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No. 10

PRIORITIES FOR SYNGNATHID RESEARCH

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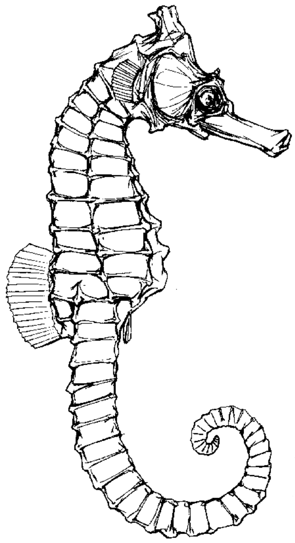

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PROJECT SEAHORSE TECHNICAL REPORT NO. 10: PRIORITIES FOR SYNGNATHID RESEARCH

1. Introduction

Seahorses and their syngnathid relatives – pipefish, pipehorses and seadragons – are icons or flagship species for marine conservation. They are directly affected by most of the threatening processes occurring in our oceans including overexploitation, incidental bycatch, habitat degradation or loss and climate change. They are charismatic and unusual which means that it is possible to foster engagement with a wide range of stakeholders from fishers and traders through to fisheries managers, government agencies and ultimately the general public. This engagement means that there are often calls by one or more of these groups for solutions to particular problems facing syngnathid populations.

Project Seahorse, an international organization with a mission to advance marine conservation, provides recommendations on syngnathid issues using the best available science. However, there are often gaps in our knowledge: the purpose of this Technical Report is to document those areas in which we lack information that we have identified as most important for syngnathid conservation. The document arises from a comprehensive review of seahorse biology reported in Foster & Vincent (2004) available for downloading at:

http://seahorse.fisheries.ubc.ca/pubs/Foster_and_Vincent2004.pdf

Although concerned only with seahorses, most of the suggestions provided in Foster & Vincent (2004) are equally applicable to other syngnathids, whose biology is usually more poorly understood.

Seahorses and some other syngnathids are exploited and traded for use in traditional medicine (particularly traditional Chinese medicine), for the aquarium trade, and for sale as curiosities (Vincent 1996). They are frequently caught in non-selective fishing gear such as shrimp trawls (Baum *et al.* 2003, Meeuwig *et al.* in press) and are vulnerable to degradation of their inshore habitats (IUCN 2006). To ensure long-term persistence of their populations we need to develop pragmatic management solutions based on an understanding of threats, consequent population changes and potential population responses to amelioration of stressors.

We encourage all researchers involved in syngnathid research to share new information through the Syngnathid Research Network – contact Project Seahorse at info@projectseahorse.org for more details.

2. Summary of Priorities for Syngnathid Research

The following table provides a summary of priority areas for syngnathid conservation research, together with associated research activities and resources to assist with conducting this research. Life-history parameters, which are needed to assess the response of syngnathid populations to changes in threats, are covered in greater detail in Section 3.

<table>
<tr><th>Priority Research Area</th><th>Research Activities</th><th>Selected Resources (Hyperlinked where available)</th></tr>
<tr><td>1. Threat Assessment:
Does a particular activity pose a significant threat to syngnathid populations?</td><td>• Identify potential threats e.g. overfishing, incidental bycatch, habitat loss
• Monitor syngnathid populations over time and space
– fisheries-independent surveys (underwater visual census, experimental trawling etc.)
– fisheries-dependent surveys (logbooks, catch landings, observer programs)
– rapid assessment surveys
• Assess magnitude of change in population numbers or other parameters (size, sex ratio) against pre-defined criteria.</td><td>Project Seahorse Technical Reports:
Monitoring Fisheries
Underwater Visual Census
FAO Fisheries Technical Paper 414. Guidelines for developing an at-sea fishery observer program
FAO Fisheries Technical Paper 434. Sampling methods applied to fisheries science: a manual
IUCN Red List criteria
McManus (1997), Musick (1999), Hutchings (2001a, b), Hutchings & Reynolds (2004)</td></tr>
<tr><td>2. Potential Management Options:
What can be done to reduce threats or ameliorate their effects?</td><td>• Define management objectives
• Identify appropriate management options
• Assess management options against objectives
• Consult with stakeholders</td><td>Berkes et al. (2001). Managing Small-Scale Fisheries
Martin-Smith et al. (2004). Collaborative development of management options for an artisanal fishery for seahorses in the central Philippines</td></tr>
<tr><td>3. Predicted Responses of Syngnathid Populations:
What do we think will happen to the population when the threats are reduced?</td><td>• Compile available information on biological parameters for syngnathid species of interest
• Construct quantitative or qualitative models of population dynamics e.g. yield-per-recruit (YPR), population viability analysis (PVA), minimum viable population size (MVP). Note that many quantitative models are dependent on accurate data on life-history parameters.
• Assess outputs of models under different management scenarios</td><td>Foster & Vincent (2004)
Curtis & Vincent (2006)
Morris & Doak (2002)
Johannes (1998)

see following section on priority life-history parameters for syngnathids</td></tr>
</table>

4. Evaluation of Response of Syngnathid Populations: What actually happened to the population?	• Implement management options as an experiment with appropriate design and controls • Monitor populations before and after implementation of management options • Assess magnitude of change in population numbers or other parameters	as in (1) above
5. Refinement & Adaptive Management: Do we need to modify or change management?	• Assess performance of experimental management against pre-determined targets • Refine models on basis of new knowledge and re-run models. • Adjust management as necessary based on outputs of models	Walters (1986), Halbert (1993), Ecology & Society Special Feature on Adaptive Management (1999),

3. Priority Life-History Parameters for Syngnathids

Population models such as YPR or PVA required to evaluate consequences of management actions or risks of population decline require basic life-history parameters including estimates of current population size, birth and mortality rates, which are often not available for syngnathids. However, Foster & Vincent (2004) suggested that seahorses, at least, conform to empirical relationships between life history parameters found in other marine teleost species. Thus patterns previously identified for other fish species could be used to as first estimates for missing life history variables for seahorses, with later refinement as data become available (see Jennings *et al*. 1999, Froese & Binohlan 2000, Pope *et al*. 2000).

Fecundity, the number of offspring an animal will produce, is dependent on the age and/or size of an individual and thus the population birth rate will depend on the age and/or size structure of the population. Similarly mortality rates will not be constant over an animal's lifespan and we need age- or stage-specific estimates in order to build a population model.

In addition, the following factors will also influence the outcomes of any model and hence the robustness of conclusions drawn:

- Nature of density-dependence. Populations do not grow indefinitely and so some form of density-dependent relationship between population size and birth and/or mortality needs to be measured or assumed.
- Demographic variation. The effect of stochastic variation in birth and death rates is much more important in small populations than large populations.
- Temporal variation. Life-history parameters will not remain the same over time but will vary with environmental conditions. In addition, parameters may co-vary e.g. reproductive output may increase in years of increased survival.
- Spatial variation. Under most circumstances life-history parameters will vary over space as well as time. In these cases, immigration, emigration and dispersal distance must all be incorporated.
- Individual variation. Heterogeneity in life-history parameters between individuals requires the use of individual-based modeling (IBM) with estimates of the statistical distribution of parameters as well as their mean values.

The matrices given below provides a summary of what is currently known for the life-history parameters for (a) seahorses (b) other syngnathids with shading to indicate our relative level of knowledge about each. Life-history parameters have been grouped under the general headings of Population Size, Reproduction, Survival, Growth and Movement. Finally, it must be remembered that almost all life-history parameters will be modified by the behaviour of the particular species involved.

(a) Seahorses Shading code: Nothing Known | Known for single species | Known for 1-5 species | Known for 5+ species

Life-History Parameter	Point estimate	Age- or stage-structure	Density dependence	Temporal variation	Spatial variation	Individual variation	References (note that only references that do not appear in Foster & Vincent (2004) are listed separately)
Population size or density	✓	✓	×	✓	✓	n/a	Refs in Foster & Vincent (2004), Curtis & Vincent (2005), Martin-Smith & Vincent (2005)
Reproduction: Brood size	✓	✓	×	×	×	✓	Refs in Foster & Vincent (2004), Rosa *et al.* (2005), Woods (2005a)
# broods/year	✓	✓	×	×	×	✓	Refs in Foster & Vincent (2004), Curtis & Vincent (2006)
Survival: Natural mortality	✓	✓	×	✓	✓	×	Curtis & Vincent (2006), Martin-Smith *et al.* (unpub. data)
Fishing mortality	✓	×	×	×	×	×	Martin-Smith *et al.* (2004)
Growth rate	✓	✓	✓	✓	✓	✓	Refs in Foster & Vincent (2004), Woods (2005b), Curtis & Vincent (2006), Choo & Liew (2006), Job *et al.* (2006)
Movement: Juvenile dispersal	✓	n/a	×	×	×	×	Refs in Foster & Vincent (2004), Curtis & Vincent (2006)
Immigration/ emigration rates	✓	×	×	×	×	×	Vincent *et al.* (2005), Curtis & Vincent (2006)

(b) Other syngnathids Shading as in previous matrix

Life-History Parameter	Point estimate	Age- or stage-structure	Density dependence	Temporal variation	Spatial variation	Individual variation	References
Population size or density	✓	✓	✗	✓	✓	n/a	Howard & Koehn (1985), Diaz-Ruiz *et al.* (2000), Connolly *et al.* (2001, 2002a), Hiddink & Jager (2002), Power & Attrill (2003), Rosales-Casián (2004), Sanchez-Camara & Booth (2004)
Reproduction: Brood size	✓	✓	✗	✗	✓	✓	Tomansini *et al.* (1991), Franzoi *et al.* (1993), Jones & Avise (1997), Campbell & Able (1998), Connolly *et al.* (2001), Jones *et al.* (2001), Watanabe & Watanabe (2001), Hiddink & Jager (2002), Takahashi *et al.* (2003), refs in Berglund *et al.* (2005), Forsgren & Lowe (2006)
# broods/year	✓	✓	✗	✗	✗	✓	Watanabe & Watanabe (2001), Sanchez-Camara *et al.* (2005), Forsgren & Lowe (2006)
Survival: Natural mortality	✓	✗	✗	✗	✗	✗	Franzoi *et al.* (1993), Sanchez-Camara *et al.* (2005),
Fishing mortality	✗	✗	✗	✗	✗	✗	
Growth rate	✓	✓	✗	✗	✓	✗	Howard & Koehn (1985), Duque-Portugal (1989), Campbell & Able (1998), Payne *et al.* (1998), Connolly *et al.* (2001), Sanchez-Camara *et al.* (2005), Forsgren & Lowe (2006), Kirby *et al.* (2006), Silva *et al.* (2006),
Movement: Juvenile dispersal	✓	n/a	✗	✗	✗	✗	
Immigration/ emigration rates	✓	✗	✗	✗	✗	✗	Lazzari & Able (1990), Connolly *et al.* (2002a,b), Sanchez-Camara & Booth (2004), Monteiro *et al.* (2005)

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