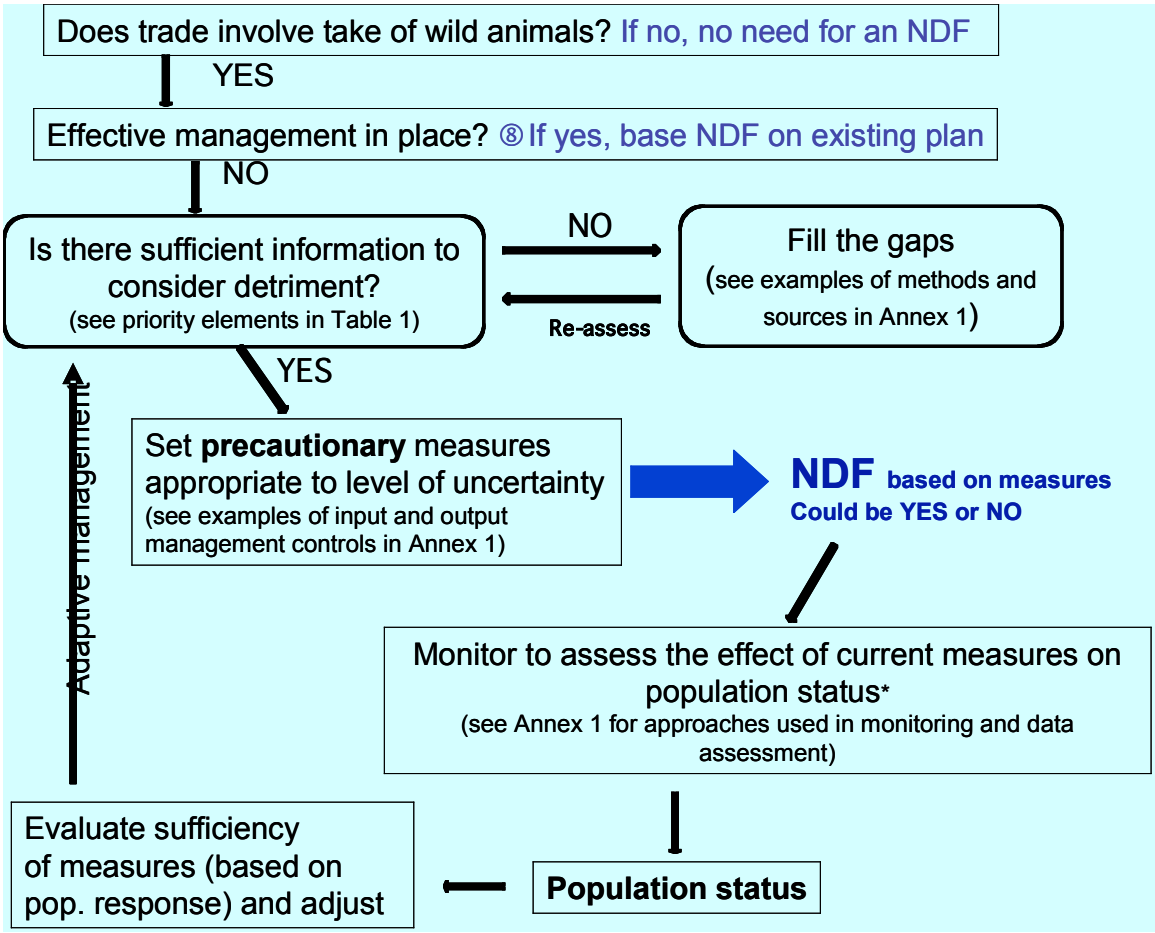
Seahorses

Hippocampusinfo.org

General

Fishbase.org
Databases and guidelines available in the UN Food and Agriculture Organization (www.fao.org)
Information on marine species and fisheries available in the Sea Around Us project of the University of British Columbia (www.searoundus.org).
IUCN Species Specialists Groups
GoogleEarth

Annex 2. Flowchart describing the logical steps for making an NDF for fish species in trade.



*Level/frequency of monitoring depends on life history, level of interaction and uncertainty (Annex 1 includes approaches for evaluating the quality and uncertainty in data).

Table 1. Biological characteristics, harvest and other impacts to be considered when making an NDF. All significant sources of mortality should be considered when making an NDF, including from legal and illegal direct take, bycatch, non-harvest related mortality and due to habitat loss.

Information needed	**For what**
which species	taxonomy
where (locations, depth, habitat)	spatial distribution; habitats
when (time of year)	temporal distribution
how many	abundance (preferably over time)
size/age stucture	size/age distribution; growth; mortality
sex (male, female, juvenile)	sex ratio
mature (yes/no)	size/age at maturity; maturity schedule
all significant sources of mortality	make NDF in context

The Fish Working Group (WG) considered five case studies produced for the workshop: seahorses *Hippocampus* spp., humphead wrasse *Cheilinus undulatus* from Indonesia, sturgeons from the North west Black Sea and lower Danube river, *Arapaima* spp. from Brazil and eel *Anguilla anguilla* from Sweden. An extra species group was considered for sharks given the presence of experts in the group. After examining case studies in detail the WG considered each case study against the areas of information on the species, harvest, management measures and monitoring methods. The group further considered the logical steps to be taken when making an NDF. A flowchart was constructed reflecting the group's view on how NDF would be made on the short term and on a rolling basis to review the integrity of management and information associated with a species (**Annex 1**). An attempt to prioritize the critical elements to be taken into account to complete a NDF for each species groups was made (**Table 1**). In addition, the WG considered the main problems, challenges and difficulties found in the elaboration of NDF, and reviewed the available references for an NDF formulation.

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- Many training manuals and databases exist to support those making NDF;
- In terms of risk, fish listed on Appendix II of CITES have already been concluded by Parties to be vulnerable and trade is a particularly important threat;
- More uncertainty requires more caution and leads to more monitoring; and
- Experts, who understand the use of fisheries management tools, are available to Scientific Authorities.

The WG concluded the following were essential to enable the NDF process for fish:

- A need to consider all sources of significant mortality affecting species in trade
- A need to consider whether establishing harvest/export quota is enough to achieve conservation goals
- Collaboration between Scientific Authorities and fisheries experts
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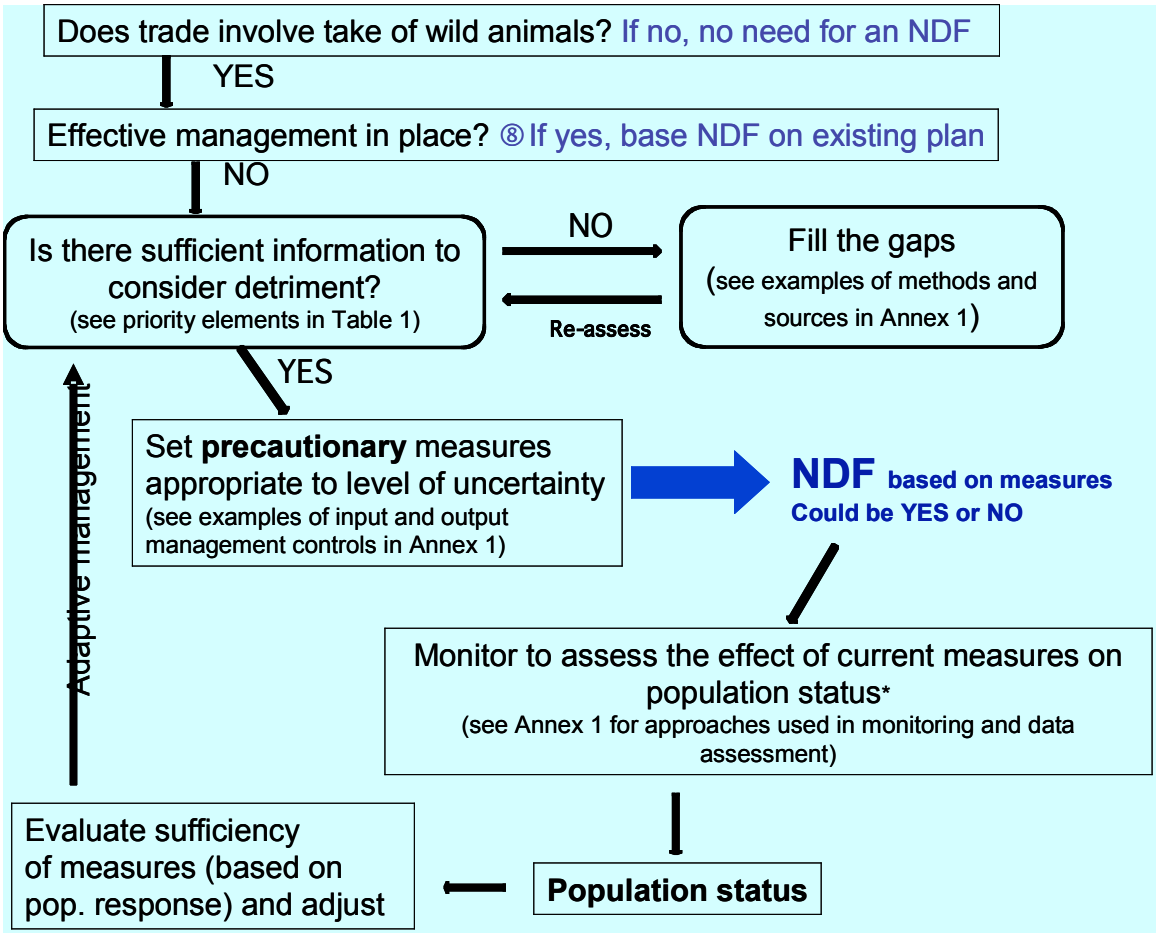
Annex 1. *Flowchart describing the logical steps for making an NDF for fish species in trade.*



*Level/frequency of monitoring depends on life history, level of interaction and uncertainty (Annex 1 includes approaches for evaluating the quality and uncertainty in data).

Table 1. *Biological characteristics, harvest and other impacts to be considered when making an NDF. All significant sources of mortality should be considered when making an NDF, including from legal and illegal direct take, bycatch, non-harvest related mortality and due to habitat loss.*

Information needed	For
which species	taxonomy
where (locations, depth, habitat)	spatial distribution; habitats
when (time of year)	temporal distribution
how	abundance (preferably over time)
size/age stucture	size/age distribution; growth; mortalit
sex (male, female, juvenile)	sex ratio
mature (yes/no)	size/age at maturity; schedule
all significant sources of mortality	make NDF in context

WG 8 - FISHES

Arapaima spp./Brazil

Anguilla anguilla/Sweden

Hippocampus spp.

Cheilinus undulatus/Indonesia

Sturgeon/NW Black Sea and Lower Danube

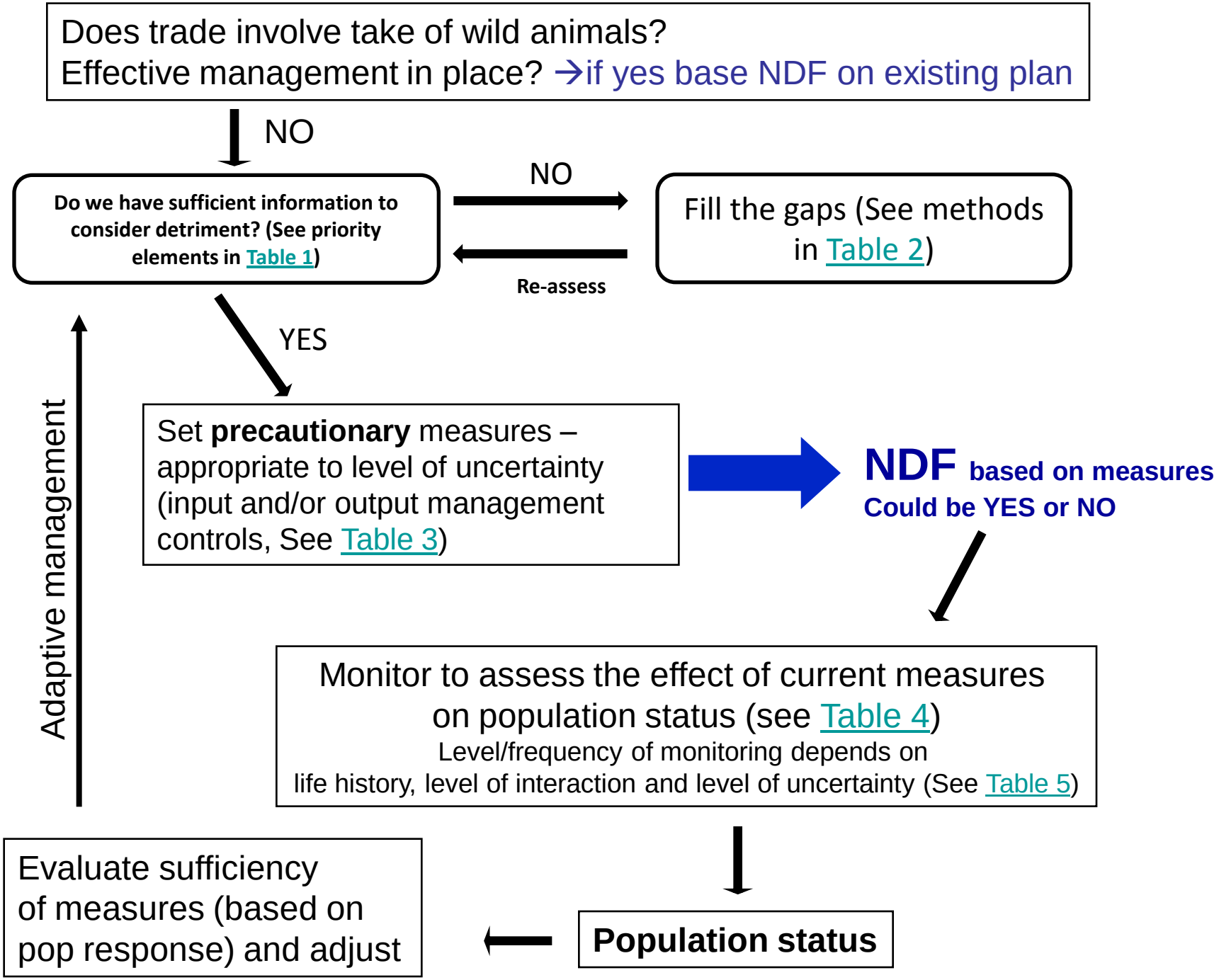
sharks

Assumptions:

- Fisheries management has a long history
- Many training manuals, databases, etc.
- Fishes listed on Appendix II are vulnerable and trade is an important threat
- More uncertainty, more caution, more monitoring
- Experts, who know fisheries, are available to Scientific Authority

Vulnerability

- Biological characteristics leading to greater vulnerability included a longer life span, later sexual maturation, slower growth and lower natural mortality
- Specialists versus generalists
- Marine species cannot be considered less vulnerable on the basis of biological attributes such as high fecundity or large-scale dispersal characteristics
- Reasons: 1) exploitation, 2) habitat loss


Does trade involve take of wild animals?
Effective management in place? →if yes base NDF on existing plan
NO
Do we have sufficient information to consider detriment? (See priority elements in Table 1)
NO
Fill the gaps (See methods in Table 2)
Re-assess
YES
Adaptive management
Set precautionary measures – appropriate to level of uncertainty (input and/or output management controls, See Table 3)
NDF based on measures
Could be YES or NO
Monitor to assess the effect of current measures on population status (see Table 4)
Level/frequency of monitoring depends on life history, level of interaction and level of uncertainty (See Table 5)
Population status
Evaluate sufficiency of measures (based on pop response) and adjust

Recommendations

- **Must consider all sources of significant mortality - c**onsider whether quota is enough to achieve conservation goals
- **Collaboration between Scientific Authorities and fisheries experts**
- **Transboundary migrants and shared stocks require regional NDF cooperation**

- Be cautious with fisheries dependent data, verify when possible
- When possible, base NDF on both fisheries independent and dependent information/data
- Need techniques and legislation to distinguish among farmed, captive bred and wild individuals

- Management on which NDF is based should employ principles of adaptive and participatory management
- Parties need to report to Secretariat methods by which NDFs are being made on an annual basis

Thanks


International Expert
Workshop on CITES
Non-Detriment Findings
Cancun, Mexico
2008 11 20

Table 1 – Biological characteristics/ Harvest/ Other Impacts

Information needed	**For what**
which species	taxonomy
where (locations, depth, habitat)	spatial distribution; habitats
when (time of year)	temporal distribution
how many	abundance (preferably over time)
size/age stucture	size/age distribution; growth; mortality
sex (male, female, juvenile)	sex ratio
mature (yes/no)	size/age at maturity; maturity schedule
all significant sources of mortality	make NDF in context

Mortality: (legal and illegal) direct take, bycatch, non-harvest related mortality

Other Impacts: habitat degradation and loss

Table 2 – Methods/Tools

Biological and species status data	**Possible methodologies**
Taxonomy and life history	DNA sampling Voucher (museum) specimens Ageing methods Age and growth models Visual inspection Gonad sampling Measuring/weighing Life stage characterization Info on similar species Mark re-capture
Abundance and distribution (spatial/temporal approach)	Fisheries dependent sampling (CPUE) Visual surveys Recruitment indices Mark-recapture Interviews Fisheries independent sampling (See monitoring methods)
Population structure (spatial/temporal approach)	Length frequency analysis Age frequency analysis Catch curve analysis Genetic analysis (metapopulations structure) Sex ratio analysis
Habitat and other impacts	GIS Remote sensing Visual surveys Substrate sampling Sonar Water quality assessment Temperature, salinity, turbidity assessment Ecosystem assessment
Harvesting and trade data	Catch (port sampling, observers, trade data) Effort Market sampling Interviews Rapid Rural Appraisals Genetic analysis Catch and trade document schemes Dock-side sampling Databases Harmonised Systems (HS) codes (WTO customs codes)

References/ Resources

- Inter-governmental/ regional fisheries bodies to assist countries with fisheries management
  - IUCN Specialist Groups
  - FAO
  - SPC
- Many reference books/ manuals on methods, models, etc.
  - E.g. Hippocampusinfo.org, Fishbase.org

Table 3 – Management measures

Management and conservation measures
Quotas
Size limits
Gear restrictions
Seasonal closures
Spatial closures
Rights-based management (e.g. licensing)
Community-based management
Capacity building
Environmental education
Product form regulations (e.g. whole shells or animal)
Transport regulations (e.g. hhw shipped alone and by air)
Labelling/certification
Bag limits
Management history (formal and informal)

Should consider both input and output controls, as appropriate
Note that in most cases a quota alone will not achieve conservation goals

ESTIMATING SUSTAINABLE QUOTAS: IS IT ENOUGH FOR A FISH NDF?

- Setting quotas is the most direct way to manage fishing mortality
- BUT it requires accurate estimates of catches and stock size
- High risk of overfishing due to uncertainties

- Quotas should be combined with other precautionary measures, such as:
    - effort control (limited entry)
    - minimum size
    - gear restrictions (control the use of destructive gears)
    - protected areas

- To be effective, a management system must be in place:
    - Monitoring
    - Enforcement (reducing IUU fishing)
    - Adequate policies and incentives for sustainable use

Table 4 – Monitoring and data integration

Monitoring
Population monitoring Harvest monitoring Trade (domestic and international) monitoring Compliance assessment Ecosystem assessment Participatory monitoring
Data integration for NDF elaboration
Analyse time trends Stock assessment methods Analyse spatial patterns Demographic analyses (e.g. life tables, matrix methods, etc.) Rapid assessment methods

Table 5 – Assessing quality

An example: assessing quality of abundance estimates FAO Fish. Rep. 833 (2007)

Reliability index of population abundance information	Source of data or information
5	Statistically designed, fishery-independent survey of abundance.
4	Consistent and/or standardized catch-per-unit effort data from the fishery.
3	Unstandardized catch-per-unit effort data from the fishery; scientifically-designed, structured interviews; well-specified and consistent anecdotal information on major changes from representative samples of stakeholders.
2	Catch or trade data without information on effort.
1	Confirmed visual observations; anecdotal impressions.
0	Information that does not meet any of the above, or equivalent, criteria; flawed analysis or interpretation of trends.

- peer review
- stakeholder consultation
- public communication
- regional consultation/agreement
- statistical methods (from standard deviations to power analyses to Bayesian methods)

TRANSPARENCY of process

Talking pts

- Input versus output
- Level of monitoring – depends on:
  - Life history
  - Level of interaction versus cost – e.g. low catches in bycatch fishery – fisheries independent surveys more appropriate than observer coverage
  - Level of uncertainty
  - Whose responsible for data collection? Who bears the burden of proof?
  - Existence of organisations to assist countries get it right

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Assessing CITES non-detriment findings procedures for *Arapaima* in Brazil

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Summary

Arapaima are listed as endangered fishes according to the Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES), thus their international trade is regulated by non-detriment finding (NDF) procedures. The authors critically assessed Brazil's regulations for NDF procedures for *Arapaima* using IUCN's checklist for making NDFs, and found that those regulations cannot ensure the sustainability of *Arapaima* populations. *Arapaima* are among the largest fishes in the world, migrate short distances among several floodplain habitats, and are very vulnerable to fishing during spawning. They are threatened mainly by overfishing. The fishery is largely unregulated because government regulations on size, season, and even moratoriums on capture have been very poorly enforced. *Arapaima* remain poorly understood and the taxonomy and geographical distribution of the genus remain uncertain. There are no data on catch levels or status of wild populations, although available information suggests they are in decline. Brazil's NDF procedures for specimens originating in the wild are inadequate as they rely on 'technical opinion reports', which do not necessarily require scientific evidence. Furthermore, Brazil's NDF procedures exempt the need for NDF reports on 'captive' specimens; however, 'captive' specimens originating in the wild and raised in captivity can be exported because regulations do not specify that they must be 'captive-bred'. Six suggestions are offered to improve the reliability of NDF procedures for *Arapaima* in Brazil, emphasizing the utility of participatory monitoring and adaptive harvesting to strengthen much needed harvest control capacity in other tropical fisheries.

Introduction

Aquatic living resources are being degraded worldwide to the point that international policy and institutional arrangements have been established to curb the situation. The most prominent of these arrangements is the Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES), which attempts primarily to curb threats to biological species caused by international trade. One approach promoted by CITES has been the use of non-detriment finding (NDF) procedures. NDF procedures essentially require proof that the level of exports and associated harvesting is non-detrimental to the survival of the species in the wild or to their role in the ecosystem (Rosser and Haywood, 2002). Unfortunately, however, non-detriment finding (NDF) procedures have not been very effective worldwide. According to Rosser and Haywood (2002), 'current problems in making non-detrimental findings result mainly from lack of capacity and resources to implement monitoring schemes across the wide range of species in international trade.' Consequently, the CITES Secretariat has been seeking to improve existing NDF procedures: in 2008 an international workshop on the topic included a series of case studies covering various regions and taxa worldwide. The present study was developed for that workshop, contributing to the implementation of more effective NDF procedures for tropical fishes.

Tropical fishes are affected by the same broad range of conservation issues as most other taxa in the world. However, they are also affected by issues typical of developing countries where they tend to occur; they deserve attention because these countries comprise about two-thirds of the world. Conserving tropical fishes and their fisheries is especially difficult because they tend to be marked by high biological diversity and poor biological understanding, large geographical areas and scarcity of human and financial resources, and rapidly growing human populations and affluence (Berkes et al., 2001; Castello et al., 2007; Ruddle and Hickey, 2008).

This paper focuses on *Arapaima* spp. in Brazil. *Arapaima* are exceptional fishes from tropical South America and have been exported from Brazil since 1975 (BioTrade Facilitation Programme, 2006; CITES, 2008). *Arapaima* are among the largest freshwater fishes, growing to 3 m in length and 200 kg; they are highly specialized, obligate air-breathers that typically surface every 5–15 min to gulp air; and they have supported important regional fisheries. This paper focuses on the floodplains of the Amazon River where *Arapaima* have been studied the most and covers much of their range where they are (and were) abundant.

Methods

We tested the hypothesis that existing information and resource management schemes for *Arapaima* in Brazil allow for reliable NDF procedures. The analysis primarily followed the application of IUCN's checklist for making NDFs (Rosser and Haywood, 2002). This methodology relies on the assessment of 26 issues related to the species of interest (see Appendix I). These issues have been chosen to allow for 'easy qualitative checks that permit a basic assessment of the confidence with which an NDF may be made by scientific authorities' (Rosser and Haywood, 2002). The checklist was designed to require educated guesswork, as there is great difficulty in meeting hard criteria for sustainable use of many species, and it is practically impossible to extrapolate quantitative data from the few species that have been

studied. To apply the checklist to *Arapaima*, we followed two steps: first, we reviewed the literature on *Arapaima* related to biology, population status, management, protection, conservation incentives, population monitoring, and harvesting control; second, we assigned scores from 1 to 5 to all issues assessed, with high scores related to presence of requirements of sustainable harvests, and low scores to uncertainty, lack of management capacity, or non-sustainability. This was done considering the information for the whole of Brazil, but not for small regions where information may be atypically good (e.g. Mamirauá Reserve in Amazonas State). The scores were plotted on a radar graph for ease of interpretation.

We supplemented this analysis with a critical assessment of Brazil's NDF procedures. This was done because individual countries design and implement NDF following advice given by their own scientific and administrative authorities. Information on Brazil's NDF procedures was obtained directly from the website of the Brazilian Institute for Environment and Renewable Resources (IBAMA) and through direct contact with IBAMA's personnel. However, we could not find specific data for cases where NDF reports have been made for *Arapaima*, because such data currently are not publicly available. Thus, our assessment was made for the entire area of Brazil considering the application of Brazil's regulations using the available information on the species. We sought to identify possible ways through which exports of *Arapaima* from Brazil potentially could be detrimental to their survival in the wild.

Results and discussion

The general characteristics of the *Arapaima* appear to allow for sustainable exploitation. However, we found that it is practically impossible to produce reliable NDF for the species in Brazil because of lack of monitoring and management capacity, scarcity of information on various topics, and deficiencies in Brazil's NDF procedures. Details follow.

Biology and ecology

Taxonomy. It is widely held that *Arapaima* is a monotypic genus, including only *A. gigas* (Schinz in Cuvier, 1822). However, there have been no species-level taxonomic analyses since Günther (1868) put the three species described by Valenciennes (in Cuvier and Valenciennes, 1847) into the synonymy of *A. gigas* without presenting any analysis or rationale. Our own study of populations in Brazil and Guyana (Fig. 1) and examination of *Arapaima* specimens preserved in several large international collections (including type materials in Paris and London, and non-types in Manaus and several US museums) suggests that all four nominal taxa are valid. At present, we can map approximate distribution of the genus *Arapaima* (Fig. 1), but distributions of the four previously described species remain unknown. Hrbek et al. (2005, 2007) studied variation in DNA for *Arapaima* from seven regional fish markets in the Amazon basin, covering a very large geographical area, including the Mamirauá Reserve, and inferred that their samples came from a single, panmictic population. However, those results cannot refute Valenciennes' four-species hypothesis because a taxonomic analysis was not done (i.e. they did not examine type materials or morphology of sampled specimens). Previous studies have shown that some Amazonian fish genera have both widespread, common species as well as localized or rare species (e.g. *Cichla monoculus* vs many localized taxa; Kullander and Ferreira, 2006). The present uncertainty on the taxonomy and geographical distribution of *Arapaima* highlights the urgent need for additional studies as well as caution in translocations of individuals.

Life history. The majority of the existing information stems from one area no greater than 1000 km^2, the Mamirauá Reserve, Amazonas State, Brazil, which represents less than 1% of the total distribution of the species (Fig. 1). *Arapaima* make short, seasonal migrations among all eight habitats of the Amazon River floodplain (based on Castello, 2008a,b). Most *Arapaima* inhabit lakes and channels during low-water periods, roughly from September to January each year. At that

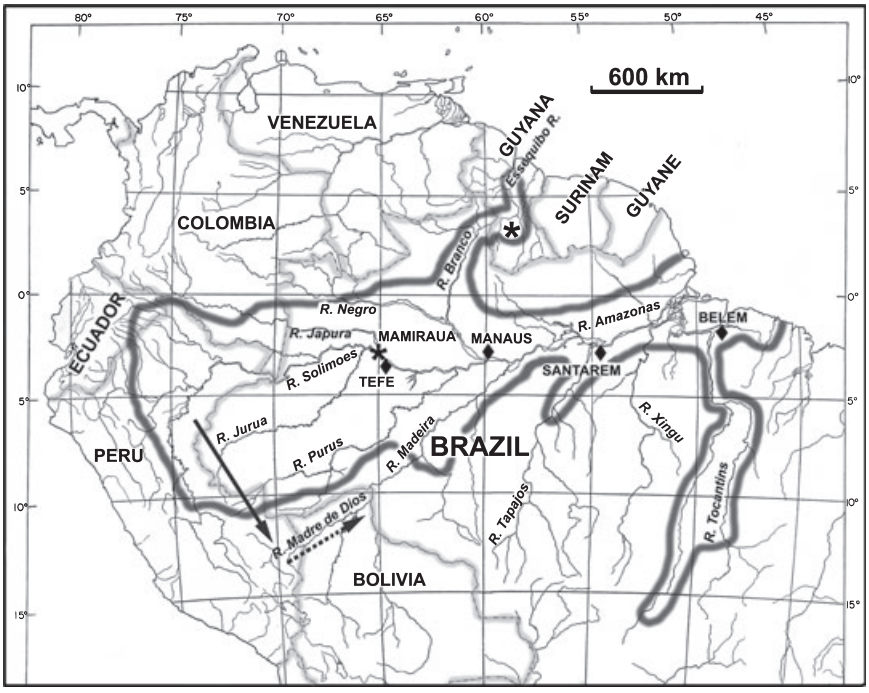

Fig. 1. Best available information on geographic distribution of *Arapaima* genus in northern South America (dark grey boundary). Stars = study areas. International boundaries shown as light grey bands; diamonds mark cities mentioned in the text. Solid arrow = a translocation of cultured *Arapaima* above waterfalls and rapids of Madeira River, Peru; dashed arrow = subsequent downstream spread of breeding populations into Bolivia. Distribution boundary line = synthesis of published accounts, museum records, personal communications from colleagues and, where data were lacking, a Google Earth search for suitable lagoon habitats below physical barriers such as river rapids

time, the adults form pairs and reproduce between December and May each year (Queiroz, 2000). Both sexes build their nest in the margins and banks of lakes, temporary lakes, and connecting channels during rising water levels. The males protect their young by staying very close to them for about 3 months, feeding in the food rich environment of flooded forest. As water levels decline, adult *Arapaima* separate from their young, and they all migrate back to lower habitats of flooded forests. With further decline in water levels, they migrate to connecting channels and lakes.

Growth and reproduction. *Arapaima* are relatively long-lived fishes of fast body growth. *Arapaima* will grow to 70–100 cm in length and about 10 kg in weight in their first year of life, and about 160 cm and 45 kg in 3–4 years (Arantes, 2009). In Mamirauá, total lengths of up to 285 cm have been confirmed (L. Castello, pers. obs.), and female *Arapaima* mature sexually at about 1.68 m in total length (Queiroz, 2000; Arantes, 2009). Data indicate that *Arapaima* populations show great growth potential when juveniles and individuals engaged in reproduction are protected (Castello, 2007). For one studied population at the Mamirauá Reserve, total number of individuals more than 1 m long increased from about 2350 in 1999 to 20, 650 in 2006 (Castello et al., 2009). Similar trends were observed in other areas (Arantes et al., 2006, 2007). Aspects of fecundity and fertility of *Arapaima* remain unclear (Lowe-McConnell, 1964; Lüling, 1964; Neves, 1995).

Habitat. *Arapaima* inhabit most low-gradient (i.e. lowland) aquatic ecosystems of the Amazon and Essequibo basins, including (flooded) forests, rivers, lakes, and coastal drainages, usually up to the first major rapids or waterfall on a river (Fig. 1). There are commercially viable populations of *Arapaima* in degraded floodplains such as those in the Lower Amazon (McGrath et al., 1993), suggesting some degree of capacity to adapt to habitat or environmental changes.

Role in the ecosystem. *Arapaima* are large-bodied predators, and thus probably help regulate the stability of their ecosystems. They are primarily piscivorous, and their prey are generally abundant, small-bodied, detritivorous and omnivorous fishes (Sánchez, 1969; Queiroz, 2000). However, there are no studies on the ecosystem roles of *Arapaima*.

Global population size. It is impossible to estimate the population size of *Arapaima* in their entire range. Through a genetic analysis, Hrbek et al. (2005, 2007) estimated that the total population of *Arapaima* in an area greater than 100 000 km^2 in the Amazon basin was around 150 000 individuals. We believe such an estimate is unrealistically low because censuses made in the Mamirauá Reserve show that there are well-managed *Arapaima* populations with over 50 000 individuals in areas of less than 500 km^2 (Arantes et al., 2006, 2007). Population census data from managed and non-managed areas also show that population densities vary greatly depending on management activities, from 0 to 200 individuals per ha (L.C., unpubl. data), making it difficult for extrapolation of population census data to larger areas.

Current global population trends. Global population trends of *Arapaima* are likely decreasing in the entire Amazon basin. In the 1800s and early 1900s, *Arapaima* were the most important fishery of the Amazon (Veríssimo, 1895), but landings and size of captured individuals were reduced drastically by the 1950s (Isaac et al., 1993; Fig. 2). Data from localities in the Central and Lower Amazon regions show predominance of juveniles (Fig. 2), a common sign of overexploitation. The most complete and longest time-series of data available for *Arapaima* are weight data of sun-dried, boneless fillets landed in Manaus, the largest city of the Amazon (Fig. 2). Such time series data illustrate the paucity of data, although the accuracy of the data is questionable. Landing data from Manaus city may be biased due to underreporting of catches by fishers or lack of monitoring activities (Castello et al., 2009). Similarly,

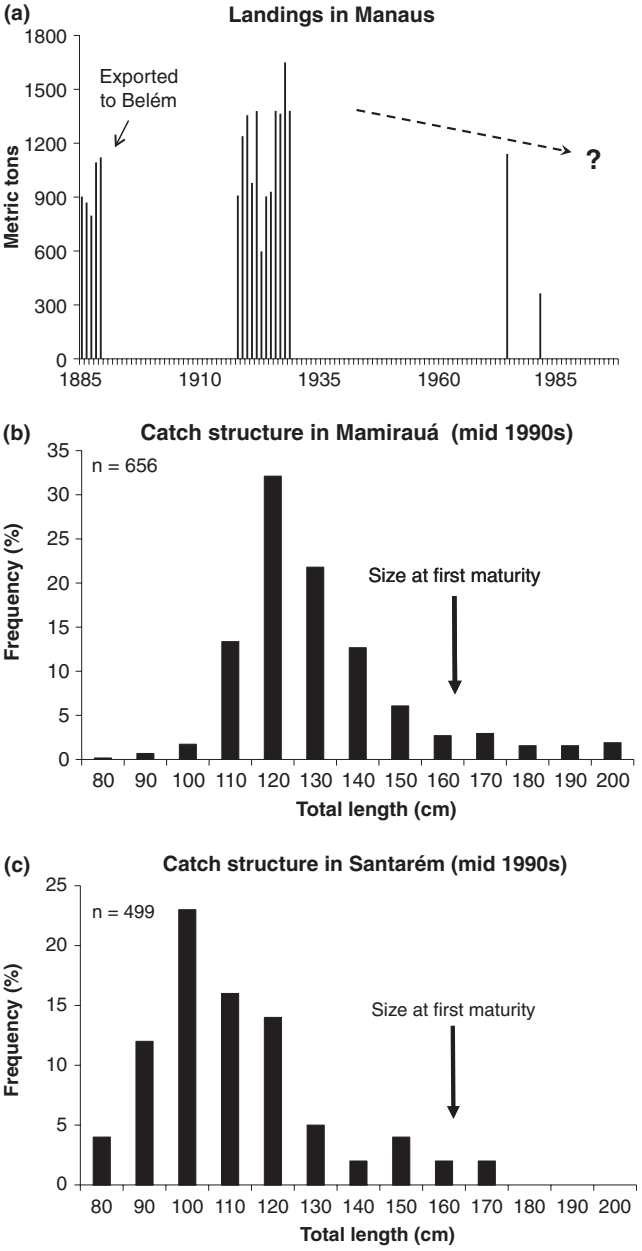

Fig. 2. Main data on landings and catch structure of *Arapaima* in Brazil. Top panel (a) data summary of *Arapaima* landings in Manaus (see map, Fig. 1). Data between 1889–1893 from Veríssimo (1895), refer to total exports from rural areas, State of Amazonas where Manaus is located, to the city of Belem (Fig. 1). Data for 1930s from Pereira (1954); 1979 and 1986 data summarized by Isaac et al. (1993). Middle (b) and bottom (c) panels = catch structure of *Arapaima*, Mamirauá Reserve and Santarém, respectively. Mamirauá data from Castello (2007); Santarém data estimated from analysis of dried tongue bones (Martinelli and Petrere, 1999). Size at first maturity from Queiroz (2000), consistent with more recent data (Arantes, 2009)

catch structure data from Mamirauá Reserve and Santarém city may be biased due to gear selectivity or underreporting of catches. There are no additional data on *Arapaima* populations, but reversal of that apparent resource decline trend is unlikely given lack of significant changes with respect to the principal causes of overfishing, at least at the appropriate spatial and temporal scale.

The only analysis of population trend done for *Arapaima* was by Queiroz and Sardinha (1999), with results in line with our above suggestion. Through a virtual population analysis, Queiroz and Sardinha (1999) concluded that fishing mortality rates at the Mamirauá Reserve (Fig. 1) in the early 1990s were exceedingly high and threatened the population with stock collapse. That population analysis was for an area of 562 km^2. Compounding the problem of data scarcity is the fact that the inherent variability of fish population dynamics in ecosystems such as the Amazon floodplains remains largely unknown. Therefore at present it is difficult to judge whether any observed population trend (or prediction, as in the case of Queiroz and Sardinha, 1999) is a natural or human-caused phenomenon.

Exceptions to the above-suggested trend include community-based conservation efforts. Several riverine communities are undertaking conservation activities related to *Arapaima* (McGrath et al., 1993; Castello et al., 2009), as their relatively small-ranging migrations make them suitable for small-scale management efforts. However, there are no data on the numbers of communities effectively conserving *Arapaima*, thus the geographical extent of these efforts remains unclear.

Conservation status. *Arapaima* were listed in the IUCN Red List as 'vulnerable' in 1986 and 1988, and then as 'insufficiently known' in 1990 and 1994 (World Conservation Monitoring Centre, 1996). The Red List criteria and category is now 'data deficient', which means that 'there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and / or population status.' *Arapaima gigas* is the only South American freshwater fish listed in CITES Appendix II. The conservation status of *Arapaima* in Brazil has not been rigorously assessed; they were not included in Brazil's recent list of threatened species commissioned by the Ministry of Environment.

Main threats. The principal threat appears to be overfishing, even though habitat degradation and by-catch are also issues of concern. Overfishing appears to be rampant in the entire region, except in a few local communities where they are being conserved with varying degrees of success. However, a lesser-known threat is long-distance translocation of specimens by aquaculture enterprises (L.C., pers. obs.), a process that threatens to homogenize the genetic pool and even possibly extirpate locally adapted races or species. Following a translocation by Peruvian authorities, *Arapaima* recently colonized areas of Bolivia for the first time (Fig. 1).

Management

Management measures. Government attempts to manage the *Arapaima* fishery in the Brazilian Amazon have been largely ineffective. IBAMA implemented a minimum catch length of 1.5 m in 1986 (Portaria nº 14-N, de 15 de fevereiro de 1993) and a closed season (December-May) in 1991 (Portaria Normativa nº 489 de 05 de Março de 1991). IBAMA also banned the *Arapaima* fishery in the State of Tocantins in 1990 (Portaria Normativa de 23 de Março de 1990), the State of Amazonas in 1996, and the State of Acre in 2008. But illegal fishing of *Arapaima* is so widespread that most *Arapaima* are now probably caught and traded illegally. Enforcement of the above management regulations is extremely poor because IBAMA lacks human and economic resources to do so effectively (Castello et al., 2009). Until 1999, the office of IBAMA in Tefé (Fig. 1), for example, was staffed by just eight agents, did not even possess a boat, and was responsible for an area of 251 000 km^2 (about the size of Italy).

A new management regulation implemented in 2004 in the State of Amazonas promoted a potentially promising strategy of management for *Arapaima*. The regulation exempted the existing ban for fishers that census their *Arapaima* populations, and was developed because of previous work done at the Mamirauá Reserve. Research in Mamirauá showed that expert fishers can assess accurately the *Arapaima* populations by counting individuals at the moment of aerial breathing (Castello, 2004). Accuracy of the counts was assessed through direct comparison with mark-recapture and total catches. This methodology was used in a system in which local fishers assess *Arapaima* populations each year, then collaborate with the Mamirauá Institute and IBAMA to use the data in determining fishing quotas for the next year (Viana et al., 2004). In this system, the Mamirauá Institute provides institutional and technical assistance to local fishers, IBAMA oversees management actions and approves (or not) legal permits for the annual fishing quotas, and the fishers are responsible for complying and enforcing management regulations. Due to lack of information fishing quotas to date have been determined based on trial-and-error and educated guesses. Nine years of experimentation have shown that where this management model was implemented, fishers' profits more than doubled, fishers engaged in the process, and *Arapaima* populations recovered rapidly (Viana et al., 2004; Castello et al., 2009). Those population trends were compared to neighboring populations that remained stable at low densities, suggesting that the observed trends were the result of local management efforts (Castello et al., 2009). Incorporation of that management system into regional legislation in 2004 was followed by rapid dissemination. Whereas in 1999 only four riverine communities used it to manage *Arapaima*, more than 100 communities in the State of Amazonas now use it (including two regional cities). Similar legislation has been established in the State of Acre in Brazil in 2008, and in Guyana in 2006.

Monitoring system. Lack of information on population levels and associated harvests has been a major issue impeding sustainable management of *Arapaima* (Castello, 2004). Conventional mark-recapture methods are prohibitively difficult due to costs, labor, and the enormous geographic areas involved; monitoring of landings is practically impossible because of the decentralized and illegal nature of the trade. In many instances, reported landings can be as little as one-fifth of the actual *Arapaima* catch. Effective monitoring of the catch can be made in riverine communities, but requires much effort in developing trust with fishers.

Utilization, trade, and harvest

Utilization and trade. Most wild *Arapaima* are harvested by local fishers, commercialized through middlemen, and

consumed in regional urban centers. *Arapaima* are key food resources because their air-breathing behavior makes them vulnerable to expert fishers who use harpoons and can choose the larger individuals. Also, a high proportion of their body (Bard and Imbiriba, 1986) is boneless, tasty meat that can be iced or salt-dried for future consumption or commercialization.

Harvest. Most harvesting of wild *Arapaima* is done during the dry season roughly between September and January each year when water levels in the floodplains are low and fish densities high (Veríssimo, 1895). Fishing is done using gillnets and / or harpoons. Gillnets are now widely used and harpoon usage is likely decreasing. Harpooning, however, is the most traditional fishing method (at least since the early 1800s) and preferred by expert fishers. Other fishing methods such as hook and line and traps are also used. Another (probably much smaller) source of harvest is the collection of young wild *Arapaima* to supply increasing numbers of (often large) aquaculture enterprises. Because the technology to breed *Arapaima* is in its infancy, most aquaculture enterprises depend on continuous collection of wild specimens. Cultured *Arapaima* are now routinely commercialized in most large urban centers in the Amazon. However, official data on such harvests and translocations are not available.

Brazil's NDF procedures

Application of IUCN's checklist for making NDF and assessment of Brazil's regulations for NDF procedures show that there is insufficient information to produce reliable NDFs and that certain regulatory deficiencies undermine the potential quality of NDF reports. Thus, the case of *Arapaima* in Brazil illustrates some of the deficiencies of NDF procedures worldwide.

IUCN's checklist for making NDF. Application of IUCN's checklist for making NDF for *Arapaima* in Brazil showed the most problematic area as being the management of the harvest (Fig. 3). Factors related to the biology and management of *Arapaima* received the highest scores (Fig. 3, right side), a result of the apparent biological adequacy to harvesting and existence of management regulations. However, factors related to status, control, monitoring, incentives, and protection received the lowest scores (Fig. 3, left side), a result of lack of enforcement and monitoring schemes as well as widespread illegal fishing.

We note that IUCN's checklist for making NDFs is intended to serve even when considerable guesswork is necessary (Appendix I), although the results can obviously vary among users. However, we suspect that our colleagues working in the more data-rich regions of the globe may be inclined to assign scores that are even lower than those assigned by us in the present study. Our conclusion that it currently is impossible to make reliable NDFs is likely conservative.

Brazil's NDF procedures. Brazil's regulations concerning NDF procedures for CITES species in Appendix II are detailed in Decreto Lei N^{o} 3,607 from 21 September 2000. Article 8 therein is the only regulation concerning NDF. As noted above, *Arapaima* is the only CITES Appendix II fish in Brazilian freshwaters. This law establishes that the 'scientific authority' must issue a technical opinion report attesting that the export will not undermine survival of the species, and that such a report must be submitted to the 'administrative authority'. This technical report requirement is exempted for specimens raised in captivity (Article 17). Decreto Lei 3,602 also has several other regulations on CITES species in Brazil, but most of those focus on administrative procedures, conditions of transport of specimens, etc.

There are two problems with those procedures. First, it would be nearly impossible for any scientific authority to be able to issue a technical opinion report showing evidence that the export will not undermine the survival of the species, as required by Decreto Lei 3,602, because there is a paucity of information on wild *Arapaima* populations. As we explained, there are critical uncertainties with respect to taxonomy, population size and trend, and total harvest. Also, existing schemes to monitor wild populations and manage associated harvests are wholly ineffectual. Previous exports may have been authorized despite lack of data, because there is no requirement for scientific evidence in the technical opinion reports. To our knowledge, the only area in Brazil with sufficient information for issuing an NDF report is the Mamirauá Reserve (Fig. 1), where since 1999 an annual census is taken of well-managed populations of *Arapaima* under intensive study (Castello et al., 2009). Second, Brazil's NDF procedures cannot ensure that *Arapaima* specimens are

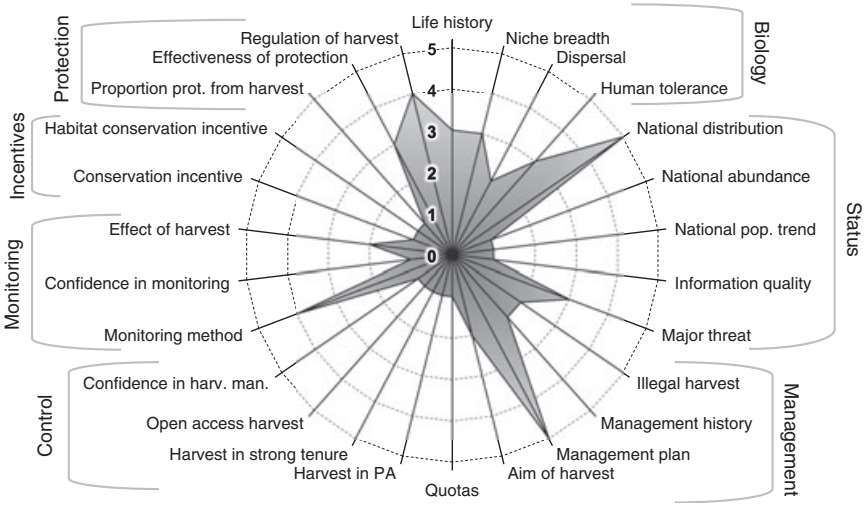

Fig. 3. Radar graph of factors affecting management of *Arapaima* in Brazil. See Appendix I for data

exported legally without detriment to wild populations, because Article 17 does not specify that exported specimens have to originate from a 'captive bred' population (i.e. self-sustaining population). Under present regulations, aquaculture enterprises in Brazil can collect *Arapaima* from the wild to subsidize 'captive' populations, in fact routinely done for use in exports. Furthermore, Article 17 is unclear about the definition of the term 'captivity'. Aquaculture enterprises may have facilities that are naturally connected to surrounding waterbodies, and such connections may also passively supply 'captive' populations with wild *Arapaima*. This seemingly unlikely scenario is quite possible in floodplains of the Amazon where water levels vary seasonally by up to 15 m and where cages or pens are rarely used in aquaculture. Fortunately, these issues have recently begun to be addressed by IBAMA through routine inspections of aquaculture enterprises to ensure that *Arapaima* are captive bred (José Dias Neto, Coordenador geral de Gestão de Recursos Pesqueiros, IBAMA, Brasilia, pers. comm.).

Toward reliable NDFs

Our analysis has shown that there is potential for sustainable harvests of *Arapaima* in Brazil, and hence NDF, but such potential is not being achieved because of deficiencies in NDF procedures and lack of management capacity. Therefore, we suggest six recommendations to improve NDF procedures in Brazil. (i) *Arapaima* listing in CITES Appendix II could be based on the genus name to provide urgently needed protection to all possible species therein, at least until the taxonomy is better resolved and the status of each taxon is evaluated. (ii) Adaptive management strategies for *Arapaima* that use a yearly census (Castello, 2004; Arantes et al., 2007) to determine yearly harvest quotas of sexually mature individuals could improve future NDF report reliability. The counting of *Arapaima* when combined with catch monitoring, which we suggest can be done, provides a useful framework that addresses current weaknesses and focuses on strategic data. (iii) NDF reports prepared by scientific authorities and submitted to administrative authorities for licensing of exports of CITES species could be based on IUCN's checklist for NDF procedures. (iv) All documents used in licensing of exports of CITES species could be publicly available, as CITES species are a matter of public concern. (v) NDF report exemptions for cultured CITES species could be based on evidence that captive populations are self-sustaining and independent of wild populations. (vi) Greatly increased attention of governments worldwide to promote the study and monitoring of key fish resources such as *Arapaima*. Even the most elaborate system for making NDF procedures cannot overcome the impossibility of assessing fish resources for which there are no data. In the preceding list we have identified various knowledge gaps and deficiencies in monitoring and management activities that could be targeted in future efforts.

Lack of management capacity of *Arapaima* (Fig. 3) can be strengthened through intensive monitoring of wild populations combined with adaptive harvesting. Sound monitoring of harvested populations is most important because the effects of harvesting on wild fauna and flora most often are manifested by population decline (Walters, 1986), although obviously many other issues are key for the survival of any species. Participatory monitoring and management of *Arapaima* populations, as in the Mamirauá Reserve, can be very useful because *Arapaima* populations can be counted with accuracy, precision, and cost-effectiveness unparalleled in fisheries. Counts of *Arapaima* by experienced fishers have been shown to vary by 10–30% in the actual numbers of individuals (Castello, 2004; Arantes et al., 2007) and are about 200 times faster and less expensive than abundance estimates obtained through mark-recapture methods (Castello et al., 2009). Thus, annual harvests can be determined rather safely if based on continuous monitoring and assessment of population trends. However, this strategy can only work if population monitoring is reliable and harvest control is effective (i.e. minimal illegal harvesting). This is key, as was investigated and noted earlier (Castello, 2004, 2007; Arantes et al., 2006, 2007; Castello et al., 2009). Yet increasing numbers of government and non-governmental organizations have been promoting the use of population counts of *Arapaima* with little attention given to the quality of monitoring or regulation enforcement.

For improving the preparation of NDF procedures in other tropical developing countries, we highlight the utility of resource use approaches that are synergistic and participatory. The management system for *Arapaima* at the Mamirauá Reserve has been effective largely because the Mamirauá Institute, IBAMA, and local fishers have been collaborating in such a way that has overcome issues of lack of monitoring and management control capacity. There is increasing recognition worldwide that similar resource use approaches have already become essential elements of the fisheries management paradigm worldwide (Berkes et al., 2001; Castilla and Defeo, 2005; Orenzans et al., 2005) and in Brazil (Castello, 2008c). They could now be increasingly incorporated in broad-ranging arrangements such as CITES and NDF procedures.

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Appendix I

Questions related to main factors affecting *Arapaima* harvesting regime. Response values represent scores from 1 to 5 given to specific questions. Meanings of questions explained in Rosser and Haywood (2002).

Biology

Life history: What is the species' life history? 5) High reproductive rate, long-lived; 4) High reproductive rate, short-lived; 3) Low reproductive rate, long-lived; 2) Low reproductive rate, short-lived; 1) Uncertain

Ecological adaptability: To what extent is the species adaptable (habitat, diet, environmental tolerance etc.)? 5) Extreme generalist; 4) Generalist; 3) Specialist; 2) Extreme specialist; 1) Uncertain

Dispersal efficiency: How efficient is the species' dispersal mechanism at key life stages? 5) Very good; 4) Good; 3) Medium; 2) Poor; 1) Uncertain

Interaction with humans: Is the species tolerant to human activity other than harvest? 5) No interaction; 4) Pest / Commensal; 3) Tolerant; 2) Sensitive; 1) Uncertain

Status

National distribution: How is the species distributed nationally? 5) Widespread, contiguous in country; 4) Widespread, fragmented in country; 3) Restricted and fragmented; 2) Localized; 1) Uncertain

National abundance: What is the abundance nationally? 5) Very abundant; 4) Common; 3) Uncommon; 2) Rare; 1) Uncertain

National population trend: What is the recent national population trend? 5) Increasing; 4) Stable; 3) Reduced, but stable; 2) Reduced and still decreasing; 1) Uncertain

Quality of information: What type of information is available to describe abundance and trend in the national population? 5) Quantitative data, recent; 4) Good local knowledge; 3) Quantitative data, outdated; 2) Anecdotal information; 1) None

Major threats: What major threat is the species facing (underline following: overuse / habitat loss and alteration / invasive species / other: and how severe is it? 5) None; 4) Limited / Reversible; 3) Substantial; 2) Severe / Irreversible; 1) Uncertain

Management

Illegal harvest or trade: How significant is the national problem of illegal or unmanaged harvest or trade? 5) None; 4) Small; 3) Medium; 2) Large; 1) Uncertain

Management history: What is the history of harvest? 5) Managed harvest: ongoing with adaptive framework; 4) Managed harvest: ongoing but informal; 3) Managed harvest: new; 2) Unmanaged harvest: ongoing or new; 1) Uncertain

Management plan or equivalent: Is there amanagement plan related to the harvest of the species? 5) Approved and co-ordinated local and national management plans; 4) Approved national / state / provincial management plan(s); 3) Approved local management plan; 2) No approved plan: informal unplanned management; 1) Uncertain

Aim of harvest regime in management planning: What is harvest aiming to achieve? 5) Generate conservation benefit; 4) Population management / control; 3) Maximize economic yield; 2) Opportunistic, unselective harvest, or none; 1) Uncertain

Quotas: Is the harvest based on a system of quotas? 5) Ongoing national quota:based on biologically derived local quotas; 4) Ongoing quotas: "cautious" national or local; 3) Untried quota: recent and based on biologically derived local quotas; 2) Market-driven quota(s), arbitrary quota(s), or no quotas; 1) Uncertain

Control

Harvesting in Protected Areas: What percentage of the legal national harvest occurs in State-controlled Protected Areas? 5) High; 4) Medium; 3) Low; 2) None; 1) Uncertain

Harvesting in areas with strong resource tenure or ownership: What percentage of the legal national harvest occurs outside Protected Areas, in areas with strong local control over resource use? 5) High; 4) Medium; 3) Low; 2) None; 1) Uncertain

Harvesting in areas with open access: What percentage of the legal national harvest occurs in areas where there is no strong local control, giving de facto or actual open access? 5) None; 4) Low; 3) Medium; 2) High; 1) Uncertain

Confidence in harvest management: Do budgetary and other factors allow effective implementation of management plan(s) and harvest controls? 5) High confidence; 4) Medium confidence; 3) Low confidence; 2) No confidence; 1) Uncertain

Monitoring

Methods used to monitor the harvest: What is the principal method used to monitor the effects of the harvest? 5) Direct population estimates; 4) Quantitative indices; 3) Qualitative indices; 2) National monitoring of exports; 1) No monitoring or uncertain

Confidence in harvest monitoring: Do budgetary and other factors allow effective harvest monitoring? 5) High confidence; 4) Medium confidence; 3) Low confidence; 2) No confidence; 1) Uncertain

Utilization compared to other threats: What is the effect of the harvest when taken together with the major threat that has been identified for this species? 5) Beneficial; 4) Neutral; 3) Harmful; 2) Highly negative; 1) Uncertain

Incentives

Incentives for species conservation: At the national level, how much conservation benefit to this species accrues from harvesting? 5) High; 4) Medium; 3) Low; 2) None; 1) Uncertain

Incentives for habitat conservation: At the national level, how much habitat conservation benefit is derived from harvesting? 5) High; 4) Medium; 3) Low; 2) None; 1) Uncertain

Protection

Proportion strictly protected: What percentage of the species' natural range or population is legally excluded from harvest? 5) $>15\%$; 4) 5-15%; 3) $<5\%$; 2) None; 1) Uncertain

Effectiveness of strict protection measures: Do budgetary and other factors give confidence in the effectiveness of measures taken to afford strict protection? 5) High confidence; 4) Medium confidence; 3) Low confidence; 2) No confidence; 1) Uncertain

Regulation of harvest effort: How effective are any restrictions on harvesting (such as age or size, season or equipment) for preventing overuse? 5) Very effective; 4) Effective; 3) Ineffective; 2) None; 1) Uncertain

Assessing CITES Non-detriment Findings Procedures for *Arapaima* in Brazil

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ABSTRACT

Arapaima are listed as endangered fishes according to Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES). However, international trade of *Arapaima* is regulated by non-detriment finding (NDF) procedures, which have not been very effective. Here, we use IUCN's checklist for making NDFs to critically assess Brazil's regulations for NDF procedures for *Arapaima*. We show that Brazil's NDF procedures cannot ensure the sustainability of *Arapaima* populations. *Arapaima* are among the largest fishes worldwide. They migrate short distances among several floodplain habitats, and are very vulnerable to fishing during spawning. They are threatened mainly by overfishing and the fishery is largely unregulated, because government regulations on size, season, and even moratorium of capture have been very poorly enforced. However, *Arapaima* remain poorly understood. The taxonomy and geographical distribution of the genus remain uncertain. There are no data on catch levels and status of wild populations, although available information suggests they are declining. Brazil's NDF procedures for specimens originating in the wild are inadequate because they rely on 'technical opinion reports', which do not necessarily require

scientific evidence. Furthermore, Brazil's NDF procedures exempt the need for NDF reports for 'captive' specimens. But 'captive' specimens that originate in the wild and are raised in captivity can be exported freely because regulations do not specify that they must be 'captive-bred'. We offer five suggestions to improve the reliability of NDF procedures for *Arapaima* in Brazil, and emphasize the utility of participatory monitoring and adaptive harvesting to strengthen much needed harvest control capacity in other tropical developing countries.

NDF WORKSHOP CASE STUDIES
WG 8 – Fishes
CASE STUDY 2
Anguilla anguilla
Country – **SWEDEN**
Original language – Spanish

NON DETRIMENT FINDINGS FOR THE EUROPEAN EEL - THE SWEDISH CASE

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I. Background information on the taxa

1. BIOLOGICAL DATA

1.1 Scientific and common names

European Eel (*Anguilla anguilla* (L.)

1.2 Distribution

The European Eel is continuously distributed from North and Northwest Africa in the South, to northern Norway and the White Sea in the North. They occur from islands as Iceland, Madeira and the Canary Islands in the Atlantic to Turkey and Egypt in Eastern Mediterranean Sea (see the map). Despite their unique capabilities to migrate upstream they occur more and more sparsely with distance from the sea and with the number of dams and other obstacles. Therefore today's distribution is very much reduced compared to pristine conditions.

1.3 Biological characteristics

1.3.1 *Life history characteristics of the species*

Anguilla anguilla is a amphihaline, demersal, catadromous species that occurs in many different environments from pure freshwater lakes and streams to fully marine areas. Brackish water areas as estuaries are commonly occupied by eels. They reproduce in the Sargasso Sea which is situated between Bermuda and Puerto Rico (very roughly). After

spawning at considerable depths during early spring in the Sargasso Sea the adults die and the larvae (*Leptocephalus*) are transported by the Gulf Stream and the North Atlantic Current towards the European and North African Coasts. This transport is believed to take between one and three years. When arriving at the Continental Shelf in winter they metamorphose into glass eels, i.e. small but transparent eels of about 0,3 gram each. When water temperatures increase during spring some glass eels settle in coastal areas while others continue towards estuaries and freshwater environments (Figure 1).

After growing as pigmented yellow eels for many years they metamorphose to fat silver eels, i.e. a pre-pubertal stage prepared for a long migration back to the Sargasso Sea. The distance varies, but e.g. from the Baltic Sea eels have to swim about 7500 km to reach the spawning area. Their optimum temperature for growth is about +25 °C although they are found and survive in low temperatures as in Northern Scandinavia and at high temperatures as in North African lagoons. Under good conditions for growth they will reach the silver eel stage in about 5 years (for females), while in Scandinavia silver eels are often from about 15 to 25 years old. A few individuals become very old and large. Male eels are much smaller than females and do seldom reach more than 40 cm in length, compared to more than one meter in the largest females. With that male silver eels are usually younger than females and thus have a shorter generation time. Sex differentiation in eels is probably influenced by environmental conditions as temperature, growth rate and population densities with males dominating in heavily populated environments (often estuaries) while females normally dominate in upstream freshwater sites.

As a catadromous, slow growing species eels are exposed to many threats as fishing for all stages, upstream migration obstacles as innumerable dams, weirs and sluices, downstream obstacles as hydropower turbines and a general decrease in accessibility to former feeding areas. As a fat, long lived, semelparous fish species eels also accumulate a wide range of persistent organic pollutants (POPs) as DDT, PCBs, and dioxins, which is known to disturb their reproductive success.

1.3.2 *Habitat types*

Anguilla anguilla occupies a wide range of habitats from cool oligotrophic freshwater systems in Scandinavia to warm, hyper-saline eutrophic lagoons in the Mediterranean area. As a sub-tropical species of origin warm and productive waters are preferred. Eels, in particular small eels have a unique capability to pass obstacles as dams and water falls. However, every obstacle decreases the number of recruits passing upstream.

1.3.3 *Role of the species in its ecosystem*

Eels are omnivorous and feeds on what is easily available. Common food items for small eels are benthic animals as small crustaceans, molluscs and insect larvae, while in larger eels fish most often dominates as food. It seems quite few species predates on the night-active eel, particularly on large eels. Otters, seals, belugas, cormorants and bitterns are often mentioned as predators on eels. As omnivorous, no particular species seems to be threatened by the European eel, except the European crayfish (*Astacus astacus*, L.) which is shown to suffer from predation by eels.

1.4 Population

1.4.1 *Global Population size*

Anguilla anguilla is considered as one panmictic population. However, there are some weak genetic differences on a temporal scale, between different cohorts recruiting from the Sargasso Sea to continental Europe. The global population size of *Anguilla anguilla* is not known, although there are a few estimates of Ne (the effective population size) that indicates an alarmingly low global population size. However, trends in recruitment and in commercial catches and also some CPUE-series clearly demonstrate a dramatic decline since the late 1970s. EIFAC/ICES WGEEL has estimated that recruitment to continental Europe is now down to a few percent of the figures from the late 1970s.

1.4.2 *Current global population trends*

___increasing _X___decreasing ____stable ____unknown

1.5 Conservation status

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

_X_Critically endangered ___Near Threatened
___Endangered ___Least concern
___Vulnerable ___Data deficient

1.5.2 *National conservation status for the case study country*

Anguilla anguilla is listed in Sweden as critically endangered (CR) since 2005. In a future one might consider also to ammend Anguilla anguilla in the national legislation; the Species Protection Act 2007:845, as a species of national interest. The Species Protection Act 2007:845 prescribes that operations trading live specimens listed on annex A or B to the Council regulation EG no 338/97 (CITES appendix I or II) must have a license of operation. When having this license of operation you

are obliged to once a year send in a report over the trade carried out the year before, to the County Administrative Board. This will be in place when the regulation comes into force the 13 of mars 2009.

1.5.3 *Main threats within the case study country*

In Sweden the eel is under the same threats are as in most countries, viz. a high fishing mortality, inaccessibility to suitable growing areas, obstacles for both up- as downstream migration and high mortalities on hydropower screens and in turbines. In addition come POPs and several diseases and parasites. Among the latter, the introduced swim bladder parasite, *Anguillicola crassus*, does probably pose a significant hazard to a successful reproduction.

In contrast to countries in the core area of recruitment as France, Spain, Portugal and the UK, there is no fishery for glass eels in Sweden. The export of glass eels to countries outside the natural distribution area is otherwise considered as one major threat to the population of the European eel.

___No Threats
_X_Habitat Loss/Degradation (human induced)
_X_Invasive alien species (directly affecting the species) Parasites as A. crassus
_X_Harvesting [hunting/gathering]
___Accidental mortality (e.g. Bycatch)
___Persecution (e.g. Pest control)
_X_Pollution (affecting habitat and/or species)
_X_Other__Mortalities on hydropower screens and in turbines. Predation, mainly from a growing population of cormorants. _____
___Unknown

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

2.1 Management measures

2.1.1 *Management history*

In Sweden there were few management measures in force before 2007, when fishing for eel was prohibited for most fishermen, recreational as commercial. One important exception to this general rule includes commercial fishermen who can prove that eels constitute a significant part of their total catch and income. Freshwater areas above three hydropower turbines were also exempted from this ban as eels from such areas would suffer very high mortalities if and when migrating downstream towards the sea and the spawning site. In addition to this

general ban, also minimum legal sizes are in force as well as some restrictions in the number of fishing gears allowed per fisherman.

2.1.2 *Purpose of the management plan in place*

Today's management plan aims at breaking the negative trend in recruitment by allowing more spawners to reach the Sargasso Sea. The recent eel regulation set up by the European Council (EC 1100/2007) requires in the long run the release of 40 % in biomass of the silver eels that left each country or river basin district during a hypothetical pristine condition without mortalities induced by man. Each member state has to give in an Eel management Plan (EMP) before the end of 2008 describing how to reach this target.

2.1.3 *General elements of the management plan*

The Swedish Eel Management Plan (EMP) that covers the whole country is based on three fundaments, namely reduced fishing mortality, restocking with glass eels from areas with local surplus (in this case, the River Severn in UK) and by improving conditions for eel migration, both up- as down stream.

2.1.4 *Restoration or alleviation measures*

The hydropower industry has promised to improve the survival of downstream migrating silver eels passing intake screens (trash racks) and turbines in order to allow a mortality of 40 % only and that on the national scale. This will probably be done by cost-efficient measures at some selected hydropower stations while others have to wait before taking care of. These measures will be taken on a voluntary basis, instead of going through a number of slow legal processes in the Water-Rights Court. Also the upstream migration will be enhanced by the use of artificial eel passes enabling young eels to pass man-made dams.

2.2 Monitoring system

2.2.1 *Methods used to monitor harvest*

With today's legislation the fishermen still allowed to catch eels are obliged to report their catch using a logbook system. From the recreational fishery that still is allowed, i.e. upstream three hydropower turbines only eels that are sold in any quantities are reported to the Board of Fisheries. In parallel with the logbook system there is also a system based on contract notes drawn up by wholesale traders buying eels from the fishermen.

Besides monitoring harvest, recruitment is also monitored, mainly by collecting data on numbers of young eels caught in special traps

(eel passes) when ascending rivers. From such data a national recruitment index is built. This kind of monitoring is believed to react more directly to increased numbers of spawners leaving from Sweden, rather than waiting for higher abundances of juvenile and adult eels.

2.2.2 *Confidence in the use of monitoring*

Since 2007 when today's general ban of eel fishing came in force, most of the recreational and small scale eel fisheries is stopped and a fisherman who would like to continue with his eel fishery has to apply for a special permit or license each year. This permit is based on catch in preceding years and therefore most eel fishermen are quite concerned about reporting their correct landings.

2.3 Legal framework and law enforcement

From July 2009 the new EMP will come in force, i.e. if and when approved by the European Commission. The EMP will probably include an additional reduction in fishing efforts, increased restocking and improved possibilities for migration. The EMPs will also require different monitoring systems estimating the compliance with the 40% target set up by the European Council. The Data Collection Regulation (DCR) (EC No 199/2008) does also require a certain level of monitoring, not only of harvest/catch but also effort, capacity of the fleet etc.

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

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

Eels are used for human consumption and there is a large-scale international market where Japan, followed by Korea and Hongkong are the main consumers of most eel species taken together. From Sweden most eels are exported live, fresh or frozen to The Netherlands, Germany and Denmark. At the same time there is also a considerable import from Norway and from Denmark. The trade between countries is complex and difficult to follow. Also other species than *Anguilla anguilla* occur on the market, as well as *Anguilla anguilla* produced in aquaculture. Eel aquaculture is totally based on glass eels caught in nature and an extensive artificial production of eels is still to wait for. EIFAC/ICES WGEEL has estimated that aquaculture and capture fisheries for *Anguilla anguilla* in Europe are of equal size where both produce about 10 000 tons per year.

Several tons of pre-grown glass eels from aquaculture are also used for restocking purposes.

3.2 Harvest:

3.2.1 *Harvesting regime*

Eels of all sizes and stages are fished for. Where glass eels were and still are common there is a commercial fishery for them, traditionally for direct consumption. Today there is a large demand for European glass eels to be used as seed in aquaculture both in Europe and in e.g. China. Migrating silver eels are the main target for the traditional eel fisheries that are performed in Northern Europe as e.g. the Baltic Sea. Yellow eels of all sizes are also exploited in most countries where they occur. In Sweden the smallest minimum legal size that applies is 350 mm and thus there is no glass eels fishery. Characteristic to all eel fisheries are that they are often small-scaled and scattered, performed by single fisherman from small boots.

3.2.2 *Harvest management/ control (quotas, seasons, permits, etc.)*

As already described the main management tools includes a legislative demand for a special eel fishing permit and there are also minimum legal sizes and a restriction in effort (number of fishing days and fishing gears) in force. However there is no quota system in action applied.

The Swedish EMP in progress will most probably introduce additional restrictions from 2009 to increase the production of healthy silver eels allowed to leave for their spawning migration to the Sargasso Sea.

3.3. Legal and illegal trade levels

Being a fairly well paid species, eels are often traded outside the legal frames or that the legal demand for e.g. catch statistics does not cover small and/or recreational fisheries. From several questionnaires it has been estimated that recreational catches of eel (both from simple rod and line fishing as well as from fishing where professional fishing gear like fyke nets were used) added 50 % to the known and reported commercial catch of eels. However, the new legislation in force since 2007 has probably improved the situation quite considerably. Additional restrictions that will come in force in 2009 as a result of the EC Regulation 1100/2007 will furthermore reduce the amounts of eel traded outside the system. Official figures show that in 2077, 348 tons of live eel were exported at the same time as 125 ton was imported to Sweden. The trade with 3rd countries (i.e. outside EU) is monitored by Swedish Customs while Eurostat monitors the trade within the EU.

II. Non-detriment finding procedure (NDFs)

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

_X_ yes ___ no

So far most actions towards the restoration of the European eel have been done outside the concept of NDF. Not until very recently this concept was raised and is now discussed within the Scientific Review Group of the European Commission and its Ad hoc Eel Working Group. Some preliminary attempts have been made using the criteria in the IUCN checklist for NDF evaluations, including the preparation of "radarplots". When assessing the risk of extinction the IUCN Red list criteria were used. The European eel was listed on the National Swedish Red list as Critically Endangered (CR) in 2005 and that was followed by Norway and Germany. In the autumn 2008 also IUCN entered Anguilla anguilla as CR to their Red list.

2. CRITERIA, PARAMETERS AND/OR INDICATORS USED

Most of the following points refer to the red-listing procedure, but some of them are valid also when trying to formulate a NDF. In lack of absolute data on the population size Sweden used trends in recruitment series and commercial catch data as proxies for the stock. The following criteria were mainly used when assessing the status of the European eel from a national Swedish perspective, a reduction in recruitment of more than 90 % in less than three generations (60 years) and the fact that Sweden hosts more than 2 % of the total population of the panmictic European eel. The resulting classification then became CR *A2bcd+3d+4bcd* (ArtDatabanken, SLU 2006). One important indicator when assessing compliance with the management targets is recruitment indices, as the number of ascending young eels in rivers.

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

The trend in a national recruitment index was used when evaluating the decline in the Swedish part of the panmictic eel population. Corresponding data on the "Swedish" proportion of the total population were based on the commercial catch compared to the total catch of eels within the whole distribution area. As a panmictic species with a very wide geographical distribution, the eel population can only be managed and conserved on an international level. Both WGEEL, which is a joint EIFAC/ICES working group and the European Commission

work on these issues and WGEEL collects and provides most data and gives advice both to ICES, EIFAC and the European Commission. When trying to apply the criteria in the IUCN checklist input data mainly comes from what is available within each country and from what is compiled by this WGEEL and presented in their comprehensive reports. No single country has a complete overview of this panmictic species.

4. EVALUATION OF DATA QUANTITY AND QUALITY FOR THE ASSESSMENT

The lack of reliable and absolute data on the eel population is a constraining factor and generally indirect and relative trends and indices have to be employed. When trying to use the IUCN checklist it becomes clear that the population is in bad status mainly with concern to a low human tolerance, negative population trends, major threats, no catch quotas, no protected areas, low confidence in harvest management and a lacking protection. However, more and better data will become available in Europe within a few years when the EMPs and DCR have been fully implemented and operational. The EC Eel Regulation and the coming national EMPs will hopefully improve the situation mainly through a better protection, monitoring and control.

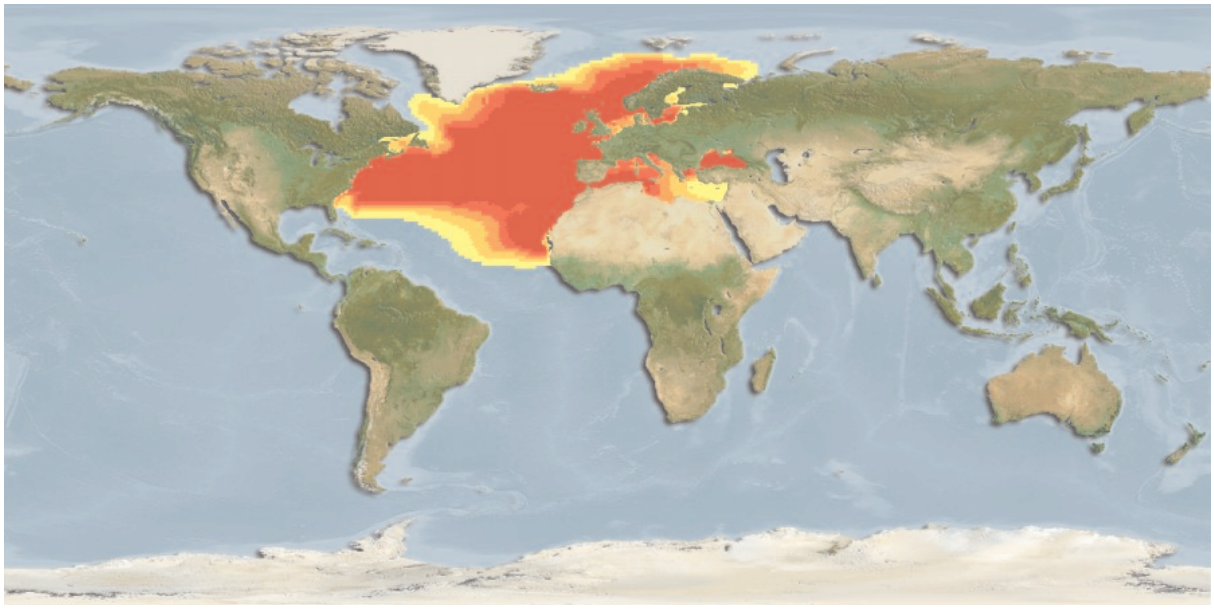
Main problems, challenges or difficulties found on the elaboration of NDF

Anguilla anguilla is widely distributed in Europe and in parts of Africa and the Middle East. That means at least 40 range states have to come to a common agreement and that on very different basis of knowledge and varying importance of eels in different countries, respectively. Within the SRG, (Scientific Review Group, established in accordance to EC Regulation 338/97 and consisting of representatives from the Member States' Scientific Authorities) and its ad hoc Eel Working Group, two quite different standpoints were recently taken. One advocate a local approach, i.e. to look at the situation at the river basin or country level, trying to estimate if there are local surpluses that could be exported out from the species' natural distribution range or not. The other view is to consider the whole population as such and weigh between deficits in some areas against surpluses in other areas and from that balance decide if there is room for exports without being detrimental to the survival of the species. In the first case a NDF might be possible, whereas in the latter case it is impossible and a stop for export is the consequence.

5. RECOMMENDATIONS

A panmictic population that has declined to very low levels as the European eel cannot be managed on a local or national scale. Instead

potential surpluses on a local scale may counterbalance deficits in other areas. This can be done through restocking suitable areas of high qualities for eel survival and growth with free access to the sea with glass eels from areas where glass eels still occur in abundance (above carrying capacity). Correspondingly, compliance with set targets (by the European Council) may well be assessed using both local indicators as well as stock wide indicators compiled by the EICAC/ICES Eel Working Group. A first natural checkpoint will be in 2012 when the EU Commission will make their first evaluation of the measures in action. This occasion seems appropriate also to reconsider if a NDF is possible on the species level making full use of all new data and experience made available through the monitoring required by the EC Regulation.



Distribution map (from FishBase 2008-11-03)

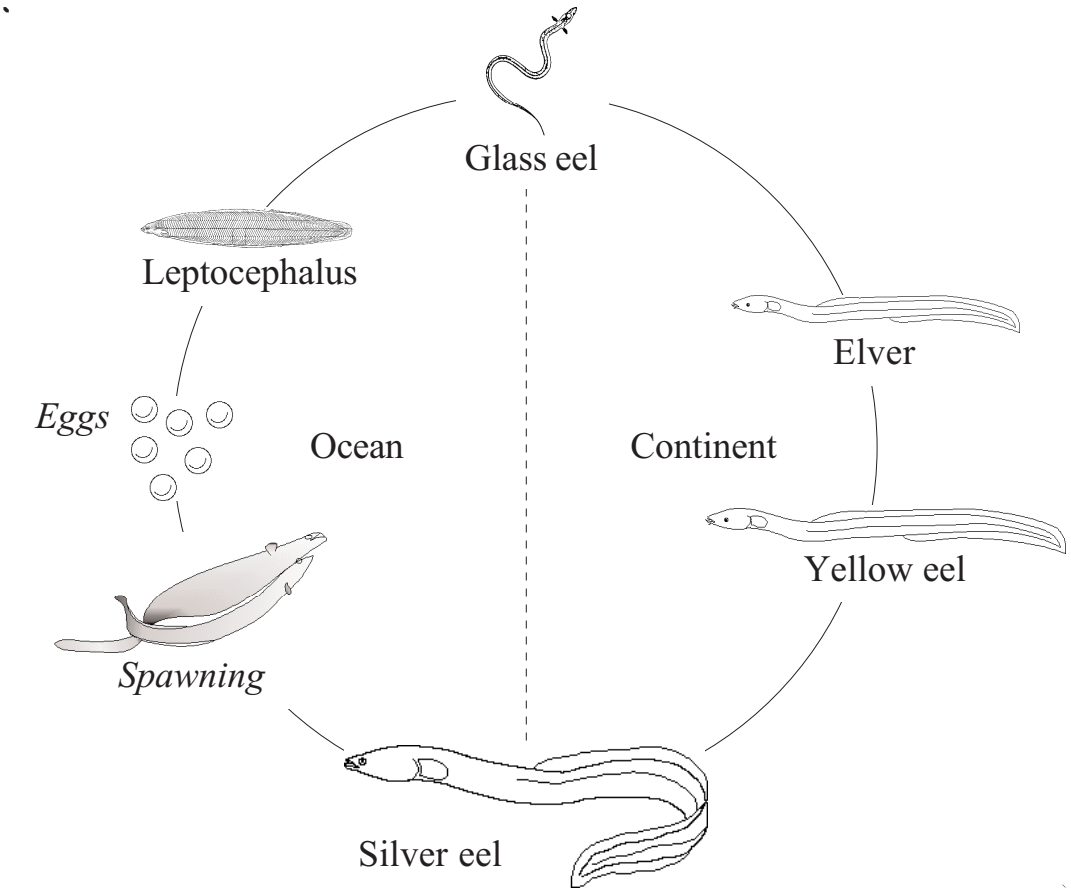


Figure 1. The life cycle of Anguilla anguilla (After Dekker 2000)

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Annex: **"Listing the European eel in CITES Appendix II- The Swedish case".**

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Introduction

Already in the 1970' a decline in the European eel (*Anguilla anguilla* (L.)) was described by Svärdson (1976). This decline was observed in the Baltic Sea. Not until later, during the 1980' when a more general and drastic decline in recruitment of glass eels to continental Europe became obvious, the eel issues were paid more attention to.

The international eel working group(s) is a joint initiative of EIFAC (European Inland Fisheries Advisory Commission) and ICES (International Council for the Exploration of the Sea). This group has analysed and reported on the decline of the eel stock since the early 1970' and the continuously decreasing recruitment since 1985. Not until 1999 and onwards ICES has advised that the "anthropogenic induced mortalities in eel" (as from fisheries, habitat loss due to e.g. migration obstacles, turbine mortalities etc.) "should be reduced to as close to zero as possible".

In 2003 the European Commission (COM) issued a first action plan how to manage the European eel on a Community basis (COM 2003, 573). After revised versions of the proposal the Council of the European Union finally adopted the Council Regulation (EC) No 1100/2007, "Establishing measures for the recovery of the stock of European eel". This regulation's main target is to restore the spawning stock and the subsequent recruitment and therefore demands EMPs (Eel Management Plans) from the respective member states. The aim of EMPs are to release 40 % in biomass of spawners (migrating silver eels) from what a pristine population would have produced without human impacts. Convincing EMPs should be produced before 2009 and the plans should after adoption by COM be implemented from July, 2009. Plans and a resulting increase in spawners are to be evaluated after three years, i.e. in 2012 for the first time. One measure among several in the Regulation from COM is to allocate a considerable proportion (60 %) of glass eels caught within a managed fishery for restocking purposes.

Since 2005 the eel is "red listed" as "critically endangered" in Sweden. Norway and Germany have then followed this approach. Since 2008 the European eel is listed as CR (Critically Endangered) on the IUCN (International Union for Conservation of Nature and Natural Resources) list (IUCN 2008).

In parallel with the work within EIFAC, ICES and the European Commission a process was initiated in 2006 aiming at listing the European Eel on CITES Appendix II. At the CoP14 in The Haag, the proposal to list *Anguilla anguilla* was adopted and will come into force in 13th March 2009. As a result, trade in Euroepan eel has not yet been regulated by CITES.

Trade with the European eel will only be permitted if a Non Detriment Finding/NDF statement can be made.

The historical background

More than 30 years ago, in June 1976 there was a joint ICES/EIFAC symposium on "Eel Research and Management" held in Helsinki, Finland. At that meeting the former director of the Institute of Freshwater Research in Drottningholm (an institute placed under the Swedish Board of Fisheries), Gunnar Svärdson presented his paper, "The Decline of the Baltic Eel Population" (Svärdson 1976). However, there had been even earlier papers on the decline indicating something had already happened to the stock of the European Eel (*Anguilla anguilla* (L.)) in the late 19th century (e.g. Olofsson 1934, Puke 1969) Svärdson's paper was the first given a wider audience. He described how the commercial catches were declining due to decreasing recruitment measured as the amount of ascending young eels in a number of Swedish rivers. This gave occasion to study the decline more in detail and the reasons behind, both from a national Swedish perspective as on the international scale. At this time, the late 1970' and early 1980', main concerns were not the species but the fishery. In e.g. Sweden there was a growing interest at that time in stocking activities as measures to enhance local stocks of eel in order to give basis for a profitable eel fishery in lakes and along the Baltic coast.

Simultaneously, international organisations as EIFAC (European Inland Fisheries Advisory Commission, a body within FAO) and ICES (International Council for the Exploration of the Sea) observed and reported on the decline, at least since the early 1980', to their respective headquarters and member countries. However, there was not until the very drastic decline in glass eel recruitment in the early 1980' was clearly seen, that more importance was given to the "eel issue". The International Eel Working Group(s) (within ICES, EIFAC and periodically joint) has reported on the bad and continuously deteriorating status of the stock since those early days but not until 1999 and onwards ICES advised that the "anthropogenic induced mortalities in eel" (as from fisheries, habitat loss due to e.g. migration obstacles, turbine mortalities etc.) "should be reduced to as close to zero as possible" (ICES 1999).

One reason behind this rather slow progress since the decline in the European eel was first reported, until today's situation, was that no single country or body took or could take the responsibility for a widely distributed species shared between many countries.

As the European eel is a panmictic species (Dannewitz *et al* 2005, Maes *et al* 2006) and is exploited and managed at local levels scattered over many small units within the area of distribution (Dekker 2000) it was realised that an international approach to improve the situation was required as the only realistic solution. In lack of a full understanding of causes behind the decline a precautionary approach was required. In 2003 then the European Commission (COM) took the initiative and issued a first action plan how to manage the European eel on a Community basis (COM 2003, 573). This proposal gave rise to extensive discussions in most member states and several revised versions of the proposal from COM (COM 2005, 472). Finally, in September 2007 the Council of the European Union adopted the Council Regulation (EC) No 1100/2007, "Establishing measures for the recovery of the stock of European eel" (EC 2007).

This regulation's main target is to restore the spawning stock and the subsequent recruitment and therefore demands EMPs (Eel Management Plans) from the respective member states before 2009. After adoption by COM (European Commission) the plans should be implemented from July, 2009. The ultimate aim of EMP:s are to release 40 % in biomass of spawners (migrating silver eels) from what a pristine population would have produced without human impacts. Plans and the resulting increase in spawners are to be evaluated after three years, i.e. in 2012 for the first time. One measure among several in the Regulation from COM is to allocate a considerable proportion (60 %) of glass eels caught within a managed fishery for restocking purposes.

Stocking has been an important measure in many countries in order to enhance local stocks, mainly to support the fishery. Starting in the 1950' stocking increased from about 50-100 million to more than 150 million glass eels and young eels per year in 1980. Those amounts have now decreased to modest 5-10 millions per year in Europe (EIFAC/ICES WGEEL 2008). One major reason behind this decrease is high prices and this in turn is due to a competition for the dwindling supply of glass eels with the aquaculture industry. As eel aquaculture and eel consumption is concentrated to East Asian countries as Japan, Taiwan, South Korea and China, there is a huge demand for seed material (glass eels) for aquaculture in e.g. China. To support the Chinese eel aquaculture large amounts of our eel species (*A.anguilla*) have been exported from Europe, even though the Japanese eel (*A.japonica*) performs better in Asian aquaculture (Briand *et al* 2007). Also other *Anguilla* species as e.g. *A. australis* and *A. rostrata* have been used for aquaculture.

When there were large exports of glass eels out of the European eel's distribution area and at the same time a strong demand for glass eels for restocking purposes within Europe, strongly endorsed by the EC Eel regulation, a request for protection and trade restrictions came up.

It might very well be that also the eel industry in Europe (both aquaculture and capture fisheries) has acted towards some control of exports as there is a competition for seed and stocking material and that European eels cultured in Asia are sold also on the European market at lower prices than normal for eels in Europe.

The concerns about exporting glass eels out of Europe were strengthened by the fact that *A. anguilla* was red listed nationally according to the IUCN:s criteria, first in Sweden in 2005 followed by Norway and Germany. Since 2008 the European eel is listed as CR (Critically Endangered) on the IUCN (International Union for Conservation of Nature and Natural Resources) list (IUCN 2008).

The process towards a possible Non Detriment Finding/NDF for *Anguilla anguilla.*

From March 13 2009 onwards all Parties to the Convention will be required to issue permits for all exports of the species. Such export permit may be issued only if the specimen was legally obtained and if the export will not be detrimental to the survival of the species.

In the European Union, which includes at least 25 eel range states, CITES is implemented through Council Regulation 338/97 and Commission Regulation 865/2006 which require both import and export permits to be issued for species listed in Annex A and B of the Regulation.

The crucial question to answer is then if it is detrimental or not to the European eel if trade between third countries or between EU and third countries is allowed to continue.

Today there is a considerable export of glass eels, mainly from France but also from Spain and probably from Portugal for aquaculture in China (CITES 2007). European eels sent out from its natural range of distribution are lost for the spawning stock irrespective if they are stocked in natural waters or consumed either directly as glass eels or as cultured products. The question is whether the stock can stand such a loss, i.e. is there a surplus of glass eels somewhere within the natural range of *A. anguilla*?

As stated earlier *A. anguilla* is regarded a panmictic species (Dannewitz *et al* 2005, Maes *et al* 2006) even though there were some deviating results and views presented by e.g. Wirth & Bernatchez (2001). Their interpretation was probably due to the fact there is a small variation in the genetic structure in temporal terms but not in spatial terms (Maes *et al* 2006). This might be due to a very small effective population size (N_e) where small groups of eels or single individuals give rise to closely related cohorts of larvae arriving in waves to continental Europe.

Ongoing discussions within SRG (Scientific Review Group, established in accordance to EC Regulation 338/97 and consisting of representatives from the Member States' Scientific Authorities) and its ad hoc Eel Working Group deals with this crucial question, i.e. whether there is a surplus of *A. anguilla*.

Some fundamental facts:

- *A. anguilla* is still considered as a panmictic species, and the weak genetic structure found is due to temporal variation that do not jeopardize the theory of panmixia. This means glass eels can be translocated within the distribution area without risks, at least from a genetics point of view (Dannewitz *et al* 2005, Maes *et al* 2006).

- ICES has since 1999 advised that the "anthropogenic induced mortalities in eel" (as from fisheries, habitat loss due to e.g. migration obstacles, turbine mortalities etc.) "should be reduced to as close to zero as possible". There were no improvements in recruitment reported at the EIFAC/ICES WGEEL meeting in Leuven in September 2008. The last recruitment season seems to be one of the worst if not the worst in documented history (EIFAC/ICES WGEEL 2008).

- Glass eels still seem to occur locally in surplus, though this has been questioned in recent years. In UK standing stocks of young eels seems unaffected despite a continuous exploitation of glass eels in the estuaries for many years (Bark *et al* 2008). However, in France where unbelievable amounts of glass eels were caught in the 1970' scientists are now questioning if today's recruits are sufficient to fill all available habitats (e.g. Beaulaton & Briand 2007).

- There are probably density dependent processes involved as both survival and growth increase inversely with density (Lobón-Cervia & Iglesias 2008).

- Many countries are now depending on restocking their waters with glass eels to be able to fulfil the demands from EC and to reach the goal of releasing 40 % of what was produced as spawners under pristine conditions. Without restocking they cannot reach the target. Today this market deals with about 5-10 million individuals only, mainly due to high prices (EIFAC/ICES WGEEL 2008).

- Stocked eels are assumed to support to the spawning stock in the Sargasso Sea (Wickström 2001, Limburg *et al* 2003), but final proof is for obvious reasons still missing. However, some doubts have been presented, mainly by Westin (2003) but this question is now addressed in several ongoing studies (e.g. the EELIAD-project (http://www.eeliad.com).

- EC is in the Eel Regulation (EC 1100/2007) advocating restocking as one measure (among others) to achieve a higher production of spawners.

- There is a demand for glass eels as seed from the aquaculture industry, both in Europe as from East Asia. Some of these eels are intended for restocking purposes (in open natural waters) after a period of on-growing and/or quarantine purposes. When on-grown eels are used for restocking the risk of changed sex-ratios in favour of males has to be considered.

- Juveniles and even silver *A. anguilla* eels have been reported as common from Japanese waters (Tabeta *et al* 1979, Okamura *et al* 2002, Miyai 2004, Okamura *et al* 2008), originating from intentional or accidental releases of the wrong species in natural waters. They pose a hazard to wild *A. japonica*, obviously with respect to parasites and diseases being introduced but in the long run they may also interfere genetically as artificial hybrids between the two species are possible to obtain (Okamura *et al* 2004).

The discussions and opinions about a NDF among different scientists within the ad hoc Eel Working Group of the SRG can be simplified or condensed into two different standpoints.

- *A. anguilla* is a widespread panmictic species that cannot be managed at local or national levels. It has to be looked upon and managed as a whole, as one stock in common, irrespective if there exist local surpluses in some countries or not. The EC Eel regulation manifests this kind of view on the stock of European eel. This view implies a NDF cannot be formulated.

- The second standpoint is that eel stocks very well can be managed at a local or national level. If there is a local surplus of glass eels in a river or estuary, that surplus can be used for any purpose, i.e. they can be sold for direct consumption, for aquaculture in Europe as well as in East Asia or used for restocking purposes within the same or in other countries. This standpoint implies a NDF can be formulated on a local scale (for a drainage basin, a country or a region).

Discussion

There is a debate among eel scientists if there still are some local surpluses of glass eels that without influencing the donor stock could be caught and used for other purposes. However, it seems that the eel stock in e.g. River Severn in the UK is still at carrying capacity. Probably that is the case also in a few other countries traditionally known for good recruitment of glass eels as France, Spain, Portugal and maybe in some of the North African countries too.

If we then conclude there is a surplus on a local scale, what would happen if those eels were not caught by humans? They would then probably starve to death or more likely be eaten by

other fish or birds. It is unlikely they would leave e.g. a crowded estuary and continue for any significant distance to explore another river. Thus, a surplus could be removed and used for other purposes. If used for aquaculture in Europe they are lost for the spawning stock, i.e. if they are not used for restocking after some on-growing. If consumed directly or after a period in aquaculture outside its natural range they are also totally lost for the spawning stock.

The only case when surplus glass eels in practice could support to the spawning stock in the Sargasso Sea is when they are used for restocking in areas below carrying capacity for eel, irrespective if that is in a neighbouring drainage basin or even in another country. The important prerequisite is that their survival is higher in the new environment (recipient) compared with the donor site. Even though there are no final proofs yet showing stocked eels do contribute to the spawning stock, a precautionary approach would be to use surplus glass eels where their survival is the best.

This kind of reasoning was the basis behind the Article 7 in the EC Eel regulation, stating 60 % of all glass eels fished in accordance with an approved eel management plan have to be used for or offered for restocking purposes. As the available amounts of glass eels on the market (<100 tons) (Briand *et al* 2007, Briand *et al* 2008) are far from enough to restock all those waters in urgent need of recruits, it is obvious that also the remaining 40 % is required for restocking in order to increase the run of spawners from all over Europe.

Conclusions

It is obvious that if there still exist some local surpluses of glass eels, those eels are urgently needed for restocking within the natural distribution area in order to produce more silver eels leaving to spawn in the Sargasso Sea. The only conclusion to be drawn from this is that you cannot produce a Non Detriment Finding for *Anguilla anguilla*.

The European Commission will in 2012 evaluate the effects of all measures implemented as results of the different EMPs. Probably the effects will not be that clear after only three year but if recruitment responds satisfactorily this conclusion may be reconsidered. If not the Commission will perform the next evaluation in 2015 and the following in 2018.

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NON DETRIMENT FINDINGS FOR THE EUROPEAN EEL - THE SWEDISH CASE

AUTHOR:
Håkan Wickström

Already in the late 19th century there were indications of a decrease in the Baltic eel population. The knowledge of this continuing decline was then brought to a wider audience at an international symposium on eel in 1976. The interest was then mainly focused on the obvious reduction in recruitment to Swedish rivers. The decline in recruitment and stock continued and from about 1980 it accelerated all over continental Europe. This is probably the case in all range states (>40) where *Anguilla anguilla* occurs naturally. There is probably no single cause but several working together. Overfishing, migration obstacles, turbine mortalities, persistent pollutants, fluctuations in ocean currents and a general decrease in accessible growing areas are proposed as causes of the decline. After a long and slow process including bodies like EIFAC, ICES, national agencies, governments and others, and finally the European Commission, the eel has now become red listed as CR (Critically Endangered), not only in Sweden (since 2005) but also internationally since 2008. The European eel is now the subject for a mandatory eel regulation issued by the European Council in 2007 (EC 1100/2007). This regulation will be implemented in July 2009. In 2007 the European eel was listed as an Appendix II species by CITES and trade regulations will come in force in March 2009.

Trade within EU will not be influenced directly by this CITES listing but to be allowed to export to third countries, i.e. outside the EU, or between non EU countries an NDF has to be found, i.e. a scientifically based permit stating that the specimen was legally obtained and that export will not be detrimental to the survival of the species. There are the IUCN Guidelines how and when to formulate a NDF, based on the status, knowledge and threats related to the species in question. However, this concept has not yet been applied to the European eel to its full extent. So far, most work towards the conservation of the species is based on the compilation and analyses of relevant data on the population done by the joint EIFAC/ICES Working Group on Eel.

Detailed data on the population of *Anguilla anguilla* are scarce and most work is based on trends in recruitment and stock and those in turn are based on relative recruitment indices and commercial catch data. When, e.g. the eel was red listed as CR in Sweden in 2005, the criteria of the decline were applied on such relative data and indices. When trying to apply for the IUCN checklist one could conclude that we have quite a good knowledge of the biology of this widespread species, but that it is not that tolerant to human activities. There is also an inadequate control, a lack of effective management, monitoring and protection. As both the species and the eel fisheries are often scattered and that the fisheries are performed on a small

scale by a single fisherman working on his own, the incentives for management and protection are probably quite weak.

Though absolute data are scarce today the EU Regulation demands much more data be collected, not only on biology and trends, but also concerning the fishing efforts, trade and a request for traceability. The European Commission will in 2012 make their first evaluation on the outcome and results of all measures implemented from July 2009 and onwards in all member states, respectively. This improved bank on eel data may then give a better basis for all range states when preparing NDFs, irrespective if on a regional or on a species wide scale. However, with today's knowledge on *Anguilla anguilla* it seems improbable any state could state that an export for consumption or for aquaculture could be done without jeopardising the survival of the species.

NDF WORKSHOP CASE STUDIES
WG 8 – Fishes
CASE STUDY 3
Cheilinus undulatus
Country – **INDONESIA**
Original language – English

NAPOLEON FISH, *CHEILINUS UNDULATUS*, INDONESIA

AUTHORS:
Yvonne Sadovy
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I. Background information on the taxa

1. BIOLOGICAL DATA

1.1 Scientific and common names:

Cheilinus undulatus (Napoleon fish/wrasse, Humphead or Maori wrasse)

1.2 Distribution:

Widely distributed on coral reefs of the Indo-Pacific with adults extensively using outer reef slope habitats; hence distribution follows that of coral reefs in region in particular the outer reef slopes for adults and inshore areas of live coral which are favoured by small juveniles (Sadovy *et al*., 2003). *For map see end of document*.

1.3 Biological characteristics

Species attains 2 m in length and can exceed 30 years of age. After a dispersive pelagic egg and larval phase of unknown duration and dispersal distincce, settlement and movements from shallow inshore waters to deeper offshore reef slope areas occur with body growth with only limited movements thereafter, as far as is known. The Napoleon fish reproduces over many months in small male-dominated temporary aggregations and is a protogynous (female to male sex-changing) hermaphrodite with female-biased adult sex ratio. Adults only reproduce in small aggregations that form briefly on a regular basis along outer reef slopes as far as is known. The species feeds mainly on invertebrates, with some fishes in the diet and is thought to

be important predator of *Acanthaster planci* (crown of thorns starfish), a species known to devastate coral reefs if its populations increase to high levels (Sadovy *et al*., 2003).

1.4 Population

1.4.1 *Global population size*

The species is naturally uncommon and thought to be declining due to historically unmanaged fisheries throughout extensive parts of its range. Population estimates have been calculated for Indonesia (see Annex 1) and the Non-Detriment Finding (NDF) for Indonesia was partly determined using these estimates. The species is 'conservation-dependent' which means that wherever it is fished and unmanaged, its numbers drop very quickly and numbers are very low. It only occurs at natural densities in fully protected areas and/or where it is not fished at all because fishing is too difficult or dangerous or otherwise does not occur. The area from which most capture and trade of the species is generated is probably the area that encompasses a large part of its global population given the high proportion of global reefs involved in source countries (Indonesia, Philippines, Malaysia and PNG – see map below). Therefore, successful implementation of CITES and national level management in these four countries is probably very important for a significant proportion of the entire species.

1.4.2 *Current global population trends*

___increasing _X__decreasing ___stable ___unknown

1.5 Conservation status

1.5.1 *Global conservation status*

___Critically endangered
_X_Endangered
___Vulnerable
___Near Threatened
___Least concern
___Data deficient
IUCN Red List Endangered (2004:
http://www.iucnredlist.org/search/details.php/4592/all).

1.5.2 *National conservation status for the case study country*

In Indonesia the species is regulated with no export of fish permitted <1kg and> 3 kg since 1995 and an annual NDF, since 2007, of 8,000 fish annually. The main threat is uncontrolled fishing. Law/regulation/

decree for Napoleon fish exists as well as a policy framework for management of harvest and export regulations. However, these are not yet sufficiently implemented to be effective. Confusion is common among fishermen, collectors, and exporters, and even within subsections of the Department of Marine Affairs and Fisheries (DKP) which is involved in fishery issues. Law enforcement needs to be more effective and there needs to be good co-operation between the various government sections that deal, respectively, with commercial fish and threatened species (i.e. PHKA, BKSDA, and DKP Quarantine, and Customs) for management. Marine Conservation Areas exist but effectiveness of protection is low or unknown.

1.5.3 *Main threats within the case study country*

___No Threats
___Habitat Loss/Degradation (human induced)
___Invasive alien species (directly affecting the species)
_X_Harvesting [hunting/gathering]
___Accidental mortality (e.g. Bycatch)
___Persecution (e.g. Pest control)
___Pollution (affecting habitat and/or species)
___Other: _____
___Unknown

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

2.1 Management measures

The species has been managed since 1995 in Indonesia when control of catching and export size was introduced due to high value of/demand for fish in the live food-fish export market. Fish less than 1kg can be used for grow-out (i.e. fattening in captivity) and those over 3 kg that are caught must be released. Only fish between 1kg and 3 kg can be legally exported. The management measure was intended to exert some control on the trade and to stop the use of cyanide as a fishing method by permitting traditional fishing methods only. Note that the catch of fish <1kg is permitted to allow for 'culturing' or 'cultivation' of fish which is seen as a type of 'mariculture' or fish farming. Since all the fish involved in culturing, cultivation or mariculture in respect of this species involve wild-caught fish raised in captivity to market size – any such defined fish must be considered as wild fish and subject to NDF permits at export.

Management in respect to the source area within Indonesia is controlled by SATSDN (domestic transport permit) which involves a permit that all traders must have to transport the fish from where it is being captured to destinations within Indonesia. Exporters must have a CITES Permit for export and permits to move fish at the national level. There are no additional management restoration or alleviation measures other than some designated marine protected areas. However, with few exceptions, fishing continues in most protected areas in Indonesia and so there are few known fully protected marine areas or natural refuges for this species. Transport within Indonesia is supposed to be conducted only under permit with catches under the NDF assigned differentially to different regions of the country. Full details of management legislation are available on pp. 34-43: http://www.humpheadwrasse.info/AC22_Final.pdf. On the import side, Hong Kong requires an import licence in advance of import of live fish and there is a stricter domestic measure for possession. For Mainland China, the other major importer, see the following note.

NOTE: Mainland China is a major importers but has not yet implemented the CITES Appendix II listing for this species. This means that while Hong Kong issues export permits from Hong Kong into Mainland China for transhipment, there are no permits issued at import into Mainland China or monitoring across the border. According to information recently received from the CITES Management Authority in China, a revision of the national listing of species has been underway (the last one was in 1988) and the Napoleon fish has been included in the proposed revised listing. The proposed revision has been submitted to the National Council and is waiting approval, which may occur within 2008. Monitoring the species under Category II of national protection is reportedly occurring but this could not be confirmed and data were not available. If approved, the revised listing would ensure much improved enforcement for the species (communication from Mr. Fan Xiangguo).

2.2 Monitoring system

Sporadic market surveys for landings are conducted as part of national level fishery monitoring, and annual landings within Indonesia have been reported to FAO since the early 2000s. Detailed underwater visual census surveys have been conducted in six locations for fish size and density in eastern Indonesia by the Indonesian Scientific Authority, in collaboration with the IUCN Groupers & Wrasses Specialist Group to produce information for the NDF. Fish collected for grow-out are supposed to be monitored regularly by the government in the different regions of Indonesia.

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

3.1 *Type of use* (origin) **and destination** (purposes)

Wild-caught live animals destined for high-value luxury food in restaurants in export trade is the major use; this is one of the highest priced live fishes at retail in this restaurant trade with retail prices (in demand centres overseas) recorded as high as US$150/kg. Major destination is Hong Kong (much of which is transhipped to Mainland China). Also destinations in Singapore (much of which goes through to Hong Kong) and Taiwan. Most international trade is in live fish although some chilled fish also occurs (as known from confiscations of chilled fish imported into Hong Kong from Indonesia). Domestic consumption is not common and occurs largely because of fish that die prior to live export or are caught incidentally as part of the multi-species reef fish fishery: exporters sometimes accept dead fishes and export these mixed with other fishes such as groupers to Taiwan and Hong Kong.

All fish marketed and trade for this species are wild-caught, with extensive capture and grow-out in captivity of sub market-sized juveniles to marketable sizes. There is no hatchery production and mariculturists do not expect that mariculture (i.e. artificial production or farming) of the species will be possible in near future. The sum of all uses of the species must be taken into account when examining total removals of fish from the wild for the purposes of NDF – these uses are: export live at market size (including wild-caught juveniles grown-out to market size), export chilled, local consumption live, and local consumption chilled. All uses need to be accounted for in determining NDF.

3.2 Harvest:

All fish are taken from the wild. For the luxury live fish trade, the preferred size range is 0.5-1 kg. The fish is considered difficult to catch by hand-line and most fish of smaller size are caught by cyanide. Dead fish are taken by spearfishing at night or incidentally while line-fishing. If targeted specifically by fishers, this species is destined for the live export market. The species is taken by fishers who have the means to catch and maintain fish alive, often with the assistance of traders/exporters in terms of supply of gear or cyanide and/or temporary holding facilities for grow-out.

3.3 Legal and illegal trade levels

Illegal (unpermitted and illegal size) exports by sea and air continue as determined by seizures in Hong Kong of shipments without permits

and fish of illegal size according to Indonesian regulation. Illegal movement of fish, including some of illegal size, also occur within Indonesia, as determined by seizures and personal observations of illegal sized fishes in trade within the country.

There have been at least four seizures of Napoleon fish from Indonesia into Hong Kong – these were either forfeited or the cases are still under investigation. Forfeited fish have been used for scientific study once the case is finished. Both live (24) and chilled (16) fish are involved, all imports were by air and there was concealment in mixed fish shipments (i.e. mixed with groupers and labelled as groupers).

II. Non-detrimental Finding procedure (NDFs)

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

__yes _X_no

2. CRITERIA, PARAMETERS AND/OR INDICATORS USED

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

4. EVALUATION OF DATA QUANTITY AND QUALITY FOR THE ASSESSMENT

Methodology and data for NDF: Two independent methods were used to calculate NDF. (1) The first involved internal consultations within Indonesia involving traders, the Indonesian CITES Management and Scientific Authorities (i.e. stakeholders) and taking into account the actual export figures which were far lower than the permitted exports at the time; the Precautionary Principle was also applied. (2) A field survey (Underwater Visual Census or UVC – see APPENDIX for detail) was conducted to determine fish abundance by size class per unit area (to thereby calculate a density of fish) mainly in the habitat occupied by adult fish (outer reef slope). Some surveys were also done on inner reefs, which are juvenile habitat areas. Total reef slope area in Indonesia was calculated to determine fish abundance by multiplying fish density by reef area. Both approaches to NDF formulation, i.e. (1) and (2) gave the same recommendation, adopted in 2007, of 8,000 animals for export annually.

Since density varied substantially between fished and unfished areas, three different fishing conditions were used; protected/unfis-

hed, medium fishing pressure and heavy fishing pressure and the proportion of Indonesia's reefs under these three sets of conditions estimated by consultation. Taking account of these three sets of fishing pressure conditions and the fish densities in each, and using an estimation of the adult habitat the total number of adults was calculated for the country. Comprehensive underwater visual censuses (UVC) for numbers and sizes of fish were undertaken in 6 locations in eastern Indonesia, where most fishing for the species is now based, to determine densities. A species-specific fishery model was then developed, using established fishery modelling techniques and biological parameters tailored for the species (Sadovy et al., 2003; Sadovy et al., 2008), to calculate a sustainable annual catch. Since fishing activity for the species includes both live and dead fish and local and export use, had to be made of the total of all of these extractive activities in the calculation of a viable export quota for NDF. To gain specific information on the grow-out phase (grow out of wild caught juveniles until they reach market size), interviews were conducted with aquaculturists involved in the fattening process of small fish (i.e. grow-out). The fishery model incorporated an interactive programme to allow for country-level, stock-specific NDFs to be calculated, and the model was spearheaded by a world fisheries expert Andre Punt, under the auspices of FAO.
(see: http://www.humpheadwrasse.info/C1023_Full_Pub.pdf).

To refine estimates of Napoleon fish habitat area to determine fish numbers for the FAO model the following method was explored: Landsat-7 satellite images were downloaded from two databases (http://www.reefbase.org; http://glcf.umiacs.umd.edu) and imported into a format easy to be handled in ArcGIS (the Erdas Imagine img format) and visualized into an ArcGIS project. The next step was the manual assessment of the coral reef edges, drawing a polyline shape file; a 100 meter buffer was applied to both sides of the lines delimiting the reef edges and the resulting area calculated of all the polygons generated in this way. (From: Evaluation of reef habitat for the Napoleon fish, *Cheilinus undulatus* (CITES Appendix II) in Indonesia, Malaysia and Papua New Guinea using Remote Sensing techniques. Axel Oddone, Roberta Onori – FAO study – unpublished). A trade survey was also undertaken (see Sadovy 2006).

Only air exports from specified ports in Indonesia are now permitted (since July 2007) to improve enforcement given the enormous challenging of enforcement in respect of import and export by sea.

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

Major problems: (1) Illegal exports by sea continue including though Malaysia and Singapore and out of the Philippines into Malaysia. In 2007 Singapore exported almost 10,000 kg of Napoleon fish to Hong Kong – these fish cannot have come from Singapore and almost certainly came from Indonesia. (2) Application of the Appendix II listing has not been applied in Mainland China, a major importer, such that import permits are not issued at the Hong Kong/Mainland China border. (3) There is poor or slow communication between the Indonesian CITES Management Authorities and Hong Kong when seizures occur in Hong Kong, and Indonesia has not notified Hong Kong, the major importer, of the air-only export ruling – both situations have important enforcement implications for Hong Kong. (4) There is concern regarding habitat loss/degradation in Indonesia: continued illegal fishing such as using cyanide can cause habitat loss/degradation and could affect the Napoleon fish in its young stages since it appears to favour living branching coral. (5) While there are a number of legislated marine protected areas (MPAs) in Indonesia, few appear to be protected giving the Napoleon fish very little protection through MPAs. (6) Fish caught under 1 kg are supposed to be released back to the wild or grown-out to market size but most fish are sold directly for market and not grown out. Floating cages are used just to keep fish until there are sufficient to be exported, not used for grow-out.

6. RECOMMENDATIONS

KEY RECOMMENDATIONS IN RELATION TO NDF

I. There is a need for more strict monitoring by the relevant authorities (customs) of exports from Indonesia to ensure that exported fish are not of illegal size and that they are not mislabelled by being hidden in mixed species shipments and recorded as 'grouper' which are not under any controls (both situations have been documented to occur). It is recommended that Napoleon fish-only exports be mandated, and no 'mixed species' shipments be allowed to address this problem.
II. Illegal, unregulated and unmonitored exports from Indonesia through Malaysia and Singapore need to be addressed.
III. It is recommended that minimum size limits be added to the export quota to help strengthen existing legislation in Indonesia and to ensure maintenance of spawning biomass; a large proportion of exported fish are in their pre-reproductive phase.

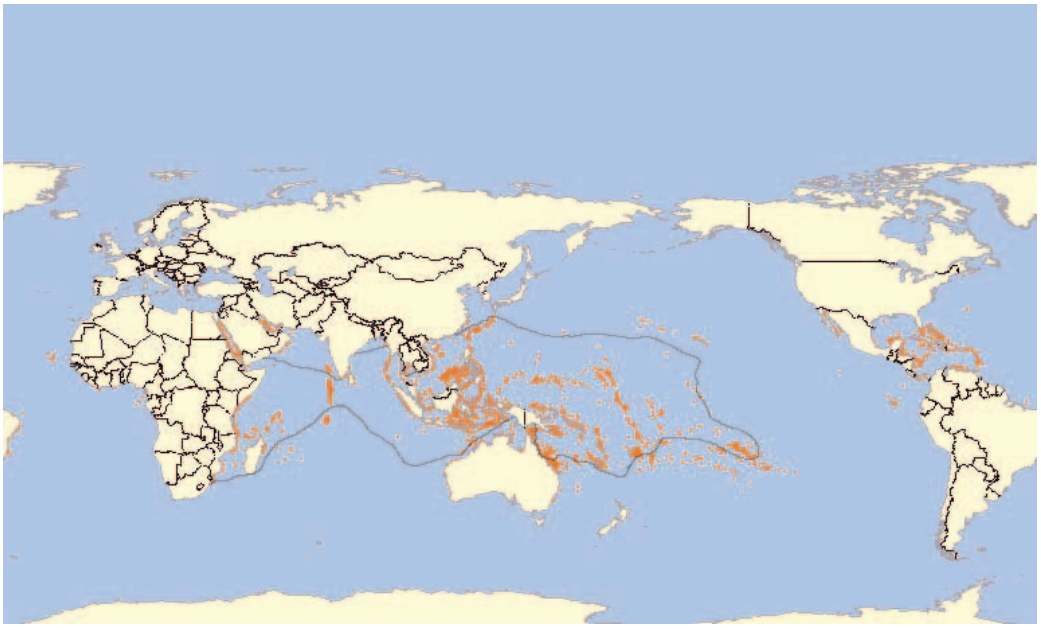
IV. Survey sites in Indonesia should be re-monitored within the next 5 years or so by UVC to determine whether the management measures in place and the NDF are being effective.
V. There is a need to improve estimates of domestic use of Napoleon fish, of both live and chilled fish.
VI. Additional studies are needed to better understand the grow-out (fattening) phase of the Napoleon fish in terms of mortality rates, length of grow-out period, numbers and sizes caught, etc. Mortality rates at capture and during fattening need to be refined for the fishery model since they represent removals from wild stock (even though they can no longer be used in any way).
VII. There is a need to develop methods applicable to data-poor/resource limited situations to corroborate and complement the UVC methodology.
VIII. There is a need to develop decision rules that link indicators and reference points in the adaptive management of the Napoleon fish. For example what will be the indicators used by the CITES Authorities in Indonesia to determine whether the NDF is effective, or to adjust it up or down accordingly?

ADDITIONAL RECOMMENDATIONS

IX. Illegal shipments or sizes of fish should be prosecuted to set an example to traders. Few if any prosecutions appear to have occurred despite a number of interventions of illegal shipments. One major problem in this regard is that illegal imports into Hong Kong occur through consignees who are not held accountable for lack of permits. This means that the exporting company cannot easily be held responsible for consigning illegal shipments.
X. There is a need to develop a protocol for handling live fish that are imported illegally.
XI. Traders in both exporting and importing countries and fishers need to understand the reasons for the CITES Appendix II listing especially since a CITES listing for a food fish is not within their experience.
XII. There is a need for cooperation between the various government departments within Indonesia in the management of the species. A major problem with the Napoleon fish is that it is the first commercial food reef fish listed under CITES Appendix II and jurisdiction for commercial food fish and threatened species fall under different departments within the government which have not had to work together before.
XIII. There is a need for closer and more efficient communication between the national level CITES Management Authorities in impor-

ting and exporting countries, especially when illegal shipments are seized and when new regulations are introduced; an example is the air-only export regulation in Indonesia which was not communicated to Hong Kong authorities. Lack of prompt communication makes enforcement more difficult on the importing side. The air-only regulation is very important since legal trade by ships into importer countries like Hong Kong is too difficult to monitor and adequately enforce due to heavy volumes of sea traffic and multiple landing points.

Distribution of Napoleon wrasse within outline (blue in colour version of map) and on coral reefs which are indicated by the dark areas (red in colour version of map)



CITATIONS AND WEBLINKS

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ANNEX 1

(EXTRACTED AND ADAPTED FROM Sadovy, 2006

– refer to original document for detail and full citations)

The "GPS (Global Positioning System) Density Survey" method was used for the Underwater Visual Censuses (UVC) during this project, as it is particularly suited to assessing abundance of uncommon and wide-ranging species, such as C. undulatus (= humphead wrasse or HHW) (Colin et al, 2005). Even in relatively undisturbed regions, HHW are among the less common of reef fishes. Conventional underwater visual survey (UVC) techniques (typically 50 or 150 m long transects) are not really feasible to document the abundance of these reef fish. To be able to survey the amount of area needed to gain a definitive idea of the occurrence and abundance of HHW, distance and areas one order of magnitude or more must be surveyed compared to conventional UVC techniques.

The GPS density survey method uses a "position logging" Global Positioning System (GPS) receiver in a water-proof floating housing which is towed on the surface by the observer. It can be used snorkeling (towed behind the swimmer) or SCUBA diving (GPS float deployed from diver reel). The GPS is set to log its position every 15-30 seconds, allowing an accurate record of the track surveyed after downloading. The observer carries a water-proof watch synchronized to the second with the time displayed by the GPS receiver. Fish within a predetermined distance either side of the swim track (up to 10 m in clear water) are surveyed by swimming along a reef feature or in a relatively straight line (in this case in adult habitat for the species) at a steady pace or drifting with currents. The time any target fish is observed is recorded on an underwater slate, as well as the estimated standard length. The standard length is estimated visually from experience with reference to a length scale in centimeters on the side of the recording slate. Total length would be somewhat greater than standard length reported here and is easily determined from standard length using the relationship of these two values. It is estimated that such length estimates are accurate to within about 10-15% for an experienced observer (McCormick and Choat 1987). Fish of 5-20 cm standard length were assigned to 2.5 cm size classes (5, 7.5, 10, 12.5, 15, 17.5, 20 cm). Those from 20-50 cm were assigned in 5 cm increments, and from 50-100 cm in 10 cm increments. Fish more than 100 cm in standard length were lumped in a single class, as it is difficult to estimate length in such large fish with precision.

When the logged data from the GPS are downloaded using Garmin Map Source World Map software (or other similar for other brands of GPS receivers), this provides a continuous

track of the survey swim and, within the accuracy limits of the GPS, a permanent record of the area surveyed, allowing for replication in the future (e.g. for follow-up studies). Using the concurrent time log and the time of fish observations, the position on the track where any fish was observed can be closely (within a few m) determined from the time and position data. The distance (and thereby the area covered depending on swath width – the swath is the distance each side of the transect being surveyed) covered during a given survey is documented and the number of fish observed provides a density (fish per unit area) value. The survey track and positions of individual fish along that track can be plotted on habitat maps, satellite images, etc., to provide a visual display of fish numbers and distribution against a habitat image providing insights into the relationship between the fish and the environment.

In essence, the GPS Density Survey is a quantitative method for measuring distribution and density of uncommon, wide-ranging reef fishes. Usually, the surveys were conducted along a given reef feature, such as the edge of the reef slope or a given depth contour along a sloping outer reef face. At other times, the surveys, particularly on shallow reef flats, ranged across open bottom without any particular feature or habitat being followed. Since the tracks are latitude-longitude referenced, these surveys can be repeated at a future date by any qualified observer. In most cases fish were surveyed 10 m either side of the swim track for a total survey swath of 20 m with each meter of track swim resulting in the survey of 20 square meters of bottom area. While it is not possible to measure the swath width being surveyed exactly, an approximation of the width is achieved by noting the angle of view from the horizontal compared to the water depth. For example, if the water is 10 m deep, then the 10 m side swath width would represent at 45 degree angle from the observer. Shallower water depths would have a higher angle of view to the point where the water might become too shallow to be able to clearly see 10 m to the side of the observer. In the present case, because HHW were so uncommon, any fish that were seen were within 10 m of the survey track and were therefore counted. Only in the situation where fish are common does the accurate determination of swath width become a critical issue, since whatever error in swath width occurs, also reflects in the abundance of fish.

The GPS Density Survey method is most useful for fishes that are easily visible against the reef surface (not camouflaged), relatively large, and are not disturbed by human swimmers. If not common then double-counting is not a potential problem and if the fish is large and wide-ranging, the GPS method is far more practical than standard line survey methods.

NAPOLEON FISH, *CHEILINUS UNDULATUS*, INDONESIA

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I. Background information on the taxon

1. Biological data

- *Species*: *Cheilinus undulatus* (Napoleon, Humphead or Maori wrasse)
- *Distribution*: Widely distributed on coral reefs of the Indo-Pacific with adults extensively using outer reef slope habitats; hence distribution follows that of coral reefs in region.
- *Biology*: Species attains 2 m in length and can exceed 30 years of age. After a dispersive pelagic egg and larval phase of unknown duration and settlement, movements from shallow inshore waters to deeper offshore reef slope areas occur with growth and only limited movements thereafter as far as is known. Reproduces over many months in small male dominated transitory aggregations. Is protogynous (female to male) hermaphrodite with female-biased adult sex ratio and wary of humans wherever fished. Adults only reproduce along outer reef slopes as far as known. Feeds mainly on invertebrates, some fish; thought to be important predator of *Acanthaster planci* (crown of thorns starfish).
- *Global population*: thought to be declining due to historically unmanaged fisheries throughout extensive parts of its range. Population estimates calculated for Indonesia – a major exporter.
- *Conservation status*: IUCN Red List Endangered (2004: http://www.iucnredlist.org/search/details.php/4592/all). In Indonesia the species is regulated with no exports of fish < 1kg and > 3kg and NDF since 2007 of 8,000 fish annually. Main threat is harvesting.

2. Species management within the country for which case study is being presented

- *Management*: 1995 control of harvest and export size introduced (see above) due to high value of/demand for fish in live food-fish export market. Measure intended to exert some control on the trade and to stop use of cyanide as a fishing method by permitting traditional fishing only. No restoration or alleviation other than some designated marine protected areas, many of which are still fished.
- *Monitoring*: Sporadic market surveys for landings. Detailed underwater visual census surveys for size and density broadly in eastern Indonesia conducted by Indonesian Scientific Authority and the IUCN Groupers & Wrasses Specialist Group. Details of legislation available on pp. 34-43: http://www.humpheadwrasse.info/AC22_Final.pdf.

3. Utilization and trade for range State for which case study is being presented

- *Type of use*: Wild-caught live animals destined for luxury food in restaurants. Major destinations are Hong Kong and Mainland China and Chinese communities regionally. International trade is in live fish whereas local markets is for dead fish. All fish are wild-caught with extensive capture and grow-out of juveniles. No hatchery production.
- *Harvest*: Fish preferred in size range 0.5-1 kg for restaurants and caught by hook and line and cyanide mainly. Cyanide is most commonly used for smaller fish. Taken by fishers prepared to catch and maintain fish alive, often with assistance of trader/exporters. No management internally other than as above. Exports/permits as in Section II below and as above.
- *Legal/illegal use*: Illegal exports by sea and air continue.

II. Non-detrimental Finding procedure (NDFs)

- *Methodology and data for NDF*: Comprehensive underwater visual censuses (UVC) for numbers and sizes of fish were undertaken in 6 locations in eastern Indonesia in key adult habitat and areas of low medium or high fishing intensity. To calculate abundance in Indonesia, reef slope areas were calculated based on satellite imagery by FAO. A fishery model **FAO Fisheries Circular 1023** was then developed with an interactive programme to allow for country-specific, stock-specific NDFs to be calculated. NDF for Indonesia was developed using internal consultations, including with traders independently of the FAO model, and both approaches gave the same recommendation, adopted in 2007 of 8,000 animals annually (see: http://www.humpheadwrasse.info/C1023_Full_Pub.pdf). Only air exports permitted to improve enforcement with some illegal air cargo into Hong Kong intercepted; Hong Kong requires permits in addition to those under App. II. The UVC method has recently been applied in E. Malaysia, a major supplier of the species, for NDF, with recommendation of zero quota under consideration.
- *Major problems*: Illegal exports by sea continue including though Malaysia and out of the Philippines. Application of Appendix II listing has not been applied in Mainland China, a major importer.
- *Recommendations*: All relevant countries to implement Appendix II esp. Mainland China; only air exports permitted; conduct in-country monitoring of landings and grow-out. Work to address illegal exports from Philippines to Malaysia. If illegal trade continues ban all export (consider Appendix I).

CASE STUDY: *HIPPOCAMPUS* SPP. PROJECT SEAHORSE

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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.

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CASE STUDY: *HIPPOCAMPUS* SPP. PROJECT SEAHORSE

AUTHOR:
Sarah Foster

The following recommendations on Non-detrimental Finding procedure (NDFs) for seahorses (Hippocampus spp.) are based on the findings of the "International Workshop on CITES Implementation for Seahorse Conservation and Trade", February 3-5, 2004, Mazatlan, Mexico (Bruckner et al. 2005).

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 more information is available. By considering immediate measures now, and developing more accurate measures later, Parties will be managing their seahorse trade according to the principles of adaptive management (Rosser & Haywood 2002).

CITES Parties have recognised the challenges of setting quotas or undertaking many other management measures for seahorses given the dearth of information on individual seahorse populations, exploitation levels, trade, and the considerable similarity in physical appearance of many species. There are, however, possible ways Parties could overcome the immediate difficulties of making early NDFs as required by the Convention. **What follows is a summary of such NDF options for wild seahorses.** Note that 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.

1. 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 (CITES Decision 12.54).
Criteria: Whether the size of individual seahorses entering trade is at or above the recommended height for seahorse exports.
Information: Height of individual seahorses being exported.

2. 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.
Criteria: The percentage of seahorse habitats, or preferably populations, which are found within a Parties marine protected areas (MPAs).
Information: **T**he location of seahorse habitats, or preferably areas of seahorse occupancy, and location of MPAs in a Parties waters.

3. Enforce existing laws – seahorses sourced from trawlers fishing in areas closed to trawling violate CITES provisions for legal acquisition, and should not be traded.
Criteria: Knowledge that seahorses entering trade from non-selective fishing practices are being sourced legally.

Please refer to the complete case study for the types of information needed to identity potential alternative management tools which could supplement or replace the suggested interim measures. Even basic types of data are useful, as long as they are presented with a corresponding metric of effort.

Making NDFs for seahorses (*Hippocampus* spp.)

International Expert Workshop on CITES Non-Detriment Findings

Cancun, Mexico, November 17-22, 2008

ADVANCING MARINE CONSERVATION

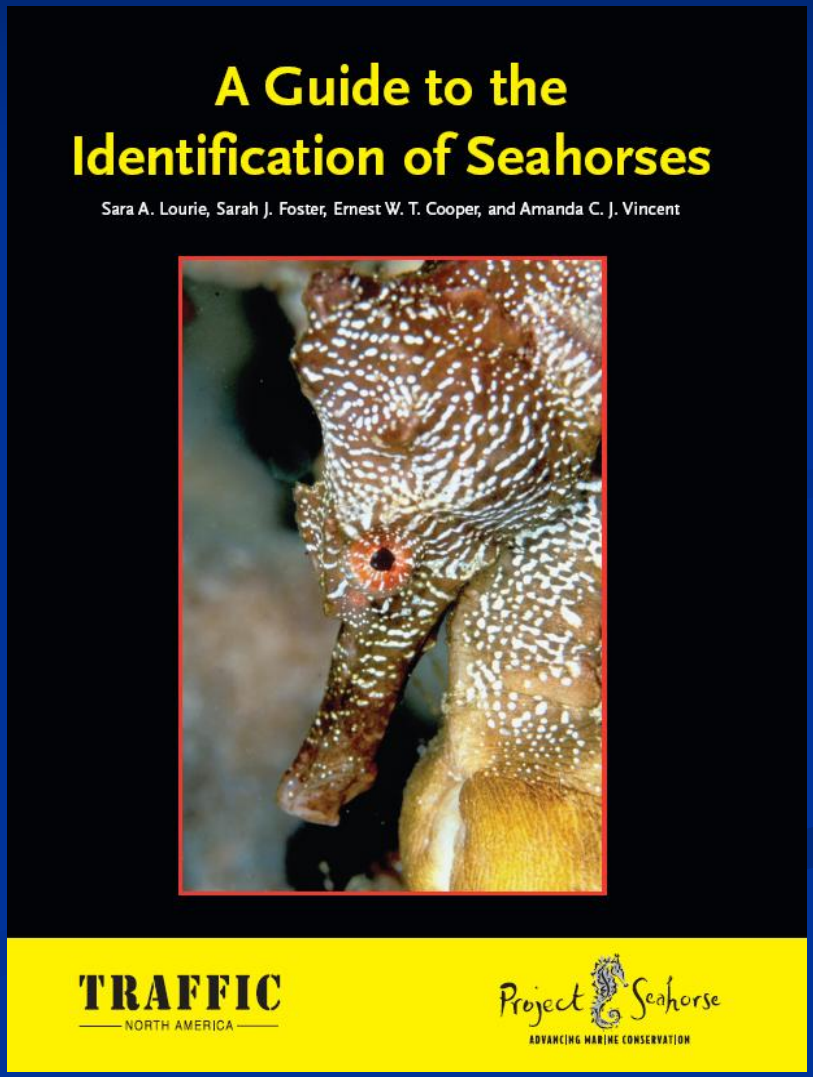
Outline

- Seahorse life history
- Seahorse exploitation and trade
- Interim measures
  - Minimum size limit
  - Protecting habitat
  - Enforcing existing laws
  - Aquaculture
- More precise measures
  - Information needs
- A web based tool

Hippocampus spp.

H. kelloggi

H. kuda



Seahorse life history and the consequences

Life History Trait	Conservation consequence
low population densities	Vulnerable to extirpations
low mobility small home range sizes	slow to recolonize over-exploited areas
low rates of natural mortality	heavy fishing will place unsustainable pressure on population
male brooding	survival of young depends on survival of male
monogamy	partner stops reproducing, at least temporarily
small brood size	limits potential reproductive rate (may be offset by higher juvenile survival)

CONCLUSION: **NOT SUITED FOR HEAVY EXPLOITATION**

Summary 2006 Red List

EN	VU	DD
1	9	23

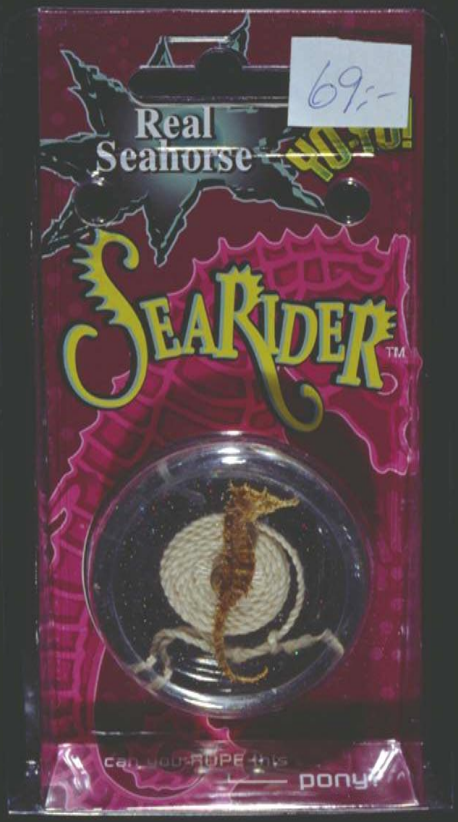
when data are very uncertain assign DD –
does not mean the species is not threatened

Trade

Traditional medicines

Ornamental display

Curiosities



Exploitation

- Enter trade from:
  - Bycatch from shrimp trawlers (largest source - mostly dried trade)
  - Target fisheries (live and dried trade)
  - Aquaculture (all live trade)

Trade impacts

- Fishers, traders and informants in many countries report that seahorse catches have declined, often despite increased fishing effort
- Trade volumes may be maintained by geographic expansion, greater retention of bycatch, greater sale of incidental landings
- Loss of habitat is a grave concern

Making NDFs now

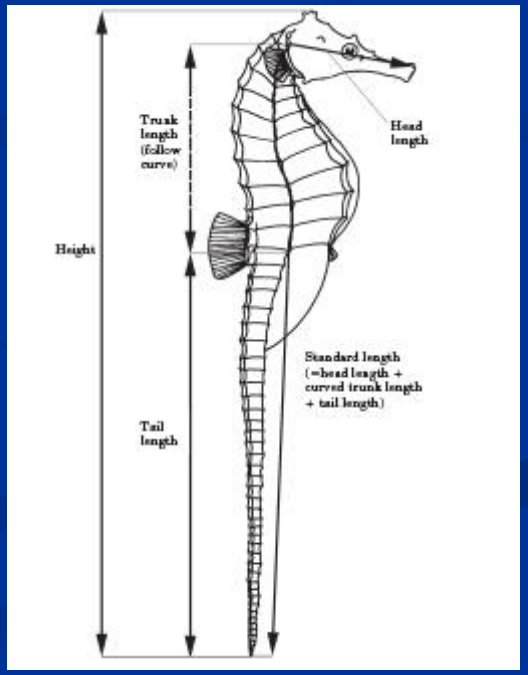
- No information on abundance and exploitation = no information to set quotas
- BUT to overcome the immediate difficulties can use other management tools
- Evoke principles of adaptive management
- Possible interim measures for wild seahorses
  - Minimum export size
  - Protect seahorse habitats
  - Enforce existing laws
- **Rules of thumb**

Important to remember

- 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

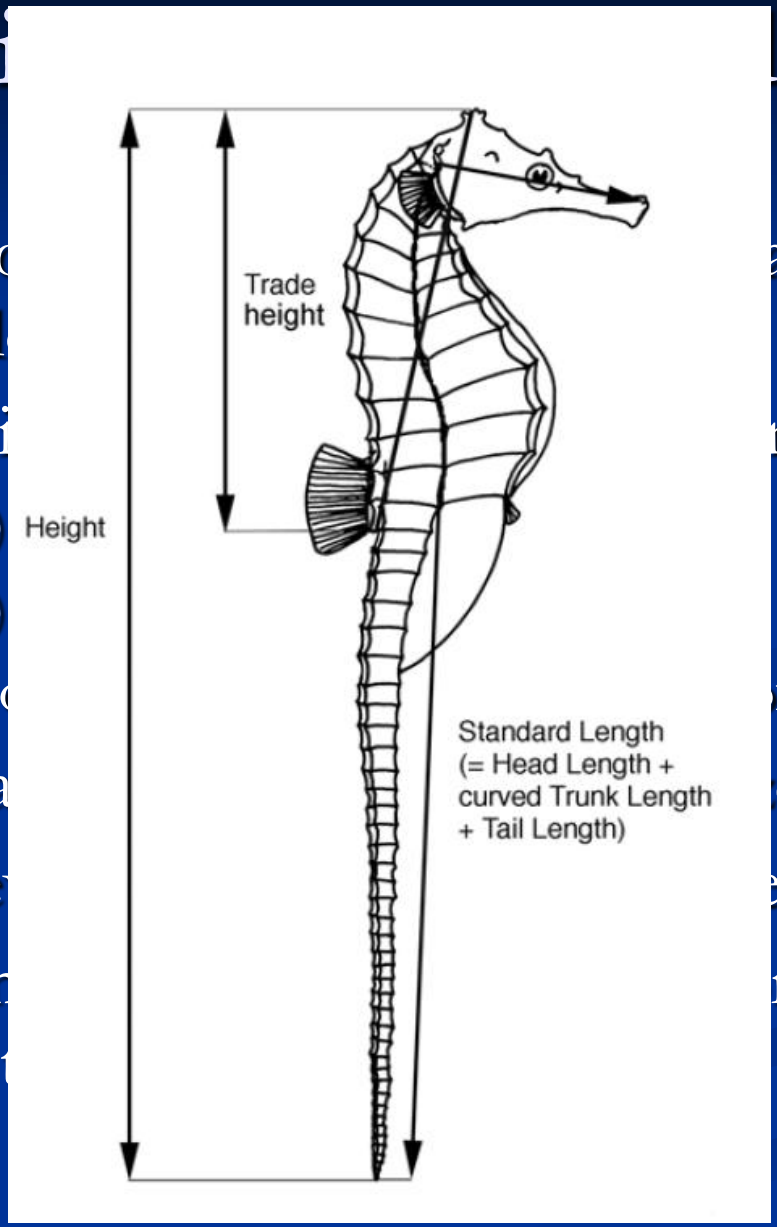
Minimum export size

- Decision 12.54
- Present recommendation = 10 cm height
- Biologically sound
- Need limited data
- Tried with other species
- Apply to dried and live trades
- Relatively easy to enforce
- … especially if many Parties adopt



Si

- Surveyed seaho an, Vancouver and Los Angel
- Recommends i mit to:
  - 14 cm (6.25”)
  - 13 cm (5.75”)
  - Trade height xy
- Clear biologica e limit
- BUT would se e species
- Need to deter mic effects of implementing



Protect habitats

- Protecting seahorse habitats should protect seahorse populations
- Useful where seahorses are caught as bycatch
- Ideally would protect areas of seahorse occupancy (where known)
- What % of habitats to protect?
- (Changes to fishing techniques)

Enforce laws

- Enforcement of existing laws (e.g., trawling bans in specific areas) is needed to improve the conservation of seahorses
- Many countries currently ban trawling in coastal waters
- Seahorses collected from these illegal fisheries should not be exported under CITES provisions for legal acquisition

Management options and stakeholders' views

HIGHEST PREFERENCE

LOWEST PREFERENCE

Minimum Size Limits

Marine Protected Areas

Tenurial Systems
Temporal Closures

Sex-Selective Fishing

Total Allowable Catch
Reduced Number of Fishers

Maximum Size Limits
Slot Size Limits

Martin-Smith *et al 2004*

Aquaculture

- Need to determine production capabilities, degree of reliance on wild populations, and environmental concerns
- Need for marking systems to distinguish aquacultured seahorses from wild-caught specimens
- For now must rely on thorough paper documentation
- No need to impose a standard minimum export size for aquacultured seahorses produced in non-detrimental facilities

Making NDFs later

- More accurate measures for making NDFs on species and population specific levels are needed
- Requires collection of basic data
- two different types of data should be collected:

  a) fisheries and and b) population data

Any data is better than none!

- When vital resources are rapidly degrading … we often have neither the time nor the resources for such data-gathering… The choice is between giving imperfect advice or none at all. Data-less and data-poor management are … an imperative… Management should be judged by its fruits, not its roots

(Johannes 1998)

Data needs

Information needed	**Fishery (landings surveys)**	**Population (field surveys)**
which species	are caught	are observed
where (locations, depth, habitat)	at which they are caught	at which they are found
when (time of year)	at which they are caught	at which they are found
how many	are caught PER UNIT EFFORT (including discards)	are observed
size stucture	of captured individuals	of observed individuals
sex (male, female, juvenile)	of captured individuals	of observed individuals
pregnant (yes/no)	of captured individuals	of observed individuals

Also need: species, numbers and sizes in trade

Future NDFs?

- Info on population size and intrinsic rates of population increase = quotas
- Info on reproductive peaks = seasonal closures of trawl grounds
- Info on population specific height at maturity = population specific minimum size limits

Assessing sustainability

- Long-term monitoring of these data will also provide an indication of population health
- Recommended that Parties use indicator fisheries and trades to test and evaluate various management measures through an adaptive management process

Changes since listing

- **Dried trade – TCM importers/wholesalers**
  - Listing appears to have had little effect
  - International trade regulations are necessary
  - Worry about potential negative impacts on their business
- **Live trade**
  - Listing has had an effect: changes in sources, increased importance of cultured individuals, sizes declined, volumes dropped and values doubled
  - Neutral or positive about CITES listing

Hippocampus Info

- www.hippocampusinfo.org
- a web-based tool to assist countries in preparing scientifically sound and defensible NDFs for seahorses
  - Seahorse identification
  - Seahorse trade statistics
  - Resources about seahorse distribution, biology and trade
  - Generic resources about marine conservation issues and solutions
  - Country-specific information
  - Decision tools to assist Parties make NDFs

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STURGEONS OF THE NW BLACK SEA AND LOWER DANUBE RIVER COUNTRIES

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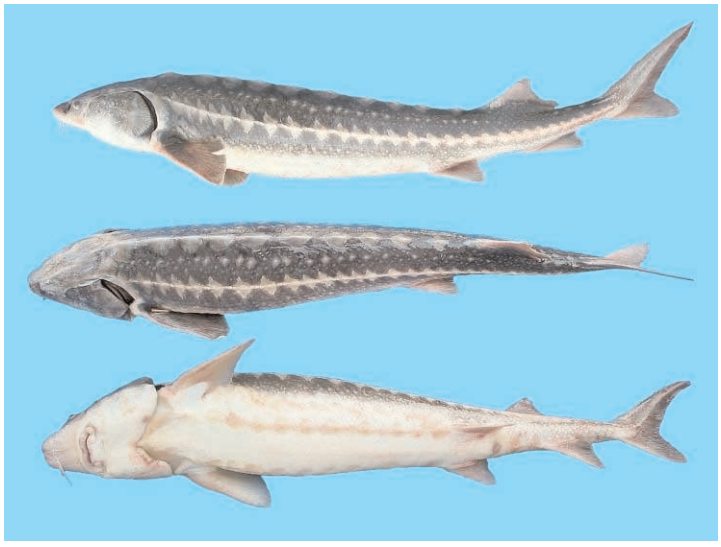
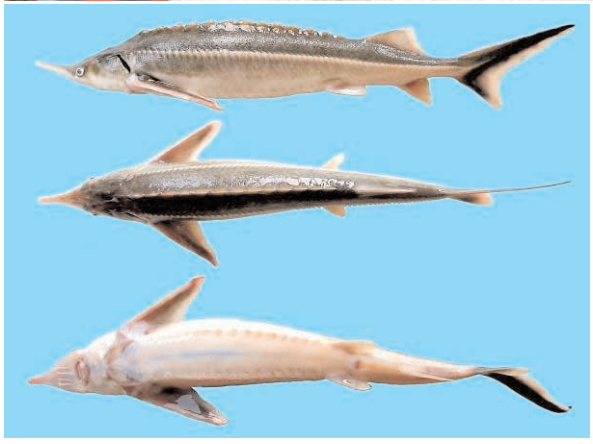
I. Background information on the taxa

1. BIOLOGICAL DATA

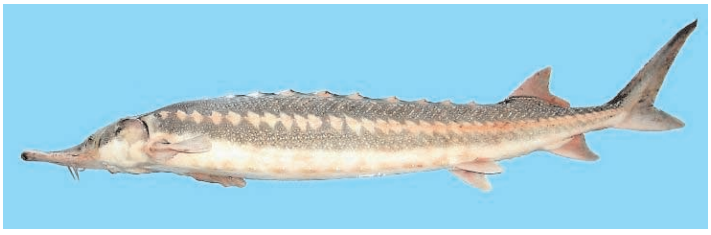
1.1-2. *Scientific* (common names) *and distribution* (only in Eurasia)



Acipenser gueldenstaedti (Russian sturgeon)



Acipenser ruthenus (Sterlet)



Acipenser stellatus (Stellate sturgeon)

Acipenser sturio (Common or Atlantic sturgeon)

Huso huso (Beluga sturgeon)

1.3 Biological characteristics

According to Bloesch J. *et al* (2006) "Acipenseriformes are confined to the northern hemisphere. Biogeographic analysis suggests that the order originated in Europe about 200 million years ago and that early diversification took place in Asia. The majority of species occurs in the Ponto-Caspian region, one third in North America and the remainder in East Asia and Siberia.

Box 1: Summary of high-level sturgeon taxonomy

Class: Osteichthyes (bony fishes)
Subclass: Actinopterygii (ray-finned fishes)
Order: Acipenseriformes (sturgeons and paddlefishes)
Family: Acipenseridae (sturgeons)
Genera: *Acipenser*, *Huso*, *Scaphirhynchus**, *Pseudoscphirhynchus**

* = genus not represented in the Danube River Basin

Sturgeons migrate mostly for reproduction and feeding. Three different patterns of migration have been described:

— *potamodromy* (migration between key habitats within a freshwater riverine and/or lacustrine system)
— *anadromy* (most of the life cycle takes place at sea, but spawning migrations are conducted into freshwater),
— *freshwater amphidromy* (spawning migrations are conducted into freshwater, whereas feeding and growth occur during migration to and from salt water),

Although Acipenseriformes do not have a common life history and variation within and between species is the rule rather than the exception, there are some traits that all sturgeon and paddlefish species have in common. These are summarized below.

Almost all members of Acipenseriformes are endangered or threatened with extinction.

All species reproduce in freshwater or water of low salinity although adults may migrate into brackish or even salt water for feeding. Some even adapt to high levels of salinity during ontogenesis and migrate into full seawater after reaching a certain size, generally remaining on the continental shelf (Danube example: *A. sturio*). Other sturgeon species or races spend their entire life cycle in freshwater (Danube examples: *A. ruthenus*, *A. nudiventris*, resident form of *A. gueldenstaedti*). It has also been found that migratory Ponto-Caspian species mature in freshwater ponds.

Sturgeons exhibit a 'periodic strategy' life-history, which is typical for large fishes with high fecundity and long life spans living in environments with large-scale cyclic or spatial variation. The life cycle of Acipenseriformes is generally quite long with puberty occurring late in life. Individuals spawn repeatedly, but most females do not spawn annually.

Spawning rate is once in 2-11 years for females, and once in 1-6 years for males.

The timing of spawning is highly variable. Most species spawn from spring to early summer over a wide range of temperatures (6 to 25° C). For several diadromous[1] sturgeon species (or winter (or fall) and spring (or vernal) races have been recognized. Fish of the winter race spend the winter in the river or the river mouth, hibernating in holes or deeper river bends, undertaking little or no feeding activity. They spawn far upstream, the year(s) after entering the river. The vernal races do not hibernate and only enter the river when temperatures are rising. Vernal fish mature the same year, lower in the course of the rivers, puberty is reached earlier and they spawn later in the same season. Spawning migration also depends on the flow regime of the rivers.

Studies indicate that the availability of suitable spawning habitat is vital for the reproductive success of Acipenseriformes. Spawning sites are characterized by hard substrates, varying in size from gravel to

1 diadromous = species that migrate between fresh and salt water at some point of their life cycle.

boulders, with many crevices and where water velocity near the bottom is generally low (i.e., boundary flow velocity). These areas are typically in the mainstream of the river, or close to the banks. The water depth at spawning sites varies from a few meters to 26 m and the current velocity ranges from 0.5 to 2.2 m s^{-1} in the water column, allowing for wide dispersal of fertilized eggs.

Almost nothing is known about mating and spawning habits. However, considering the short duration of sperm motility (only one or two minutes), a good degree of synchrony in the release of the male and female gametes has to be presumed. The ova remain fertile after release into freshwater for up to one hour, so that erratic eggs may be fertilized by freshly ejaculated sperm. Likewise, sperm must be diluted rapidly by the high velocity of the river current.

Eggs are adhesive and can be found immediately downstream of the spawning ground. During embryogenesis water velocities in the range 0.5 – 1.5 m s^{-1} have been reported. Hatching occurs after 200-250 hours, depending on the species and water temperature. The size of newly hatched larvae ranges from 6 to 15 mm. The free embryos of several species are pelagic for a few days (Danube examples: A. stellatus 11-12days) and are transported downstream by the currents at a velocity up to 45 cm s-1 or 40 km day^{-1}. After displacement from the spawning ground, the yolk sac larvae settle down, usually on coarse substrate in a much lower water velocity (1 to 5 cm s^{-1}) and start feeding on both planktonic and benthic organisms. The water velocity and substrate requirements for eggs and larvae are different for fertilization, embryogenesis, yolk-sac resorption, first feeding and active exogenous feeding. The habitat requirements for juveniles change with the seasons.

Annual spawning success and recruitment are highly variable and depend on the flow regime during the reproductive period of the spawning female. High flows can create increased bottom velocities which preclude or greatly reduce spawning success. Off-flow regime is also important for the time of egg development, hatching and downstream migration of larvae. Water level fluctuations, due to flow management by hydropower stations can also have negative effects on spawning and reproduction success. Year class strength is determined within the first months of sturgeon life. After the first year, sturgeons are usually no longer subject to predatory pressure.

Particular spawning sites are usually frequented each year. Such site fidelity might derive either from the distinct characteristics of the site or from homing behaviour. Homing fidelity has yet to be proven for sturgeons, but is thought to be a significant factor.

Periods of high flow are an important trigger for the spawning migrations of many acipenseriform species, the higher water levels at

such times enabling fish to pass through river stretches containing rapids or shallows. Any reduction in river discharge during the period of migratory activity of sturgeons diminishes the attractiveness of the river, and thus reduces the number of anadromous spawners, whether those entering from pre-estuarine regions into the main river, or from the main river into tributaries.

Spawning populations of Acipenseriformes show a complex multi-aged structure.
All sturgeons show a strong tendency towards hybridization with other sturgeon species, especially if suitable spawning habitats are lost and animals of different species are confined to only a few suitable sites.

Overview of sturgeon species in the Danube River Basin
It is generally accepted that six species of Acipenseridae are, or were, native to the Danube River Basin.

- *Acipenser gueldenstaedti* (Danube or Russian sturgeon)
- *Acipenser nudiventris* (Fringebarbel or Ship sturgeon)
- *Acipenser ruthenus* (Sterlet)
- *Acipenser stellatus* (Stellate or Starred sturgeon)
- *Acipenser sturio* (Common or Atlantic sturgeon)
- *Huso huso* (Beluga or Great sturgeon)

Other acipenseriform species and hybrids have been introduced into pond- and aquaculture in the Danube Basin, for the production of caviar and sturgeon meat. These include *Polyodon spathula* (North American paddlefish), *Acipenser naccarii* (Adriatic sturgeon), *A. baeri* (Siberian sturgeon) and *A. ruthenus* x *Huso huso* (bester).

In the case of hybrids, there is no clear-cut demonstration of superiority compared to parental growth, food conversion and fecundity, and the use of exotic species and/or genotypes as well as hybrids in aquaculture is questionable, in terms of the risks of escape into open waters and contamination of wild sturgeon populations.

Sturgeon juveniles of various species, as well as hybrids, can also be found in the aquarium or pet trade, where they are sold to hobbyists. Although not used for intentional stocking of river systems, individuals of allochthonous taxa are sometimes released or escape and can occasionally adapt to conditions in the wild outside of their native range (see section 2.4 'Introduction of exotic species and genotypes, alteration of the genetic status of populations').

Diadromy and migration

Of the six sturgeon species native to the Danube Basin, four are – or were – migratory (diadromous) species living in the Black Sea shelf zone and entering the Danube Delta or Danube River itself for spawning: *A. gueldenstaedti*, *A. stellatus*, *A. sturio*, *H. huso*.

Migration of sturgeons can be observed throughout the year in the Lower Danube. However, the three anadromous species (*A. gueldenstaedti*, *A. stellatus*, *H. huso*), exhibit a dual-peaked migration pattern, where fish either enter the river to spawn in the same year (these individuals belong to the 'vernal' or 'spring' race) or over-winter in the river, using deeper stretches of water or depressions in the river-bed, and spawn the following year (these individuals belong to the 'fall' or 'winter' race).

The occurrence of two different races and migration patterns is explained by the longer distances the winter races have to cover to use suitable upstream spawning sites (homing fidelity has not been confirmed as yet), as well as by the duration of migration and overwintering being necessary for ripening of the gonads and ovulation of female spawners. Spawning shoals are often accompanied by immature males.

The dual-peaked migration pattern is documented through the correspondingly two-peaked catching success of commercial fishermen on the Lower Danube River (spring and autumn), indicating that catches might take place in the vicinity of key habitats (spawning / overwintering).

The Danube sturgeons include one exclusively freshwater species (*A. ruthenus*), one species that forms both migratory and freshwater stocks in the Black Sea and Danube Basin (*A. gueldenstaedti*), and one species which occurs only in its freshwater form in the Danube Basin (*A. nudiventris*).

Another important component of the life cycle of sturgeons in Danube River is the dispersal of early life stages, which takes place first through passive drifting and subsequently by active movement of individuals. Dispersal rates and patterns are also influenced by various environmental factors, meaning that individuals of the same species might display considerably different behavioural patterns during their early life stages according to the particular conditions in a given tributary or river stretch.

Reproduction

Four sturgeon species still reproduce in the Lower Danube River (*A. gueldenstaedti*, *A. ruthenus*, *A. stellatus*, *H. huso*).

Traditional spawning sites for anadromous species were situated in the Middle Danube River and major tributaries, such as the Tisza, Sava and Drava Rivers. Due to the blocking of migration routes by the Iron Gates dams these spawning sites can no longer be reached by migratory sturgeons.

The locations of spawning sites in the Lower Danube River under the changed (post-Iron Gates) migratory and hydrological conditions are mostly unknown and subject to current field research. Only two spawning site of *Huso huso* have been identified recently (through catching larvae). There is no information available about the location of spawning sites or the extent of reproduction of potamodromous species/forms (*A. ruthenus*, *A. gueldenstaedti*, *A. nudiventris*) anywhere in the Danube Basin.

Juvenile rearing habitat

Important rearing habitats and nursery grounds of juvenile migratory sturgeons can be found in the Lower Danube River and the Danube Delta, as well as in shallow areas of the continental shelf in the Black Sea.

Feeding

Sturgeons possess tactile barbels located at the front of the mouth, which is protactile, meaning that it can be pushed outwards and forwards, with thickened lips. The animals show a digging behaviour with the help of the rostrum. Eyes are very small relative to the size of the fish and probably do not contribute much to the location and capture of prey.

Most species feed mainly on bottom invertebrates (insects, insect larvae, annelids and molluscs) and also occasionally on bottom fish. Some species reduce or cease feeding during their migration in freshwater.

Huso huso is the only true predator among the six Danube sturgeon species. In the Black Sea it preys mainly on bottom-dwelling and pelagic fish, while in the river it switches to freshwater fish (e.g. members of the cyprinid family).

The following tables summarize key facts and important events about and for the Danube River sturgeon species.

Table 1: Status and characteristic traits of sturgeons from the Danube River as compiled from literature. Grey areas indicate the occurrence of a species in the Black Sea – Danube River system in the given time period according to literature
(❍: no occurrence, ❑: status is unclear; ■: depends on stocking; ◆: stocks recovered due to stocking, legal protection and improvement of water quality; ●: reserves are reduced to a minimum).

Species	***Acipenser gueldenstaedti*** Danube or Russian (migratory form)		***A. gueldenstaedti*** Danube or Russian Sturgeon (resident form)		***A. nudiventris*** (Danube stock) Ship Sturgeon		***A. ruthenus*** Sterlet		***A. stellatus*** Stellate or Starred Sturgeon		***A. sturio*** Common or Atlantic Sturgeon		**Huso huso** Beluga or Great Sturgeon	
Distribution Status														
TIME PERIOD	HISTORIC	CURRENT	HISTORIC	CURRENT	HISTORIC	CURRENT	HISTORIC	CURRENT	HISTORIC	CURRENT	HISTORIC	CURRENT	HISTORIC	CURRENT
Upper Danube River	rare	extinct	❍	❍	rare	extinct		rare ■	rare	extinct	❍	❍	rare	extinct
Middle Danube River		extinct		very rare		very rare		◆		extinct	❑	❍		extinct
Lower Danube River		rare	❑	❑		❑		●		rare	rare	extinct		rare
North Western Black Sea		rare	❍	❍	❍	❍	❍	❍		rare	rare	extinct	rare	rare
Max. length [cm]	236		no information		221		125		218		600		800	
Max. age [yrs.]	33		no information		36 *		24		35		48		> 100	
Reproduction														
Age at maturation [yrs.]	11 – 13		no information		6 – 9		3 – 5		5 – 6		7 – 9		10 – 13	
Masc./Fem.	12 – 16				12 – 14 **		4 – 7		7 – 10		8 – 14 ***		13 – 15	
spawning season	March-Nov.		no information		April-May**		April-May		May-June		May		April-May	
absolute fecundity [eggs female–1]	29.500 – 406.800		no information		200.000 – 1.300.000		7.000 – 108.000		70.300 – 430.000		790.000 – 1.820.000 ***		228.400 – 964.800	
Migration														
pattern	anadromous		potamodromous		potamodromous		potamodromous		anadromous		anadromous		anadromous	
pea /seasonal races	spring-fall		no information		no information		April-May		spring-fall		no information		spring-fall	
Feeding regime														
	benthic organisms (fishes and invertebrates)		benthic organisms (fishes and invertebrates)		benthic organisms (fishes and invertebrates)		benthic organisms (mainly invertebrates)		benthic organisms (fisher and) benthic organisms		benthic organisms (fishes and invertebrates)		marine and freshwater fishes	

1.4 Population:

1.4.1 *Global Population size:*
Actual global population size is very difficult / impossible to estimate.

1.4.2 *Current global population trends:*
___increasing_X_decreasing ___ stable ___unknown

During the last 30 years populations of most / all sturgeon species are declining. This is clearly reflected in the decline of world catch of sturgeons and paddlefish, from 28,000 tonnes in year1978 to less than 2,000 tonnes in year 2002 (Pikitch *et al*. 2005)

1.5 Conservation status

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

_X_Critically endangered	___Near Threatened
_X_Endangered	___Least concern
_X_Vulnerable	___Data deficient

According to IUCN Red List the six species of sturgeons native to the Danube River basin are globally classified as either 'Vulnerable' (one species), 'Endangered' (four species) or 'Critically Endangered' (one species):
- *Acipenser gueldenstaedti* (Russian sturgeon) Endangered
- *Acipenser nudiventris* (Ship sturgeon) Endangered
- *Acipenser ruthenus* (Sterlet) Vulnerable
- *Acipenser stellatus* (Stellate sturgeon) Endangered
- *Acipenser sturio* (Common or Atlantic sturgeon) Critically Endangered
- *Huso huso* (Beluga sturgeon) Endangered

1.5.2 *National conservation status for the case study country (Romania)*
The six species of sturgeons native to the Danube River basin are nationally classified as either 'Vulnerable' (one species), 'Endangered' (three species), 'Critically Endangered' (one species) or 'Extinct' (one species):
- *Acipenser gueldenstaedti* (Russian sturgeon) Endangered
- *Acipenser nudiventris* (Ship sturgeon) Critically Endangered
- *Acipenser ruthenus* (Sterlet) Vulnerable
- *Acipenser stellatus* (Stellate sturgeon) Endangered
- *Acipenser sturio* (Common or Atlantic sturgeon) Extinct
- *Huso huso* (Beluga sturgeon) Endangered

1.5.2 *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_____
___Unknown

Habitat Loss / Degradation (human induced): Hydropower damming, navigation, dredging for sand / gravel induced spawning and nursery habitats in the river.

Harvesting [hunting/gathering]: During 1990 – 2000 about 800 professional fishermen fishing for sturgeons in the river; fishery poorly / no regulated

Accidental mortality (e.g. bycatch): by shad fisheries in the river. Low to medium intensity poaching still exist after the commercial harvesting moratorium declard in May 2006.

Pollution (affecting habitat and/or species): Serious heavy metal bioaccumulation has been observed with ageing of specimens, less in beluga (predating on pelagic fish) and more on Russian and stellate sturgeon (feeding on bottom fauna) (Suciu 2004).

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

2.1 Management measures

2.1.1. *Management history*

During the communist regime (1947 – 1989) the harvesting of sturgeons was strictly controlled by the state. Fishing was permitted only in the sea, using long lines of un-baited hooks. Practically all sturgeon fishing of Romania was concentrated in only one fishing site (St. George), which enabled strict control of the state over harvesting and trade with products derived from sturgeons .

After 1989, during almost 11 years, enforcement of fishery regulations was totally neglected. Over 80 fishing sites along the 860 km of river were established. A new Law on Fishery and Aquaculture was

adopted only in year 2001 (Law 192 / 2001). To protect sturgeons during spawning migration, this act introduced the prohibition system in the Danube River based on successive 2 or 3 month fishing ban, starting in on 15th of February in the Black Sea and continuing in three steps till end of June, at river km 863 (Iron Gates II HP dam). The principle of this prohibition system was to allow access of migrating adults to spawning grounds located upstream.

After the CITES 45th SC meeting held in June 2001 in Paris, Romania and the other Lower Danube and Black Sea basin countries (Yugoslavia, Bulgaria, Ukraine, Turkey, Georgia and Russian Federation) were requested to establish and implement regional management system of sturgeon stocks, including monitoring of status of populations / stocks and joint setting of non-detrimental harvesting / catch quotas.

Two regional meetings on conservation and sustainable use of sturgeons in the region were held in Sofia / Bulgaria (Oct. 2001) and Tulcea / Romania (June 2003).

At the First Regional CITES Meeting of the seven Black Sea and Azov Sea sturgeon range countries (Bulgaria, Georgia, Romania, Russian Federation, Turkey, Ukraine and Yugoslavia) held in Sofia between 23-26 October 2001, participants agreed on establishing of the Black Sea Sturgeon Management Action Group (BSSMAG), formed by 2 - 3 representatives of each country.

The Agreed Conclusions of this first regional meeting could not be signed by the representatives of the seven countries participating in the meeting.

(http://www.indd.tim.ro/rosturgeonsn/index.php?option=com_content&task=view&id=22&Itemid=35)

As agreed, BSSMAG was working mainly as an E-mail dialog group and within non-periodically organized meetings. Two experts of the CITES Secretariat Scientific Support Unit were observers of the e-mail dialog group, receiving CC of each message circulated in the group.

A "Regional Strategy for the Conservation and Sustainable Management of Sturgeon Populations of the N-W Black Sea and Lower Danube River in accordance with CITES" (Annex 1) was agreed in Tulcea during the second Regional Meeting and an Agreement between Fisheries and CITES Management Authorities from Republic of Bulgaria, Romania, Serbia and Montenegro and Ukraine, concerning the implementation of the Regional Strategy, was finally signed in late 2005. The whole process was guided / supervised by the CITES Secretariat.

In December 2001 CITES SA for Acipenseriformes of Romania (Danube Delta National Institute - Tulcea) launched the idea of organizing every year in July and December sturgeon management stake-

holder meetings, with participation of fishery scientists, fishery managers, law enforcement institutions, fishermen associations and CITES administration.

These meetings became regular events during the next years and contributed decisively to systematic improvement of communication and sharing of information on status of populations. The meeting held annually in July / August was to discuss the results of law enforcement activity and the results of monitoring the recruitment from natural spawning in that year, while that held in early December was to discuss the results of annual monitoring of effects of catch quota of the current year and establish the catch and export quota proposal of Romania for the next year.

According to the agreed regional management strategy (objective 1.7.3), BSSMAG had to adopt by consensus non-detrimental regional catch and export quotas for each species based on the results of monitoring system, gradually implemented in countries of the region. This process encompassed examination of monitoring results and quota proposal of partner countries, consultation with national experts, Fishery MA and CITES MA followed by regional negotiations. All this would have been not possible (in only 2-3 weeks time) without the E-mail dialog group working system adopted during the first regional meeting held in Sofia (Oct. 2001).

A key management event was also the launching in July 2003 of the webpage "Sturgeons of Romania and CITES", http://rosturgeons.danubedelta.org, which became since June 2008 www.indd.tim.ro/rosturgeons .

After four years (2002 - 2005) the data gathered by monitoring regularly key status indicators of the populations (age class structure of annual cohorts of adult sturgeons migrating in the Danube River for spawning and the annual natural recruitment / juvenile production index) were used by CITES SA to convince the recently (2005) established National Agency for Fishery and Aquaculture (NAFA) of Romania to agree that continuing commercial harvesting of sturgeon stocks for export would be detrimental to their survival.

Three national expert and stakeholder meetings were held in March and April 2006 to discuss the proposal of CITES SA to declare a 10 year moratorium for commercial catches of sturgeons from the wild in Romania and to adopt a special conservation and recovery programme along with measures for quick development of sturgeon aquaculture.

Finally, in May 2006 Ministries of Environment and Agriculture of Romania issued a joint ministerial order on "conservation of wild sturgeon populations and development of sturgeon aquaculture in Romania" (Annex 2).

The initiative of Romania, taken late, in May 2006, after publication by the CITES Secretariat of catch quotas for the region as agreed in November 2005, could not be adopted by the other three countries in the same year. The next year the quota setting procedure by consensus forced the whole region to adopt zero catch and export quota for sturgeons from the wild.

In June 2006, Romania organized at S?ruleflti (near Bucharest) the third Regional Meeting on Sustainable Management of Sturgeons of N-W Black Sea and Lower Danube River in accordance with CITES. CITES MA of Serbia and Ukraine and Fisheries MA of Serbia, Ukraine and Bulgaria as well as sturgeon experts from the region participated in the meeting. The reasons and consequences of the conservation measures adopted by Romania were discussed and the need for a regionally coordinated supportive stocking programme was agreed in a document called "Recommendations of the Expert Meeting on coordination and implementation of sturgeon stocking programmes for the Lower Danube River and of the North-West Black Sea Region" (Annex 3), signed by experts of all four countries.

2.1.2. *Purpose of the management plan in place*

Already in year 2005 all four countries of the region adopted national management plans deriving from the agreed Regional Strategy of 2003. The purpose of the management plan adopted by Romania in 2004 is to implement the Regional Strategy for conservation and sustainable management of sturgeon population in the region.

2.1.3. *General elements of the management plan*

The main elements of the Management Plan adopted by CITES and Fishery Authorities of Romania are:

(i) improvement of knowledge of actual biology of sturgeon populations spawning in the Danube River;
(ii) progresses in description of their genetic diversity, in artificial propagation and restocking procedures;
(iii) improving monitoring of catches and overall fishery management;
(iv) determining existence of possible sub-populations and adapting the management plan accordingly;
(v) improving national regulations and their implementation / enforcement;
(vi) adaptive management under CITES;
(vii) revisions and implementation of management Plan;
(viii) financing activities of the Plan

2.1.4. *Restoration or alleviation measures*

Since 2005 Romania is implementing a supportive stocking programme of the Danube River with specially produced young sturgeons of endangered species. Conditions are specified in Annex 1 of the joint ministerial Order of May 2006.

2.2 Monitoring system

In February 2002 BSSMAG agreed on a common Regional Monitoring System (Annex 1.2) of effects of current catch quotas on sturgeon stocks migrating for spawning in the Lower Danube River.

2.2.1 Methods used to monitor harvest

Compulsory tagging of every legally captured specimen of sturgeon using commercial tags (Fig. 7 / Annex 4) and reporting the fish on special signed and stored reporting sheets was introduced by a special Order of the Ministry of Agriculture (No. 350 / 2001). Since 2003, the characteristics of every sturgeon captured were posted on-line in a data base included on the webpage http://rosturgeons.danubedelta.org, which became since June 2008 www.indd.tim.ro/rosturgeons.

2.2.2 *Confidence in the use of monitoring*

Since till 2002, catch quotas were established and divided among fishing companies only as weight of fish and caviar, under-reporting of length and weight was clearly visible when analysing distribution the Length – Weight relationship of fish. This situation was corrected in year 2003 by asking the CITES Secretariat to publish catch quotas both as weight of fish and number of specimens (Fig. 1 / Annex 4).

Confidence in the monitoring of harvested sturgeons has improved significantly in since year 2003, when CITES MA adopted the decision to issue CITES export permits only for the caviar obtained from sturgeons included in the data base of catches, where catches were recorded on-line by specialized officers of the two Fisheries administrations. This measure had clearly the effect of bringing most of caviar to the legal market, because of the significantly higher price obtained by both fishermen and caviar processors when the caviar was exported.

2.3 Legal framework and law enforcement:

Conservation of sturgeons was for the first time in Romania specifically addressed by the joint ministerial Order of May 2006 (Annex 2)

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

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

Meat of wild sturgeons was sold mainly on the local market and is still used by fishermen of remote communities of the Danube delta for consumption in their own families. Caviar was bought by caviar processing companies from professional fishermen and was mainly directed to export. The use of cartilaginous notochord for preparation of special glue has almost disappeared.

Since sturgeon aquaculture has a very short history in Romania (first successful artificial propagation of beluga sturgeon in Romania only in April 2004), there is still no / very little sturgeon meat or caviar originating from local aquaculture on the market. Most sturgeon meat sold now in Romania originates from aquaculture in Bulgaria and Poland.

3.2 Harvest:

3.2.1 *Harvesting regime*

Wild sturgeons were captured in Romania historically (before Second World War) both in the sea (with un-baited hook lines) and in the river (with special drifting trammel nets). Only sexually ripe adults were harvested since all fishing was targeting fish during migration for spawning. Harvesting effort during has significantly grown during the period 1990 – 2005. Even after implementation of regional monitoring system in Romania it was impossible to determine the catch per unit of effort, since number of fishing gears and duration of daily fishing was impossible to record individually.

During the first year of effective implementation of CITES regulations in Romania (year 2001) a number of about 1200 licensed fishermen were recorded. Before closing the commercial fishing of sturgeons from the wild in 2006, the number of fishermen licensed for fishing of sturgeon was reduced to about 600.

Commercial harvesting season was in winter till prohibition during spawning season (March - May) and in fall (Sept – Nov.)

3.2.2 *Harvest management/ control*

Individual catch quotas derived from dividing national quotas, agreed regionally for Romania and published by CITES Secretariat, were distributed to fishing and fish processing companies, to whom fishing right was concessioned by the state. Individual permits for capture of sturgeons by professional fishermen were issued by NAFA Romania at the proposal / request of the fishing companies. Till year 2005 control of fishing was performed by the border police and rangers of the Danube Delta Biosphere Reserve of Tulcea.

Since 2006, NAFA Romania has significantly strengthen its Fishery Inspection Department, which has taken the leading role in surveying the fishing sites were capture of a limited number of live specimens for artificial propagation is permitted, with special authorisation of NAFA. Fishery inspectors tag all sturgeons captured with transponder tags and fill in capture recording sheet for each fish. The data of these recording sheets are centralized in a data bank posted annually on the webpage: http://www.indd.tim.ro/rosturgeonsn/index.php?option=com_content&task=view&id=29&Itemid=43

Most wild adult sturgeons captured alive and tagged after 2006 survive the artificial propagation procedure and are released back in the river: 169 out of 172 captured in year 2007 and 174 out of 188 captured in year 2008. Characteristics and individual PIT tag serial numbers are posted on the webpage.

3.3 Legal and illegal trade levels:

During 2002 - 2006 over 95 % of caviar exported was derived from wild sturgeons captured legally. Most probably that the caviar sold on the local black market was captured illegally.

II. Non-detrimental finding procedure (NDFs)

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

___yes __X_no.

Since no population status data and very little fishery management data were available till 2001, experts of countries of the region agreed during the Sofia meeting (Oct. 2001) that adaptive management by monitoring the effects of current catch quota on the population was the only way forward. At that time it was impossible to know if the catch quotas requested / agreed are detrimental or not to the survival of populations spawning in the Danube River.

One step forward was taken when in 2003, the region was reduced to only four countries of NW Black Sea and the lower Danube River (BG, RO, SR, UA). Turkey and Georgia were literally not having any sturgeons of commercial importance left in their rivers, while Russian Federation and Ukraine were separately managing sturgeon stocks of the Sea of Azov, which we agreed that do not inter-mix with sturgeons spawning in the lower Danube River.

2. CRITERIA, PARAMETERS AND/OR INDICATORS USED

Ten population status indicators were adopted in the common Regional Monitoring System (RMS) agreed in February 2002 (Annex 1.2). Nine of them were fishery dependent: (1) Number of fishermen; (2) Number of fishing hours using standard gillnets of 100 m; (3) Number of fish captured; (4) Catch / species / fishing zones; (5) Catch per Unit of Effort; (6) Sex ratio; (7) Distribution of length frequencies / classes; (8) Distribution of age frequencies / classes and (9) Rapid Rural Appraisal (RRA) of captures in 5 selected fishing sites. One indicator was fishery independent: Number of downstream migrant juveniles [CPUE], which has developed during the nine years of monitoring into a true juvenile production index used to evaluate the evolution of recruitment from natural spawning.

Intentionally the process of deciding non-detrimental catch quota was composed of three steps:

1) adopting in year 2001 precautionary catch quota (based on historical levels of catches);
2) monitoring the effect of the quota (and other impacts) via RMS indicators in relation to reference directions (e.g. increase or decrease in the proportion of first spawners and second / third /fourth spawners; annual abundance of YOY from natural spawning as compared with the reference year 2000); and
3) adjust quota according to the results of monitoring.

Although in early 2004, based on the information from the Caspian Sea region (Ivanov, 2000), Romania started a process of adopting of quota sharing criteria system among the four countries of the region, it was impossible to reach an agreement and consequently quotas were adopted by consensus, through negotiations, as compared to quotas adopted by each country in year 2001 and the results of monitoring.

In reality the proportion of implementing the RMS varied very much between countries of the region, from almost no monitoring in former Yugoslavia / Serbia, to various degrees of monitoring the effects only in the river in Bulgaria and only in the Black Sea in Ukraine. Even Romania has failed to monitor indicators (2), Number of fishing hours using standard gillnets of 100 m, and (5), Catch per Unit of Effort, and these were subsequently left out of the RMS.

In this process four of the RMS indicators: 1)number of juveniles [CPUE] migrating annually downstream in the river; 2)distribution of age frequencies / classes; 3)distribution of length frequencies / classes and 4) sex ratio of the adults captured / forming the cohort of the

current year, were considered in descendent order as the most important in reflecting the effect of catch quota adopted for the current year (1) and the status of adult sturgeons in the Black Sea which had reached at least once sexual maturity, as result of fishery exploitation during the last 30 – 40 years (2, 3 and 4).

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

Data for all fishery dependent indicators (except (2) and (5)) were obtained from the fishery administrations via catch recording system implemented on the webpage. Age class distribution was established by DDNI Tulcea / CITES SA for Acipenseriformes of Romania, by determining age on cross-sections in bony pectoral fin rays collected by professional fishermen. Age was determined independently by three technicians and differences were solved / tackled jointly, tacking in consideration the sex, length and weight of the respective fish.

Data on status and management of sturgeon populations of N-W Black Sea and Lower Danube River were sent every year in late November via BSSMAG among partner countries of the region. The example of Romania for year 2004 is given in Annex 4.

Monitoring of abundance of young of the year (YOY) sturgeons (1.5 – 2 month old / 10 – 30 cm long) on a river bottom area of about 8 ha was developed by DDNI Tulcea already 1997 – 1999, and was systematically conducted since year 2000, at River Km 118, downstream of the port of Reni / Ukraine. A special fishing gear was developed to capture young sturgeons on this nursery site: a 96 ml long, 2.5 m high trammel net with 20 mm mesh size of the middle net. This was drifted downstream on the bottom over 850 m along the right bank of the river at water depth of 6 – 14 m (Table 1).

Table 2: Results of monitoring YOY sturgeons born in the lower Danube River (2000 – 2008)

Data	Nr. of netting	Beluga [No.] [% /CPUE]		Russian sturgeon [No. [%/CPUE]		Stallete sturgeon [No.] [% /CPUE]		sterlet [No.] [% /CPUE]		Total [Nr] [% /CPUE]	
12-14-07 **2000**	8	59	58,42 % 7,375	6	5,94 % 0,75	11	10,89 % 1,375	25	24,75 % 3,125	101	100 % 12,625
26-29-06 2001	16	27	84,37 % 1,687	2	6,25 % 0,125	—	— 0	3	9,38 % 0,187	32	100 % 2,00
10-13-07 2001	8	12	57,14 % 1,5	2	9,52 % 0,25	5	23,82 % 0,625	2	9,52 % 0,25	21	100 % 2,625
Total 2001	24	39	73,6 % 1,625	4	7,6 % 0,167	5	9,4 % 0,208	5	9,4 % 0,208	53	100 % 2,208
19-20-06. 2002	14	59	71,08 % 4,214	3	3,62 % 0,214	—	— 0	21	25,30 % 1,5	83	100 % 5,928
03-25.07 2002	29	16	25,80 % 0,551	10	16,13 % 0,345	2	3,23 % 0,069	34	54,84 % 1,172	62	100 % 2,138
Total 2002	43 1,744	75	51,72 % 0,302	13	8,97 % 0,046	2	1,38 % 1,279	55	37,93 % 3,372	145	100 %
10-26-06 2003	17	0	0 %	0	0 %	0	0 %	0	0 %	0	0 %
9-25-07 2003	18	Hybr ids 5	7.25 % 0.278	0		3	4.35 % 0.167	61	88.40 % 3.389	69	100 % 3.833
Total 2003	35	5	7.25 % 0.143	0		3	4.35 % 0,086	61	88.40 % 1.743	69	100 % 1.971
22-30.06 2004	14	40	70.18 % 2,857	1+2H	0.214		0	17	29.82 % 1.214	60	100 % 4.071
01-23-07 2004	27	29	26.61 % 1,074			5	4.59 % 0.185	75	68.80 % 2.778	109	100 % 4.037
Total 2004	41	69	40.83 % 1,683	3	1.77 % 0.073	5	2.96 % 0.122	92	54.44 % 2.244	169	100 % 4.122
14-17-06 2005	6	73	84,88 % 12,17	1	1,16 % 0,166	0	0 %	12	13,96 2	86	100 % 14,33
05-07-07 2005	5	37	20,11 % 7,4	0	0 %	14	7,61 % 2,8	133	72,28 % 26,6	184	100 % 36,8
Total 2005	11	110	40,74 % 10	1	0,37 % 0,091	14	5,19 % 1,273	145	53,70 13,182	270	100 % 24,55

27-30-06 2006	13	3	0,23	0	0	0	0	0	0	3	0,23
03- 07-07 2006	15	13	0,87	0	0	0	0	0	0	13	0,87
12-14-07 2006	7	2	0,29	0	0	0	0	0	0	2	0,29
Total 2006	35	18	100% 0,51	0	0	0	0	0	0	18	100% 0,51
29-31-05 2007	13	18	1,384	0	0	0	0	4	0,308	22	1,692
05-08-06. 2007	14	5	0,357	0	0	0	0	3	0,214	8	0,571
12-14-06 2007	14	4	0,286	1	0,071	0	0	8	0,571	13	0,928
Total 2007	41	27	62,7% 0,659	1	2,3% 0,024	0	0	15	35 % 0,366	43	100% 1,049
11-13-06 2008	5	26	5,20	0	0	1	0,20	0	0	27	7,40
17-20-06 2008	9	14	1,55	0	0	1	0,111	1	0,111	16	1,778
23-27-06 2008	12	34	2,83	0	0	6	0,50	2	0,166	42	3,499
Total 2008	26 2,846	74	87,06%	0	0% 0,308	8	9,41% 0,115	3	3,53% 3,269	85	100%
TOTAL			**471**		**25**		**48**		**401**		**945**

CPUE = number of fish captured in one netting over the same surface of about 8 ha, at Danube River Km 118.

A total number of 945 YOY sturgeons of four species were captured during the period of nine years (2000 – 2008). All were individually measured length and weight and sampled fin clips for DNA extraction, photographed, tagged with Floy Fingerling Tags (FFT) and released back in the river (Fig. 1).

Due to extreme low water levels, in year 2003 no natural spawning was recorded in beluga sturgeon. Only 5 hybrids of Russian sturgeon female and beluga male were captured during routine monitoring.

Timing of presence of first YOY sturgeons at River Km 118 during the respective year was determined based on timing of spawning and behaviour of early life stages of beluga after hatching in the river (Suciu 2005).

Fig. 1: (Up)
YOY beluga sturgeon captured sampled and tagged with FFT at Danube River Km 118 June11, 2008

(Down) Six YOY beluga sturgeons captured in one netting on June 17, 2008 at Danube River Km 118.

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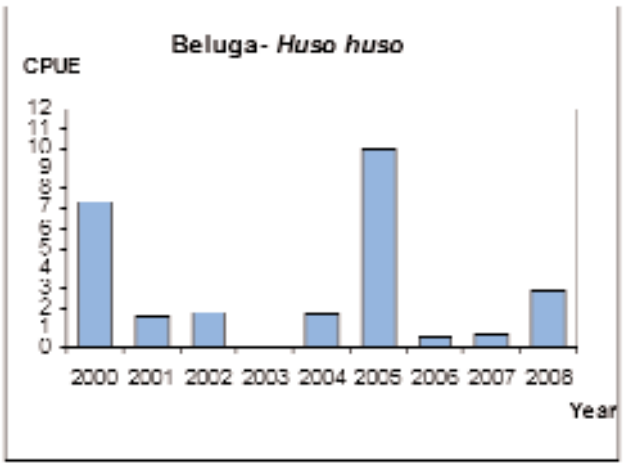
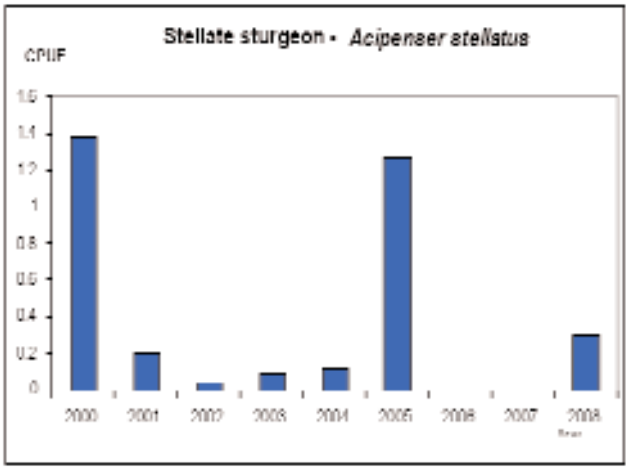
Juvenile production index graphs (Fig. 2) were drawn from these data and are used to evaluate success of natural spawning and natural recruitment.





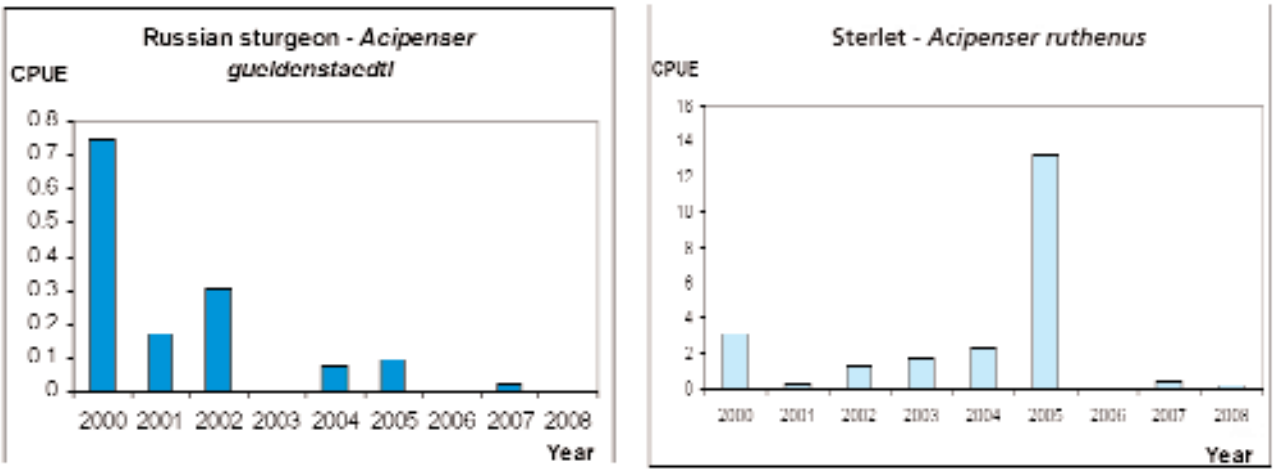


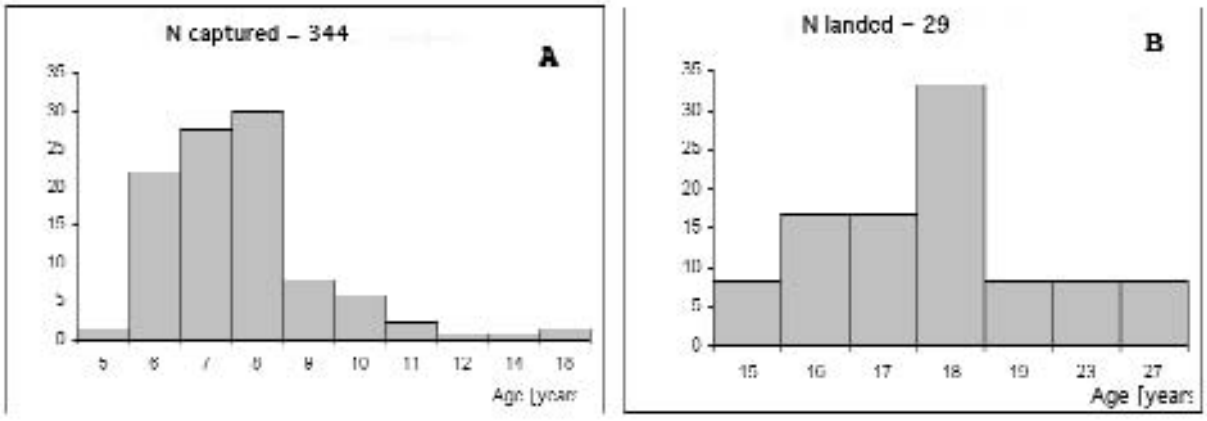
Fig. 2: Juvenile Production Index from natural spawning of sturgeons in the lower Danube River (2000 - 2008)

Low or even missing recruitment during the respective year was linked to small number of adult sturgeons captured during that year, like in Russian sturgeon after 2002 and with repeatedly missing first time spawners in the cohort migrating into the river for spawning in successive years in Russian sturgeon after 2002 and in beluga sturgeon after 2005.

In the Danube River stellate sturgeon females are spawning for the first time ate age of 7 – 8 years, Russian sturgeon females at age of 9 years while beluga sturgeon females at age of 14 years.

Age structure of adults monitored annually (Fig. 3) was used to evaluate the effects of adopted catch quota. We found that the age structure recorded in year 2003 in stellate sturgeon (Fig.3A) could be considered as relatively unaffected by fishery because first spawners (6 – 8 years old) were dominant (over 70%).

Already in year 2003 age structures of Danube sturgeon (Fig.3B) and beluga sturgeon (Fig.3C & D) migrating for spawning in the Danube River were clearly lacking first time spawners (less than 5%).



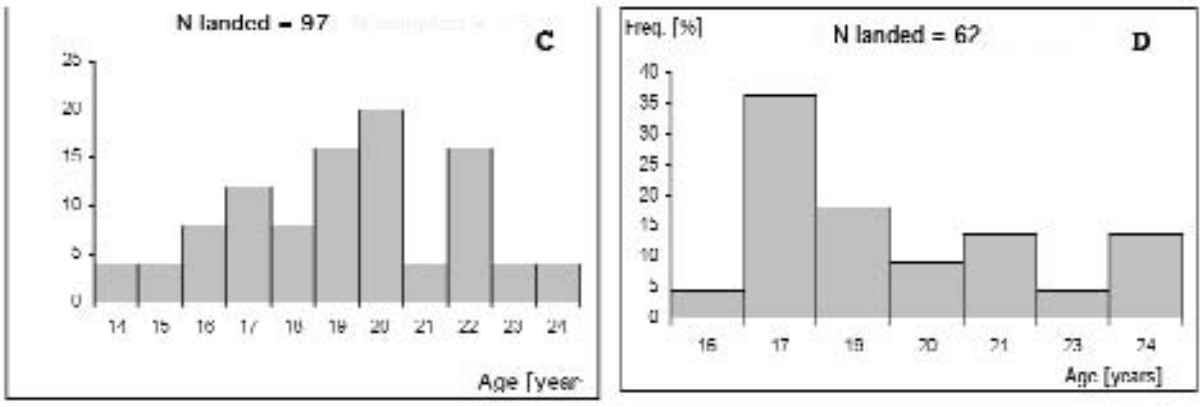


Fig. 3: Age class frequencies in: A- stellate sturgeon males (2003); B – Danube sturgeon of mixed sexes (2003); C - beluga sturgeon of mixed sexes (2003) and D – beluga sturgeon females (2004) landed in Romania (years in parentheses).

The data on missing / very small classes of first time spawners in cohort of adults of Russian sturgeon and beluga migrating in the Danube for spawning was interpreted as clear signal of a whole series of heavily affected year classes of these species, situation caused by uncontrolled over-fishing during 1990 – 2000 (N?vodaru, 1999). This indicator along with poor natural recruitment and increasingly low number of adult specimens captured were the main arguments adopt /declare in May 2006 a ten year moratorium for commercial catches of wild sturgeons in Romania, measure adopted the following year also by Bulgaria and Serbia.

4. EVALUATION OF DATA QUANTITY AND QUALITY FOR THE ASSESSMENT

Implementation of compulsory reporting and recording in the data base on the webpage of all sturgeons captured in Romania resulted in acquisition of the largest number of individual data on sturgeons in the whole history of Romania: 717 specimens in year 2003; 863 specimens in year 2004 and 535 specimens in year 2005. Data quality improved over the years, as already explained in chapter 2.2.2.

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

The main problem on the elaboration of NDF findings and deciding if continuation of commercial captures for export and domestic use was detrimental to the survival of population consisted in the quantity and quality of monitoring data recorded by partner countries of the region. So, age class structure data provided by Ukraine were based

only on fish captured during experimental trawling in the Black Sea, while natural recruitment data were totally missing in the reports of Bulgaria and Serbia, mainly due to poor / lacking research and monitoring activity on the river.

Also, in Romania it was very difficult / impossible to obtain fishery dependent data on sterlet and all NDF quotas setting process in this species had to rely only on monitoring of natural recruitment via abundance of YOY in the control section at Danube River Km 118.

Monitoring the abundance of YOY sturgeons, as the only fishery independent population status indicator, requested working in extremely difficult conditions on the border with Ukraine (difficult access and supply of fuel, living in tents for almost two month, no electricity and difficult communication).

To correct this situation and provide normal working conditions, the Romanian Ministry of Environment has decided in year 2006 the construction of an International Monitoring Station for Migratory Fish (sturgeons and Danube shad) at River Km 100 / Isaccea. The construction worth 300,000 Euro has been finalized in July 2008 and the Station will be operational in spring 2009. It will provide good working and living conditions for a number of 8 experts from Romania and partner countries of the region.

6. RECOMMENDATIONS

The NDF system adopted by us is applicable only for populations and rivers were natural recruitment still consists the basis for the survival of sturgeon populations (Paraschiv 2006) and genetic diversity and equilibrium of species (Onara 2007) is still little or not heavily disturbed by human impact.

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Annex index:

Annex Number	Title
1	Regional Strategy for the Conservation and Sustainable Management of Sturgeon Populations of the N-W Black Sea and Lower Danube River in accordance with CITES
1.1	Effective breeding number (Ne) of sturgeons to be used in all propagation activities for supportive stocking
1.2	Monitoring system of effects of current catch quotas on sturgeon stocks
2	Order on conservation of wild sturgeon populations and development of sturgeon aquaculture in Romania
2.1*	Effective breeding number (Ne) of sturgeons to be used in all propagation activities for supportive stocking
2.2	Capture recording file for sturgeon brood stock
2.3	Register for the artificial propagation of sturgeon
3	Recommendations of the Expert Meeting on coordination and implementation of sturgeon stocking programmes for the Lower Danube River and of the North-West Black Sea Region
	Status and management of sturgeon populations of N-W Black Sea and Lower Danube River during 2000 - 2004 in Romania

* This annex repeats Annex 1.1 because it was included in both the Regional Strategy (…) (Annex 1) and the Order on conservation of wild (…)(Annex 2).

8. ANNEXES

Annex 1

Regional Strategy [*]
for the Conservation and Sustainable Management
of Sturgeon Populations of the N-W Black Sea and Lower Danube River
in accordance with CITES

(26 November 2003)

Introduction

In accordance with Resolution Conf. 12.7 representatives of the Fisheries and CITES Management Authorities of countries of the N-W Black Sea and Lower Danube River (**Annex 2)** met in Tulcea, 24 - 27 November agreeing on this Regional Strategy.
Species concerned: beluga sturgeon (*Huso huso*), Russian sturgeon (*Acipenser gueldenstaedti*), stellate sturgeon (*Acipenser stellatus*), ship sturgeon (*Acipenser nudiventris*) and sterlet (*Acipenser ruthenus)*
Countries of the region: Republic of Bulgaria, Romania, Serbia and Montenegro, and Ukraine
Geographic location: N - W part of the Black Sea and Danube River till Iron Gates / Djerdap

1. Strategy Objectives and Management Recommendations

The recommendations listed below for each objective have been given a priority order (I - III) by being assigned to one of following three categories: (**I**) in 1 – 2 years, (**II**) in 3 - 5 years, (**III**) in 5 – 10 years.

1.1 Sturgeon Population and Life History Information Needs

Objectives: 1.1.1 Develop and implement standardized population assessments on all existing populations

1.1.2 Conduct life history research / assessments where needed.

Recommendations: a. Develop as standardized sampling and assessment techniques as possible to conduct population studies (estimates, age / growth, size structure, etc.) (**I**)

b. Establish river / sea zones that need life history research / assessment work (**I**)

c. Assess homing and imprinting behavior (**II**)

d. Assess early life stage behavior in each species and population (**II**)

1.2 Protection of essential habitats

Objectives: 1.2.1 Identify critical habitats and habitat requirements for various life stages

1.2.2 Identify barriers and other factors within the N-W Black Sea and Lower Danube River System negatively affecting populations of different sturgeon species

1.2.3 Enhance habitat where possible

1.2.4 Monitor threats to key habitats.

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[*] Based on :
Staras, M., *et al*. (2000) Management Strategy of Sturgeons Stocks of Lower Danube River System. Final Report, GEF / WB / DDBRA Tulcea: 48 p
Wisconsin Department of Natural Resources Bureau of Fisheries Management and Habitat Protection (2000) Wisconsin' s Lake Sturgeon Management Plan, 12 p

Recommendations:

a. Identify critical seasonal habitats, threats to key habitats and habitat improvement opportunity (**I**)

b. Start assessment of behavior of adults in the N-W Black Sea **(I)**

c. Assess behavior of migrant adults below Iron Gates I & II dams (**I**)

d. Study the possibility and feasibility to construct fish passes at Iron Gates I & II dams (**II**)

e. Evaluate implemented habitat protection and improvement projects (**II**)

f. Determine habitat needs for different (sub-) populations (**III**)

1.3. Genetics, Propagation and Restocking / Reintroduction

Objectives:

1.3.1 Identify and conserve existing sub-populations / populations and develop recommendations regarding management, rehabilitation and reintroduction taking into account the genetic make-up of these populations.

1.3.2 Ensure regionwide coordination of all propagation activities for supportive stocking (rehabilitation) or reintroduction.

1.3.3 Maximize genetic variability in hatchery reared fish used for rehabilitation or reintroduction, following internationally recognized guidelines (e.g. guidelines of the US Atlantic States Marine Fisheries Commission for the Atlantic sturgeon) (**Annex A**)

1.3.4 Establish best technical criteria and protocol for maximum quality assurance in propagation efforts.

Recommendations: a. Countries conduct studies for identifying of sub-population of sturgeon species spawning in the Lower Danube River (**I**)

b. Countries conduct research on recovery, rehabilitation and reintroduction of the sturgeon species in need **(I)**

c. Take measures to ensure that only breeder from the Danube River native stock are used, and to prevent unauthorized release and hybridization (**I**)

d. Countries ensure a system for genetic control on the production in sturgeon fish farms and hatcheries on their territory. (**I**)

e. Acclimate fish to water body prior to release (**I**)

f. Countries form a **Regional Expert Committee** which co-ordinates all activities deriving from item.1.3 of the Strategy **(I).**

g. Reintroduction efforts should be directed towards ship sturgeon (*Acipenser nudriventis*) (**II**)

1.4 Harvest and Fisheries Information Needs

Objectives: 1.4.1 Develop and implement standardized exploitation assessments at regional level

1.4.2 Develop and implement a real time (online) information system to register each sturgeon captured in the region

Recommendations: a. Improve the actual Regional Monitoring System (RMS) (Annex B) of sturgeon fisheries and stocks, adopted by BSSMAG in 2002, in order to make it fully implementable in all countries of the region (**I**)

b. Determine incidental catch and harvest of sturgeons in other commercial fisheries (not licensed for sturgeons) that may be reduced or closed in future (**I**)

c. Design and launch a webpage on which to register in real time (max. 2-3 days) each sturgeon captured in the region (**II**)

d. Conduct literature review on exploitation of sturgeon fisheries, similar to those organized by the International Danube Research Association (Reinartz, 2002)[1] and, more recently, the American Fisheries Society (Fisher & Burroughs, 2003)[2] (**III**)

1.5 Stocks of different sturgeon species

Objectives: 1.5.1 Manage sub-populations / populations of sturgeons in the region to ensure their long-term conservation and sustainable utilization.

1.5.2 Clarify distinction between sturgeon populations of Azov Sea and N–W Black Sea

1.5.3 Base fishery exploitation on scientific evaluation of sturgeon stocks.

Recommendations: a. Conduct genetic study to distinguish between sturgeon population of Azov Sea, N–W Black Sea and Lower Danube River (**I**)

b. Elaborate separate management plans for main sub-populations (identified at par.1.3.1) of each sturgeon species (**II**)

c. Conduct research to develop stock assessment system of diadromous sturgeon species of the N–W Black Sea and the Lower Danube River. (**II**)

1.6 Regulations and Enforcement

Objectives: 1.6.1 Ensure strong enforcement of sturgeon fisheries regulations and relevant CITES provisions, regionally coordinated in time and space.

1.6.2 Extend CITES labeling and control system of sturgeon products (including caviar) to the domestic / internal market, implementing CITES Resolution Conf. 12.7.

1.6.3 Ensure that adequate legislation and fisheries regulations are developed and effectively implemented.

Recommendations:

a. Participate in developing a DNA based identification system of sturgeons and sturgeon products in trade (I).

b. Harmonize prohibition periods for a better correlation with the biology of species. (**I**)

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[1] Reinartz, R. - 2002 - Sturgeons in the Danube River. Biology, Status, Conservation. Literature Study. **IAD, Bezirk Oberpfalz, Landesfischereiverband Bayern**, 15 p

[2] Fisher, W.L., Burroughs, J.P. 2003 - Stream Fisheries Management in the United States : A Survey of State Agency Programs**. Fisheries**, vol. 28 : 10 - 18

c. To examine and correct those fishing practices which non-selectively target sub-adults or juveniles **(I).**

d. Restrict / eliminate the practice of catching wild broodfish for hatchery purposes during the prohibition period. (**II**)

e. Develop a regional information system on cases of violation of regulations by organizing a regional webpage on reporting of cases of violation of regulations. (**I**)

f. Amend national law to enforce CITES labeling and control system of sturgeon products (including caviar) to the domestic / internal market, implementing Resolution Conf. 12.7. (**I**)

g. Identify effective measures to combat poaching and illegal trade and implement these measures as necessary (I).

1.7 Adaptive Management under CITES

Objectives: 1.7.1 Implementation of Resolution Conf. 12.7 in all countries of the Lower Danube River region.

1.7.2 Implement consistently the adaptive management system until a scientific stock assessment of sturgeon stocks of the region will be available, in accordance with the Conclusions of the Sofia Meeting.

1.7.3 Adopt by consensus non-detrimental catch and export quotas for each species based on results of Regional Monitoring System.

Recommendations:

a. Improve national law system to enable implementation of Resolution Conf. 12.7. (**I**)

b. Keep the BSSMAG as consultative and coordinative body for developing regional protocols including monitoring and assessment of the status of stocks and natural reproduction of sturgeons in the region (**I**)

c. Organise at least once a year national workshops on management of sturgeon stocks under CITES. (**I**)

d. Negotiate annually in BSSMAG non-detrimental catch and export quotas for each species based on results of current monitoring of sturgeon populations and fisheries (RMS) and communicate these quota to the CITES Secretariat by 31 December of each year.

e. Organise a regional data base on the management of sturgeon stocks, hosted by a webpage maintained by BSSMAG. (**II**)

f. Monitor the socio economic aspects of the sturgeon fishery in the Region and take this into consideration when developing adaptive management programmes (**I**)

2. Management Plans

Objectives: 2.1 Develop, implement and update, as needed national management plans for each country of the region.

Recommendations: a. Develop and implement national sturgeon management plan for each country. **(I)**

b. Ensure management recommendations are addressed in national management plan. **(I)**

c. Exchange information on National Management Plans and their implementation through BSSMAG (**I**) .

d. The National Sturgeon Management Assessment Team of each country should meet annually to assess implementation of Plan and conduct updates when necessary **(I)**

e. BSSMAG should act as regional liaison and oversee the implementation of the national management Plan, coordinating activities of the National Sturgeon Management Assessment Team. (**II)**

3. Implementation of the Regional Strategy for the Conservation and Sustainable Management of Sturgeon Population of the N-W Black Sea and Lower Danube River in accordiance with CITES

Objectives: 3.1. Ensure that the necessary resources are available to implement the Regional Conservation Strategy

Recommendation:

a. Identify the national resources and resource needs for implementing the Regional Strategy and the National Management plans **(I).**

b. Develop proposals to secure funding to implement the activities related to the Regional Strategy and National Management Plans **(I).**

c. Request assistance from the CITES Secretariat to help in securing financial resources from Parties, United Nations specialized organizations, FAO, intergovernmental and non-governmental organizations and the industry (I).

Annex 1.1

Effective breeding number (N_e)

of sturgeons [of one endangered sub-population / population] to be used
in all propagation activities for supportive stocking (rehabilitation) or reintroduction
when producing the progeny generation for one year-class
(to achieve a generational effective population size $N_{e(GEN)}$= 100 and
an inbreeding rate / generation ΔF max = 0,50 %)
(after ASMFC, 1996[3])

Species	Average age of first spawning females [years]	Effective Breeding number **N_e**	N_e / generation	No. females / No. of males* captured in the same zone of Danube River recommended to be used / year for artificial spawning
Beluga sturgeon	14	100	7	5 / 3 3 / 5 3 / 4 4 / 3
Russian sturgeon	12	100	12	6 / 6 8 / 5 5 / 8
Stellate sturgeon	8	100	14	7 / 7 9 / 6 6 / 9
Sterlet	5	100	20	10 / 10 11 / 9 9 / 11
Ship sturgeon	12	100	8	4 / 4 3 / 6 6 /3

* Sperm from multiple male donors should not be mixed for artificial fertilisation.

Where: $1 / N_e = 1/(N_m) + 1/(N_f)$ and $\Delta F = 1/(2\ N_e) = 1/(8N_m) + 1/(8N_f)$

with N_m = number of males and N_f = number of females

N_e / generation = Δ ($N_{e,1}$+ $N_{e,2}$ +$N_{e,3}$+ ---------- $N_{e,GI}$), where GI = generation interval

[3] Atlantic Sturgeon Aquaculture and Stocking Committee (1996). ASMFC Breeding and Stocking Protocol for Cultured Atlantic Sturgeon. NOAA

Rev. 0.3
(27. 04. 2004)

Monitoring system of effects of current catch quotas on sturgeon stocks

Species monitored: *Acipenser ruthenus, A. stellatus, A. gueldenstaedti, and Huso huso*

Indicators	Location	Timing	Reason
1. **Fisheries information**			Characteristics of sturgeons captured by licensed professional fishermen; CPUE in selected fishing sites; RRA of real captures
1.1 **Number of fishermen licensed to fish sturgeons, including number of fishing boats and gears (gill nets, trammel nets, baited and unbaited hooklines, etc)**	Black Sea and Danube River	Jan. – Dec.	To evaluate catch / fisherman
1.2 Number of fishing hours using standard gillnets of 100 m	Black Sea and Danube River	Jan. – Dec.	For CPUE calculation
1.3 **Number of fish captured**	Black Sea and Danube River	Jan. – Dec.	For CPUE calculation
1.4 **Catch / species / fishing zones**	Black Sea and Danube River	Jan. – Dec.	For CPUE calculation and Evaluation of catch / river Km
1.5 CPUE	Black Sea and Danube River	Jan. – Dec.	To appreciate trend of abundance
1.6 **Sex ratio**	Black Sea and Danube River	Jan. – Dec.	Should be normally close to 50 % / 50%
1.7 Distribution of length frequencies	Black Sea and Danube River	Jan. – Dec.	Gives an indication about % of first spawners and degree of fishing pressure
1.8 Distribution of age frequencies	Danube River Km 100 – 130 *****	Jan. – Dec.	Shows the % of fish spawning repeatedly
1.9 **RRA of captures in 5 selected fishing sites**	**Black Sea** **1.** St. George **Danube River:** **2**. R Km 125 **3**. R Km 238 **4.** R Km 480 **Borcea branch:** **5.** Km 40	Nov.	To evaluate legal and illegal capture and compare it with official statistics
2. Fisheries - independent information			
2.1 Number of downstream migrant juveniles [CPUE]	Danube River Km 100******	April –Oct.	To monitor spawning success and evaluate strength of current year class / recruitment

* Here are captured yearly more than 1/3 of all sturgeons fished in Romania
** Monitoring Station for juvenile sturgeons will be constructed and organized in 2004 – 2005 at Isaccea, Romania
CPUE – Catch Per Unit of (fishing) Effort
RRA - Rapid Rural Appraisal

Annex 2

Ministry of Agriculture, Forests and Rural Development
No. 262 / 18.04.2006

Ministry of Environment and Water Management
No. 330 / 5.04.2006

Published in the Official Publication of the Romanian Government No. 385 / 4 May 2006

ORDER
on conservation of wild sturgeon populations and development of sturgeon aquaculture in Romania

Considering the scientific studies that show a continuous decline of populations of sturgeon species,

Considering the worrying evolution of sturgeon catches registered in Romania after year 2000,

Considering the actual unsatisfactory development of sturgeon aquaculture in Romania comparing with other European countries and even countries of Lower Danube region,

Considering the precedent of extinction of sturgeon species from other European rivers during the last century,

Considering the importance and the international protection given to the endangered sturgeon species by the Convention on International Trade in Endangered Species of Wild Fauna and Flora, adopted in Washington on 3rd of March 1973 (**CITES**),

Based on art. 12^2 align. (1) and align. (2) lett. d) of Low No. 192 / 2001 on fish fund, fishing and aquaculture, with later modifications and additions, art. 27 lett. b) and e) from Government Urgency Ordinance No. 236 / 2000 on the status of natural protected areas, the conservation of natural habitats, wild flora and fauna, approved with modifications and additions by Law No. 462 / 2001,

Considering the Scientific Report no. 222 / 20.01.2006 of the Danube Delta National Institute and the approval of the Commission for the Preservation of Natural Monuments of the Romanian Academy, No 994 / 08.03.2006.

Considering the joint Approval Report No. 4.705 / 22 March 2006 and No. 15 765 / 3 April 2006,

Based on art. 9 align. (6) of the Government Decision No. 155 / 2005 on the organization and functioning of the Ministry of Agriculture, Forests and Rural Development, with later modifications and additions,

Based on art. 5 align. (8) of the Government Decision No. 408 / 2005 on the organization and functioning of the Ministry of Environment and Water Management, with later modifications and additions,

The Minister of agriculture, forests and rural development and the Minister of environment and water management issue the following order:

CHAP. I – General dispositions

Art. 1 – (1) The object of the present order is the conservation of wild sturgeon populations in various degrees of endangerment and the development of sturgeon aquaculture.

(2) The sturgeon species that art. (1) is referring to are:

a) Ship sturgeon (*Acipenser nudiventris*) – critically endangered / extinct;
b) Danube sturgeon (*Acipenser gueldenstaedti*) – endangered;
c) Stellate sturgeon (*Acipenser stellatus*) - endangered;
d) sterlet (*Acipenser ruthenus*) – vulnerable;
e) Beluga sturgeon (*Huso huso*) – endangered.

Art. 2 - The purpose of present order is the conservation and rehabilitation of sturgeon populations of the species in art.1, align. (2), through temporary prohibition on commercial fishing and implementation of special actions for the development of sturgeon aquaculture.

CHAP. II – Conservation and rehabilitation of sturgeon populations of the North – West Black Sea and lower Danube region

Art. 3 – (1) In order to conserve sturgeon populations, starting with the date of publication of the present order it is forbidden:

a) commercial fishing of wild sturgeon species for a period of ten years;
b) trading of products and sub – products obtained from wild sturgeons captured in Romania;
c) using any gears or equipments for capture of sturgeons, including stationary gill nets for sturgeons (ohane) and unbaited hook lines (carmace) in fishing areas of natural waters of Romania.

(2) Any sturgeons captured accidentally shall be released in their natural environment, regardless of their condition.

Art. 4 – (1) At the proposal of CITES Scientific Authority for Acipenseriformes and the National Agency for Fishing and Aquaculture (**NAFA)** the central public authority of environment protection and water management and central public authority of agriculture, forests and rural development will adopt restocking programmes and / or supportive stocking programmes with young sturgeons from species mentioned in art. 1 align. (2) which had deficient natural spawning.

(2) The main purpose of restocking and / or supportive stocking programmes with young sturgeons is the conservation of sturgeon populations and their genetic diversity by establishing the number of live specimens to be captured annually, the methods used to capture them, the methods used for their artificial propagation and the procedures to mark and register the broodfish and the young of the year used in restocking and / or supportive stocking programmes.

CAP. III – Developing of sturgeons aquaculture

Art. 5 - (1) The fishing of live sturgeon broodfish from the wild is admitted for artificial propagation in order to obtain young sturgeons for supportive stocking of natural water bodies, only when following rules are respected:

a) the capture of a limited number of live sturgeon specimens of species mentioned in art. 1, align. (2), using non-destructive fishing methods, only with special authorization issued by NAFA;
b) ensure the implementation of programmes outlined in art. 4 align. (1) by conditioning the special authorization to capture live sturgeon specimens needed in sturgeons aquaculture by the participation in these programmes;
c) annually, until 15 November, at the recommendation of the CITES Scientific Authority for Acipenseriformes, NAFA will establish the number of live specimens from each sturgeon species to be fished in the next year which will be regionally agreed and transmitted to the CITES Secretariat until 30 November;
d) compulsory use of artificial propagation methods that ensure the surviving of broodfish;
e) compulsory employment of personnel qualified for aquaculture and fishing;
f) purchasing by NAFA of equipment needed for marking with Passive Integrated Transponders (**PIT**) of all wild sturgeons captured;
g) when wild sturgeons breeders are captured, they are marked with PIT tags by regional fishing inspector;

h) young sturgeons obtained for restocking or supportive stocking will be marked with coded wire tags (**CWT**) before releasing them in the river;
i) purchasing by NAFA of equipment that allow reading of PIT and CWT tags, as well as subsequent survey of survival of young sturgeons and wild breeders after releasing in the river;
j) growing of young sturgeons, needed for Danube stocking, in specially licensed units to the minimal total length of 10 cm / specimen;
k) producing of young sturgeons for restocking and / or supportive stocking by propagation of a minimal number of breeders, as detailed in **Annex 2.1,** that is integrated part of the present order;

(2) The central public authority of environment and water management assures the financial support to the Romanian CITES Scientific Authority on Acipenseriformes, to conduct annual scientific studies for the evaluation of status of wild sturgeon populations.
.

Art. 6 – In order to obtain a special authorization to capture live sturgeon broodfish from the wild, aquaculture companies must possess aquaculture license for production of young sturgeons.

Art. 7 – The number of sturgeon broodfish, by species and sexes, will be attributed based on the capacity of each hatchery.

Art. 8 – A recording file for captured sturgeon breeders will be filled in, in the presence of regional fishing inspector, who will transmit a copy of this document to the Aquaculture Department of NAFA. The template of recording file for live sturgeon breeders captured is presented in **Annex 2. 2.**

Art. 9 – Each breeder will be recorded in a special register where all steps, from capturing to spawning will be mentioned. The template of the special register is presented in **Annex 2. 3.**

Art. 10 – The method used for artificial propagation of sturgeons must guarantee the survival of wild sturgeon breeders and their subsequent release in the natural environment where they were captured, in the presence of representatives of NAFA.

Art. 11 – (1) In order to monitor the results of implementation of programmes presented in art. 4, align. (1) the DDBRA establishes the Danube Migratory Fish Monitoring Station (**DMFMS**), situated at Isaccea (Danube River Km 100).

2) The objective presented in align. (1) will be realized until the end of the first semester of year 2007 and the annual budget needed for functioning of DMFMS will be provided by the central public authority for environment and water management.

(3) DMFMS will be operated with participation of specialists from Lower Danube River countries managing jointly under CITES the sturgeon populations of the N-W Black Sea and Lower Danube region.

Art. 12 – The results of DMFMS monitoring will be presented in an annual report sent to interested authorities and institutes and to the CITES Secretariat.

Art. 13 – The Danube Delta National Institute Tulcea is the CITES Scientific Authority for Acipenseriformes of Romania.

Art. 14 – Non-compliance with the present order will be sanctioned according to Low No. 192 / 2001 on fish fund, fishing and aquaculture, with later modifications and additions and the Government Urgency Ordinance No. 236 / 2000 on the status of natural protected areas, the conservation of natural habitats, wild flora and fauna, approved with modifications and additions by Law No. 462 / 2001.

Art. 15 – Annexes 1 – 3 are part of this Order.

Art. 16 – The present order is published in the Official Monitor of Romania Part I.

The Minister of Agriculture, Forests and Rural Development,	The Minister of Environment and Water Management,
Gheorghe FLUTUR	Sulfina BARBU

Annex 2.1

Effective breeding number (N_e)

of sturgeons [of one endangered sub-population / population] to be used
in all propagation activities for supportive stocking (rehabilitation) or reintroduction
when producing the progeny generation for one year-class
(to achieve a generational effective population size $N_{e(GEN)}$= 100 and
an inbreeding rate / generation ΔF max = 0,50 %)
(after ASMFC, 1996[4])

Species	Average age of first spawning females [years]	Effective Breeding number **N_e**	N_e / generation	No. females / No. of males* captured in the same zone of Danube River recommended to be used / year for artificial propagation
Beluga sturgeon	14	100	7	5 / 2 2 / 5 3 / 4 4 / 3
Russian sturgeon	12	100	12	6 / 6 8 / 5 5 / 8
Stellate sturgeon	8	100	14	7 / 7 9 / 6 6 / 9
Sterlet	5	100	20	10 / 10 11 / 9 9 / 11
Ship sturgeon	12	100	8	4 / 4 3 / 6 6 /3

- Sperm from multiple male donors should not be mixed for artificial fertilization. The eggs of each female will be divided in a number of portions equal to the number of males and will be each separately fertilized with sperm of one male.

Where: $1 / N_e = 1/(N_m) + 1/(N_f)$ and $\Delta F = 1/(2\ N_e) = 1/(8N_m) + 1/(8N_f)$

with N_m = effective number of males and N_f = effective number of females

N_e / generation = Δ ($N_{e,1}$+ $N_{e,2}$ +$N_{e,3}$+ ---------- $N_{e,GI}$), where

GI = generation interval

[4] Atlantic Sturgeon Aquaculture and Stocking Committee (1996). ASMFC Breeding and Stocking Protocol for Cultured Atlantic Sturgeon. NOAA

Annex 2.2

Series ….. No. 000001

Hatchery……..

Manager …….

Sanctioned by
Fishery Inspector
Name and surname
……

Badge No……

Signature …….

CAPTURE RECORDING FILE

FOR STURGEON BROOD STOCK

No. …… Date……..

Name and surname of fisher	Permit No.	Authorization No.	External marking of fishing boat	Fishing gear

Fishing zone / site were it was captured …….

Characteristics of specimen captured:

Specification	Unit	
Species		
Sex	M / F	
Standard Length	Cm	
Total Weight	Kg	
Tag. No.		

Signatures of fishermen:

1……..

2……

3……..

Signature of Hatchery representative

Name and Surname:

……

Signature:

Annex 2.3

Hatchery …….
Name of hatchery manager…….

REGISTER FOR THE ARTIFICIAL PROPAGATION OF STURGEON

Crt. No.	Specification			Date of capture / No. of capture rec. file	Amount of eggs [Kg]/ milt obtained [ml]	Date of stripping / amount of eggs obtained [Kg]	Hatching date / Number of larvae	Date / Number of fingerlings	Date / site of releasing the broodfish into natural environment	Remarks
	Species / Tag No.	Weight [Kg]	Sex							
1										
2										
3										

Name and Surname of Hatchery manager

…….

Signature

…….

Annex 3.

Recommendations
of the Expert Meeting on
coordination and implementation of sturgeon stocking programmes
for the Lower Danube River
and of the North-West Black Sea Region

Sărulești, Romania (21–22 June 2006)

1. The experts agreed that regional coordination of the sturgeon stocking activities in the Lower Danube River with hatchery produced young sturgeons is essential for effectively conserving and restoring wild sturgeon populations in the region.
2. The regional coordination should concern, *inter alia*: tagging systems, monitoring of stocking efficiency, size of sturgeons to be used for stocking, releasing sites, numbers of sturgeons to be released, sturgeon species concerned, timing of stocking activities and accompanying management measures.
3. The countries should develop and implement a common sturgeon stocking programme, based on existing experiences in the region and the best available up-to-date scientific knowledge and practices.
4. Sturgeon stocking programmes need to be complementary to and supportive of conservation and management efforts for wild sturgeons in the region.
5. The agreed regional approach concerning stocking activities has to be implemented at national level, in accordance with local needs and capacities.
6. The Romanian proposal on "Management plan for hatchery activities in support of the conservation of wild sturgeon populations of the Danube River" should be taken into consideration for developing and coordinating future regional and national stocking activities.
7. The Black Sea Sturgeon Management Action Group (BSSMAG) needs to reinforced to improve its capacity and regional representation.
8. BSSMAG should prepare for submission by the countries a project proposal for FAO on "Capacity building for the recovery and management of the sturgeon fisheries of the Lower Danube River and N-W Black Sea".
9. The coordinated regional sturgeon stocking programmes have to include activities and management practices to combat poaching of wild sturgeons and released broodstock.
10. The countries are recommended to initiate in 2006 a two-year programme to conduct coordinated medium-scale trials on the objectives referred to in point (2) above.
11. The countries should make a first evaluation of the trials referred to in point (10) during a regional expert meeting organized after the two-year programme.

10. CITES MA's and Fisheries Authorities of countries of the region should explore possibilities to raise the necessary resources (national, EU, TACIS, etc) to implement the coordinated regional sturgeon stocking programmes.

11. CITES MA's and Fisheries Authorities of countries of the region should ensure political support and commitment to implement effectively the coordinated regional and national sturgeon stocking programmes.

Signing Experts:

Bulgaria: Dr. Angel Tsekov

Romania: Dr. Neculai Patriche

Dr. Radu Suciu

Serbia: Dr. Mirjana Lenhardt

Ukraine: Dr. Serhiy Bushuev

[In the presence of Thomas De Meulenaer, Scientific Support Unit, CITES Secretariat, Geneva, Switzerland]

Annex 4.

Status and management of sturgeon populations of N-W Black Sea and Lower Danube River during 2000 - 2004 in Romania

Species	Year	Fishery indepen-dent data	Fishery dependent data			Status of spawning stock of the year	Catch quota proposal for the next year
		JPI * [CPUE]	Sex ratio** ♀ / ♂ [%]	First -/ second -/ third time / fourth time/ ... spawners [%]***	Fishery management & Other information****		
Acipenser gueldenstaedti	2000	0.75	-	-	Poor reporting of catches	Good recruitment▼	No adaptive management
	2001	0.167	-	-	Poor reporting of catches Catches assessed by RRA*****	Low recruitment	Reduced with 8 %
	2002	0.302	73 / 23	4.5% - I ; 14% II - III ; 57% IV ; 24,5 % V & > V	Incomplete & biased reporting of catches	Moderate recruitment	Reduced with 15 %
	2003	0	83 / 17	0 % I ; 24 % II ; 52 % III / 16 % IV ; 8 % V & > V	In May - July catches upstream of rKm 141 not reported	Low % of males. Lack of first time spawners. Low / No recruitment	Reduced to only 13 % of year 2003
	2004	0.073	71 / 29	Mostly old fish (N = 6) (15 – 21 yars old)	Very probably there were fish not reported by fishermen. Improved, medium scale supportive stocking program planned for 2005.	Low natural recruitment.	Unchanged
Acipenser ruthenus	2000	3.125	Species disregarded by fishery management authorities. No reporting of catches required		Species captured but not reported in the catch statistics; 2001 - catches assessed by RRA 2003 & 2004- species captured but not reported due to management fault.	Very good recruitment	No adaptive management
	2001	0.208				Existing recruitment	First time catch quota established at 0.5 t
	2002	1,279				Good recruitment	Increased with 38%
	2003	1.743	Lack of fishery dependent data .			Very good recruitment	Increased with 120 %

	2004	2.244	Still no fishery dependent data available.			Very good recruitment	Unchanged
Acipenser stellatus	2000	1.375	-	-	Poor reporting of catches	Very good recruitment.	No adaptive management
	2001	0.625	-	-	Poor reporting of catches; Catches assessed by RRA*****	Moderate recruitment.	Reduced with 6 %
	2002	0.069	37 / 63	**Males:** (N = 116) 17% I ; 49% II ; 26% III ; 10 % IV ; 7 % V & > V **Females:** (N= 19) 52% I ; 37 % II ; 11 % III	Incomplete & biased****** reporting of catches	Low recruitment. Balanced age class distribution in both sexes.	Reduced with 18 %
	2003	0.166	31 / 69	**Males** (N = 137) 23 % I ; 58 % II ; 14 % III ; 5 % IV & > IV **Females:** (N = 166) 15 % I ; 27 % II ; 32 % III ; 16 % IV / 10 % V & >V	In May - July catches upstream of r Km 141 not reported	Moderate recruitment. Unbalanced sex ratio. Balanced age class distribution in both sexes.	Reduced with 10 %. Need for improved enforcement of regulations & quota.
	2004	0.185	31 / 69	**Males** (N=82) 46% I; 47% II; 4 % III; 3 % IV & > IV **Females** (N=37) 38% I; 39% II; 15 % III; 8 % IV & > IV	Very probably there were fish not reported by fishermen. Improved, medium scale supportive stocking program planned for 2005.	Moderate natural recruitment. Unbalanced sex ratio. Balanced age class distribution in both sexes.	Unchanged
Acipenser nudiventris	2000	-	-	-	No information	***Species highly endangered.*** Need for urgent	-
	2001	-	-	-	RRA by DDNI Tulcea revealed at least **13 specimens** captured during 1993 - 2001		Proposed catch for captive breeding

	2002	-	-	-	At least one specimen (male) captured in RO	regional captive breeding & reintroduction programme.	Proposed catch for captive breeding
	2003 & 2004	-	-	-	No information on catches		Proposed catch for captive breeding
Huso huso	2000	7.375	-	-	Poor reporting of catches	Exceptional natural recruitment.	No adaptive management
	2001	1.625	-	-	Poor reporting of catches; Catches assessed by RRA*****	Good natural recruitment.	Reduced with 13 %
	2002	1.744	53 / 47	Age class distribution not assessed. Normal length distribution in both sexes, suggesting balanced age class distribution	Reporting of catches much better than in other species (due to large size of fishes).	Good natural recruitment. Balanced sex ratio. Balanced age class distribution in both sexes.	Increased with 13 %
	2003	0.143	47 / 53	Both sexes (N = 25) 16 % I ; 32 % II ; 34 % III; 8 % IV & > IV	In February - July catches upstream of rKm 141 not reported.	Low recruitment (due to unfavourable temperature and water level conditions). Balanced sex ratio. Balanced age class distribution.	Unchanged
	2004	1.683	61 / 39	Both sexes (N = 27) 8 % I; 47 % II; 28 % III ; 17 % IV & > IV	*Reporting of catches much better than in other species* (due to large size and high value of fishes).	Good natural recruitment. Balanced sex ratio. Almost balanced age class distribution.	Reduction of 15 % requested by Bulgaria

* Juvenile Production Index (**Fig. 7**) is expressed in CPUE [No of YOY sturgeon captured in a 96 ml long trammel net drifting over a surface of about 8 ha of Danube River bottom at river Km 119]

▼ Recruitment is assessed based on the JPI (assuming that 1.5 - 2 month old YOY sturgeons form the recruits of the current year class)

** (% females / % males)
*** First time spawning individuals (**I**), second time spawning individuals (**II**), ... Fifth and more than fifth time spawning individuals (V & > V)
****2000 - No. of fishermen not controlled; poor law enforcement; Poor catch statistics. DDNI Tulcea started monitoring of Juvenile Production Index
2001 - First annual national workshop on management of sturgeon stocks under CITES (Dec.)
Poor law & regulation enforcement outside the Danube Delta Biosphere Reserve (**DDBR**) (upstream of rKm 141)
2002 - Compulsory tagging (**Fig. 8**) and reporting of all sturgeons landed in Romania implemented for the first time. Law enforcement still problematic.
National workshop on management of sturgeon stocks under CITES organised twice / year (Sept. & Dec.)
Catch quota expressed only in [Kg] resulted in under-reporting of weight of fish.
Age determined in 127 specimens of A. stellatus
2003 - All fishing zones concessioned to private companies (by end of April downstream river Km 141 and only by 1 August upstream rKm 141).
Law enforcement increasingly improved during the second half of the year.
July 5, 2003 - launching of web page "Sturgeons of Romania and CITES" (http://rosturgeons.danubedelta.org)
On line reporting of catches is functional still only in DDBR.
National workshop on management of sturgeon stocks under CITES organised twice / year (26 Aug.. & 8 Dec.)
Catch quota expressed in [Kg] and in [No of specimens] > practice of under-reporting of weight of fish visibly reduced / abandoned
Age determined in 12 specimens of *A. gueldenstaedti*; 25 specimens of *Huso huso* and 194 specimens of *A. stellatus* (N_{Total} = 231 specimens)
2004 – Web page "Sturgeons of Romania and CITES" (http://rosturgeons.danubedelta.org) was visited over 900 times (230 visitors of 14 countries, 700 visitors of Romania).
National workshops on management of sturgeon stocks under CITES held in Tulcea on August 25 and November 4. National Action Plan on implementation of Regional Conservation Strategy was adopted during the first workshop.
Fishing companies having concession of fishing zones for sturgeons improved guarding of fishing sites.
Lack of export quotas during the first 8 month of the year disrupted normal fishery management practices (fishermen were not paid; local black market was thriving).
On line reporting of catches was functional at both fishery management authorities (DDBR - Tulcea and NCFM - Bucharest).
Age determined in 6 specimens of *A. gueldenstaedti*; 27 specimens of *Huso huso* and 119 specimens of *A. stellatus* (N_{Total} = 152 specimens)
Experimental supportive stocking of Danube River with fingerlings (one month old) of beluga (10 000) and Russian sturgeon (10 000)

***** Rapid Rural Appraisals (based on interviews with fishermen)
****** Biased reporting of biometrical characteristics in stellate sturgeon (*A. stellatus*) during 2002 was corrected in 2003 by introducing expression of catch quota in [Kg] and [No. of specimens].

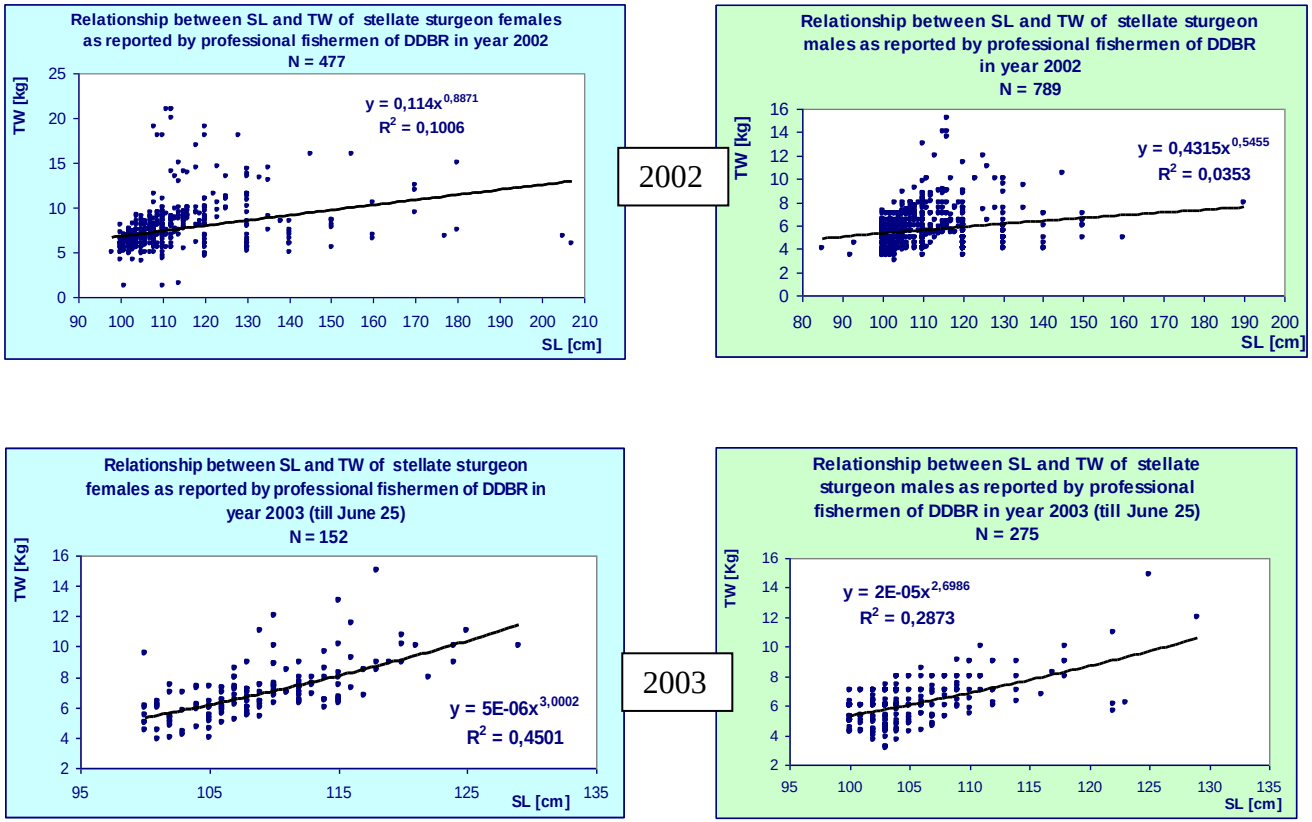


Fig. 1: Length (SL) - weight (TW) distribution in males (right) and females (left) of stellate sturgeon captured and reported in DDBR in year 2002 (up) and 2003 (down). Note in 2002 biased under- reporting of most length, as between 100 - 110 cm (minimal length), and TW, as between 5 - 6 Kg.

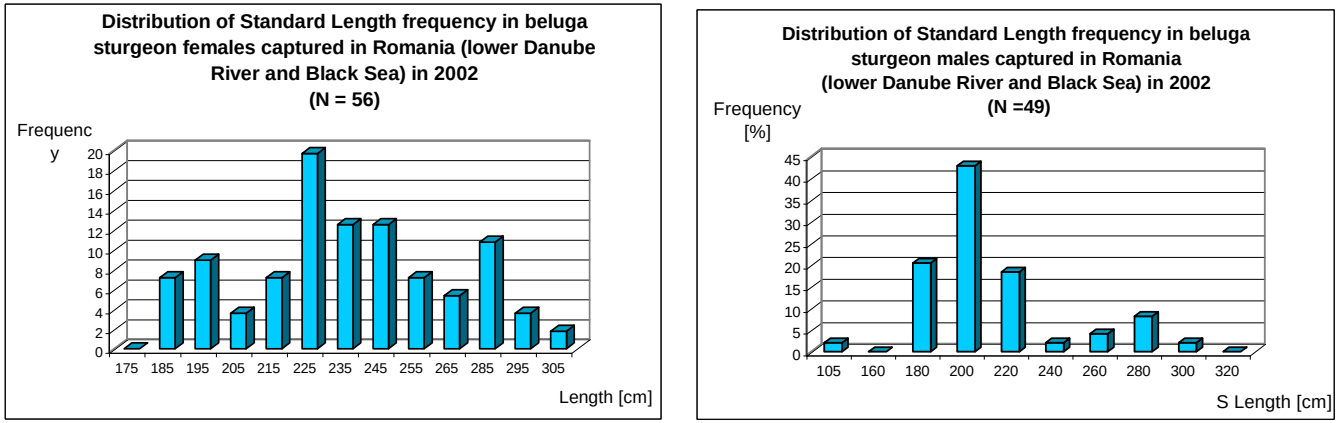


Fig. 2: Distributions of Standard Length classes in beluga surgeons captured in Romania in 2002.

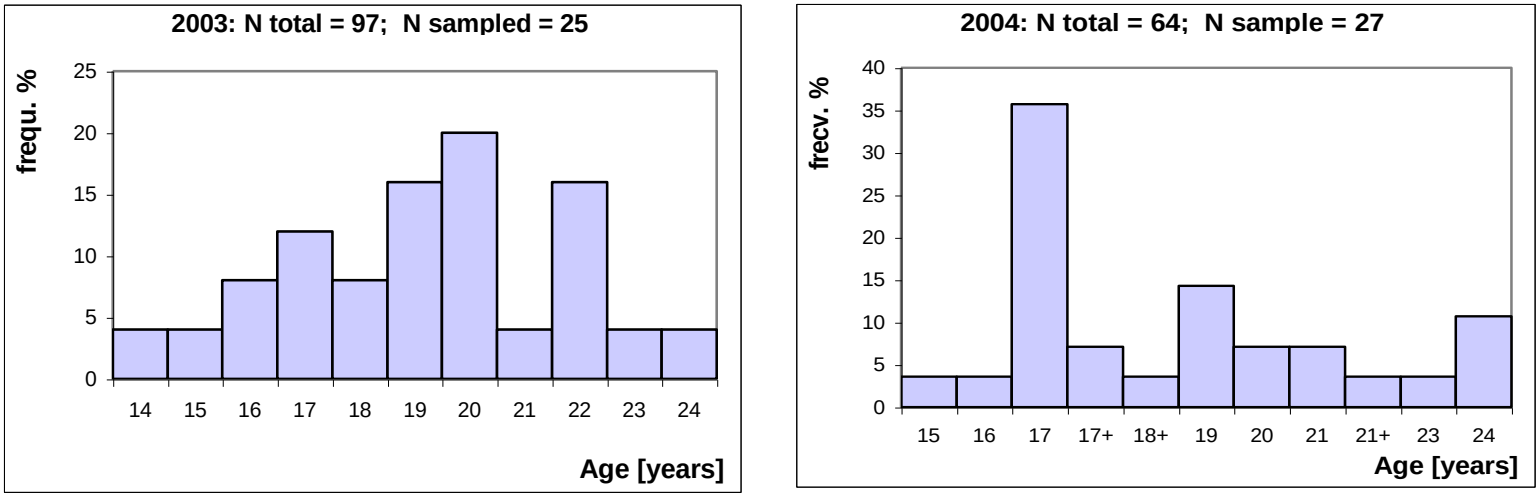


Fig. 3: Age class structure in beluga surgeons (mixed sexes) captured in Romania in 2003 & 2004

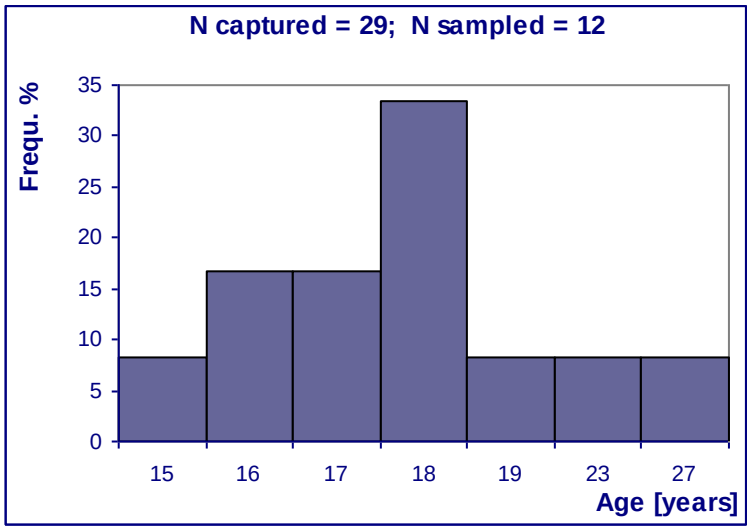


Fig. 4: Age class structure in Russian surgeons (mixed sexes) captured in Romania in 2003.

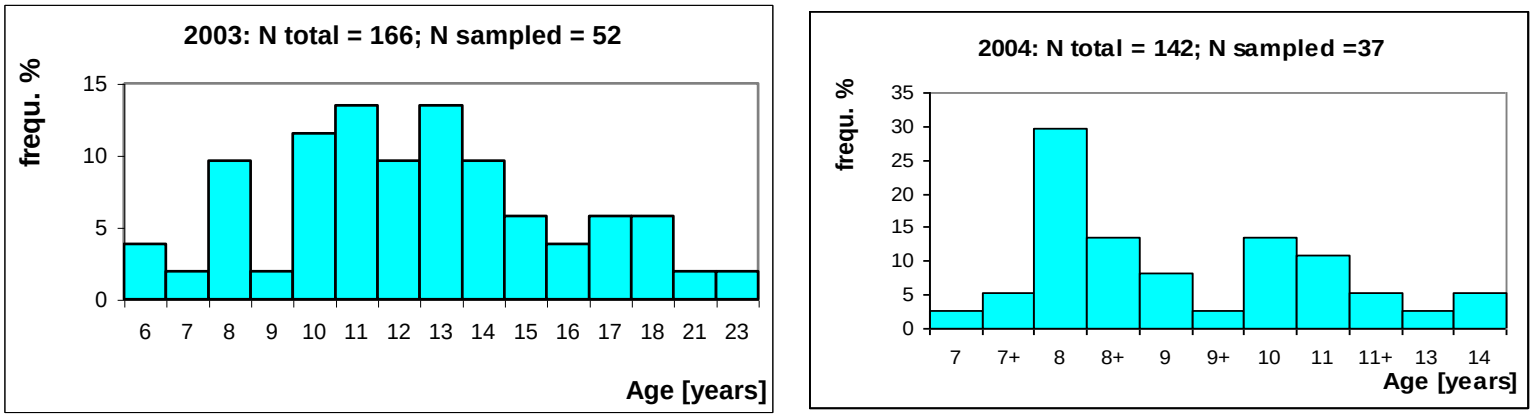


Fig. 5: Age class structure in female stellate surgeons captured in Romania in years 2003 & 2004

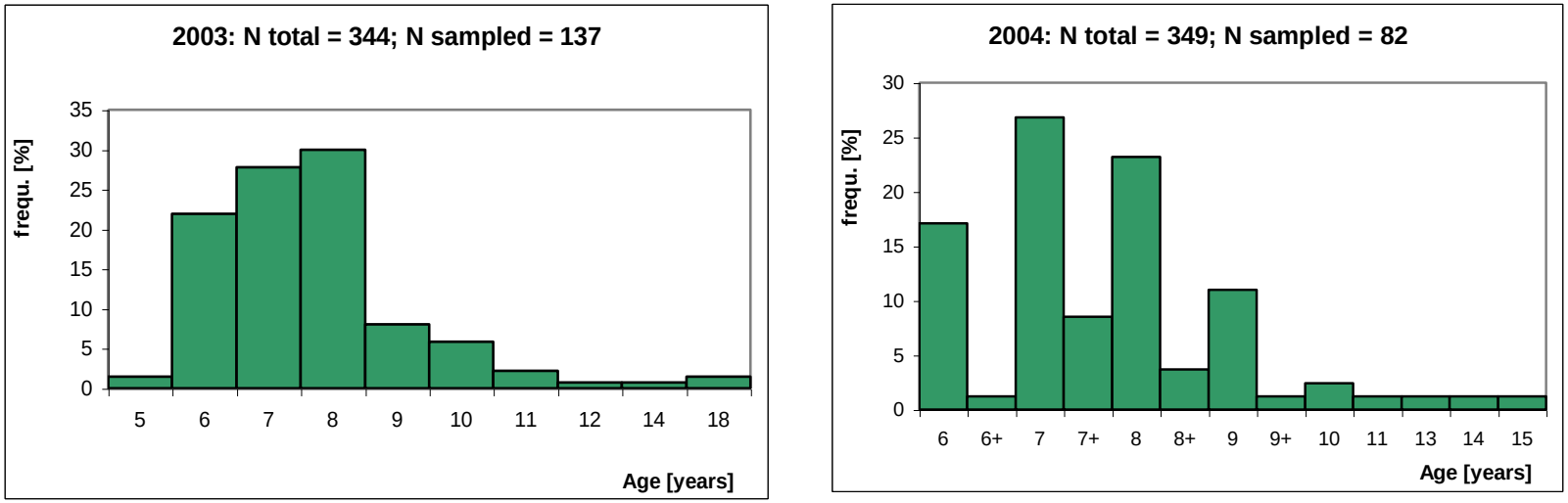
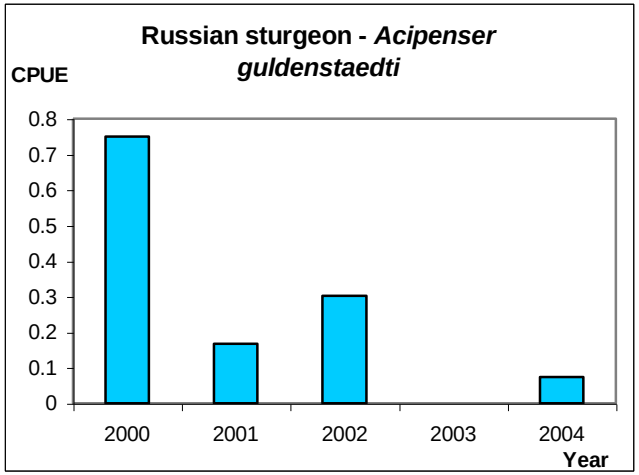
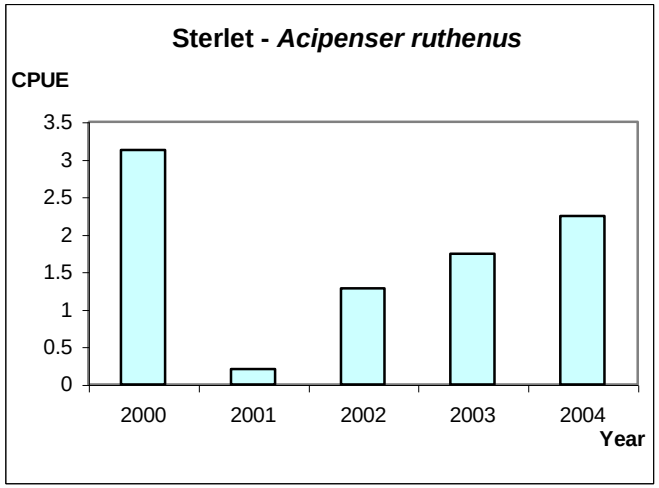
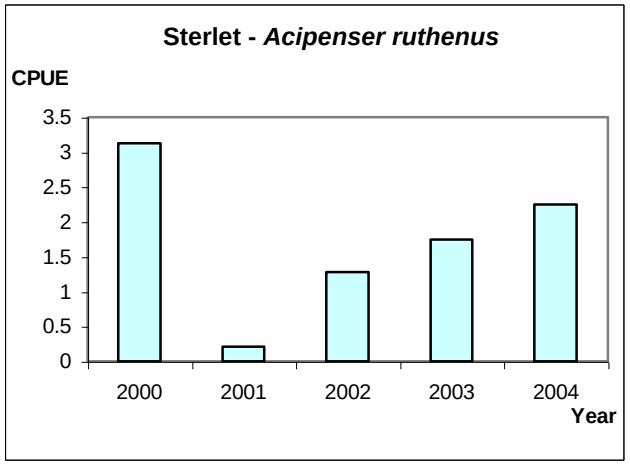


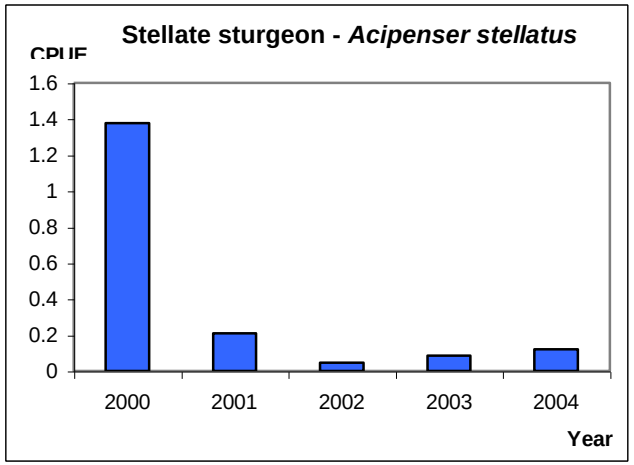
Fig. 6: Age class structure in male stellate surgeons captured in Romania in years 2003 & 2004

Fig. 7 : Natural recruitemnt of diffrerent sturgeon species in the lower Danube River during 2000 – 2004 assessed by monitoring downstream migration of YOY at river Km 119 [represented as Juvenile Production Index (JPI) graphs]









CPUE – catch per unit of fishing effort [No of YOY captured by fishing with a 96 m long, 20 mm mesh sized trommel net drifted over 850 m strech of the Danube River at river km 119]

Fig. 8: The two types of tags used by Romanian Fisheries Authorities since 2002 and a specimen of Russian sturgeon tagged after landing

NDF WORKSHOP
WG 8 – Fishes
CASE STUDY 5 SUMMARY
Acipenser spp., *Huso* spp.
Country – **NW Black Sea**
Original language – English

STURGEONS OF THE NW BLACK SEA AND LOWER DANUBE RIVER COUNTRIES

AUTHORS:
Radu Suciu

The recent management history of the lower Danube sturgeon fishery in Romania is presented, characterised by totally uncontrolled (over)fishing during 1990 – 2000 followed by adaptive management under CITES regulations. Three regional meetings of CITES and Fisheries MA of countries the lower Danube River were organized in year 2001, 2003 and 2006 in Bulgaria and Romania. These resulted in agreeing on a Regional Strategy on conservation and sustainable use of wild populations of sturgeons, including a common Monitoring System. This was encompassing eight population status indicators. Seven of them were fishery dependent: (1) Number of fishermen; (2) Number of fish captured; (3) Catch / species / fishing zones; (4) Sex ratio; (5) Distribution of length frequencies / classes; (6) Distribution of age frequencies / classes and (7) Rapid Rural Appraisal of captures in 5 selected fishing sites. The only one fishery independent population status indicator monitored, the abundance of young of the year sturgeons moving downstream over a control river bottom area of about 8 ha established at River Km 118, proved to be crucial for the NDF process.

Regularly stakeholder meetings, with participation of fishery scientists, fishery managers, law enforcement institutions, fishermen associations and CITES administration, held twice a year contributed significantly to the synergy of conservation efforts of CITES and Fisheries authorities.

Fishery dependent data were obtained by implementing a capture recording system involving commercial tagging, compulsory reporting of characteristics of each sturgeon specimen legally landed and posting these on-line by the officers of the fishery administration on a dedicated webpage (www.indd.tim.ro/rosturgeons), launched in July 2003. Quality of data improved over the last years. Implementation of compulsory reporting and recording in the data base on the webpage of all sturgeons legally captured in Romania resulted in acquisition of the largest number of individual data on sturgeons in the whole history of Romania: 717 specimens in year 2003; 863 specimens in year 2004 and 535 specimens in year 2005.

Lacking first time spawners age class in the cohort of adult sturgeons migrating in the river during two (in beluga) to three (in Russian sturgeon)

consecutive years, linked with low natural recruitment, were considered as crucial indicators of detrimental effect of continuation of commercial fishing and the base for adoption, in May 2006, by Romanian Ministries Environment and Agriculture of special regulations for the conservation of wild sturgeon populations and development of sturgeon aquaculture. This stopped commercial harvesting of sturgeons from the wild for a period of 10 years.

A large scale supportive stocking programme with individually tagged (CWT) young sturgeons produced from a controlled number of wild brood fish captured with special authorization and subsequently tagged with transponders and released back in the river, after non-destructive artificial propagation, has been implemented since 2006. Data of all sturgeons stocked in the river, including their CWT serial numbers are posted in a special data base on the webpage.

The main problem on the elaboration of NDF findings and deciding if continuation of commercial captures for export and domestic use was detrimental to the survival of population consisted in the unequal / poor quantity and quality of monitoring data recorded by partner countries of the region.