SUBMISSION NO. 5
Inquiry into the Role of Science for Fisheries and Aquaculture

Australian museum

OFFICE OF THE DIRECTOR
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RECEIVED
- 1 MAY 2012
by: ....

30 April 2012

Committee Secretariat
House Standing Committee on Agriculture,
Resources, Fisheries and Forestry
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Submission from the Australian Museum to the House of Representatives Standing Committee on Agriculture, Resources, Fisheries and Forestry Inquiry into the role of science for fisheries and aquaculture.

PREFACE

The Museum welcomes the opportunity to contribute to this inquiry. As an institution with considerable marine biodiversity research capacity and biological collections dating back some 180 years, the Museum is well placed to comment on several aspects of the current review. The Australian Museum also manages the Lizard Island Research Station – a world-class facility supporting coral reef research. Our strategic research priorities include addressing knowledge gaps and problems in understanding the biota in Australasian marine environments and understanding human impacts on the Australian biota.

Our submission focuses on Terms of Reference a)the relationship between scientific knowledge of fish species, ecosystems, biodiversity and fish stock sustainability, but some of our comments are also relevant to other terms of reference.

In 2011 the Museum provided a submission to the House of Representatives Standing Committee on Climate Change, Environment and the Arts inquiry into Australia's biodiversity in a changing climate. Some key points from that submission relating to the current inquiry, in particular, the effects of climate change relating to species dispersion, stock levels and impacts on

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fishing communities, are mentioned here. A full copy of that submission can be provided if required.

I would be pleased to arrange a behind-the-scenes tour of the Australian Museum for Committee members to highlight key areas of our collections and research capacity if there are plans to visit Sydney for a public hearing in the course of the inquiry.

SUMMARY OF KEY POINTS

- Australian commercial and recreational marine fisheries both target a very wide range of fish and invertebrate species.
- Accurate species identification is fundamentally important to effective fisheries management and aquaculture.
- Although state natural history museums have considerable expertise and substantial collections in a range of biological groups, including many of interest to fisheries and aquaculture, Australia's research capacity in species identification and fundamental biology and ecology necessary for effective fisheries management is in decline.

BACKGROUND

The Australian Museum is a statutory corporation established under the Australian Museum Trust Act 1975, with a legislative mandate to propagate knowledge about the natural environment of Australia and to increase that knowledge, particularly in the natural sciences of biology, anthropology and geology. It is principally funded by the NSW Government operating within the Department of Trade and Investment, Regional Infrastructure and Services.

The Museum's research strengths include zoology, taxonomy, systematics, molecular genetics, biodiversity, ecology, palaeontology, materials conservation, archaeology, anthropology and geology. Representing the country's first museum, and one of the oldest natural history museums in the world, the Museum holds over 18 million items in its collections including cultural objects and animal, fossil and mineral specimens. With public galleries, collections and research facilities based in the Sydney CBD, the Museum also owns and manages the Lizard Island research station in Queensland – a global centre for coral reef research on the Great Barrier Reef.

It is important to appreciate that Australian expertise and research capacity in biodiversity reside largely in the state and territory natural history museums. The state museums are the largest employers of taxonomists (scientists who specialize in the study of biodiversity) in the nation.

COMMENTS

The Australian marine fauna[1] is one of the largest in the world. Over 4500 fish species are known from Australia, and species new to the fauna being discovered at a rate of about one per week

[1] * *In fisheries legislation, the legal definition of 'fish' is wide and typically also includes crustaceans, molluscs and other marine invertebrates. For clarity, however, we distinguish between 'fish', 'crustaceans' and 'molluscs' in our discussion of fisheries species.*

(Hoese et al., 2006). In the past 10 years, many of these new species have been discovered in commercial families such as trevallies (Carangidae), dories (Zeidae), roughies (Trachichthyidae), morwongs (Cheilodactylidae), seabasses (Serranidae), snappers (Sparidae) and many families of sharks and rays, and in highly conspicuous tropical families such as butterflyfishes (Chaetodontidae) and wrasses (Labridae), as well as the more expected small, inconspicuous species that reside in the interstices of reefs. Likewise, the Australian marine crustacean and molluscan faunas, which are the primary invertebrates supporting fisheries, stand at over 5000 and 15000 species, respectively. New species are regularly discovered amongst commercial groups such as the swimming crabs (Portunidae), lobsters (Nephropidae and Scyllaridae), king crabs (Lithodidae) and octopuses (Octopodidae).

Unlike most Northern Hemisphere fisheries, which concentrate on relatively few species, Australian commercial and recreational fisheries both target a very wide range of species. It is essential to accurately know the identity of the species that Australia's marine ecologists and fishery biologists study and manage. Yet, the number of fish systematists (scientists who specialise in the identification, relationships and classification of fishes) decreased steeply from 11 at state and territory museums (where they are usually called curators) in the mid 1980s, to only four today. Similarly, the number of crustacean and molluscan curators in Australia has fallen from 16 to 8 over the same period. The workforce is in decline and is not being replaced. The era of discovery of the Australian marine fauna is far from over, but the discoverers are fast disappearing (Leis et al., 2007).

The recognition of the importance of biodiversity has led to an increase in biodiversity surveys, particularly in relation to aquatic protected areas and sustainability concerns about trawl by-catch. Responsibility for management of aquatic biodiversity and sustainability varies amongst jurisdictions and habitats, but frequently resides in whole or in part with Fisheries Agencies relevant to the particular jurisdiction. These agencies, however, generally lack the in-house taxonomic expertise required to fulfil their responsibilities. Historically, this function has been served by the museums. Perversely, state and territory museums are employing fewer curators due to budget pressures and there are fewer educational opportunities to develop the next generations (FASTS, 2007) leading to a significant loss of national capacity.

Some examples highlight the importance of systematics research for fishery management.

1. Fishery species need to be accurately identified and readily recognised. If fishery biologists cannot accurately identify the species they work with, they risk producing flawed research or mismanaging fishery stocks. Recent taxonomic research using DNA and traditional methods has shown that what were once thought to be single, widespread fish species, in fact contain two or more cryptic species (eg, Ward et al., 2008). This necessitates revised management strategies. Similarly, three of the most important commercial crustacean species in Australia - the Moreton Bay Bug, Mud Crab and Blue Swimmer Crab - have recently been shown to comprise four or more separate species each (Keenan et al., 1998; Burton & Davie, 2007; Lai et al., 2010). A species of mantis shrimp (*Oratosquilla oratoria*) that became a fishery species in the Sydney region in the 1980s to 2000s was later shown to be an invasive species (Ahyong

& Wilkens, 2010). Thus, accurate stock assessment and management needs accurate identification of the species involved. More research on Australian fishery species is required, but limited funding and declining numbers of researchers are a bottleneck.

2. Life stages of fishery species need to be identified. One of the very few fishery-independent ways to assess the size of marine populations and to discern spawning areas is to study the distribution and abundance of their larvae (Miller and Kendall, 2009), yet identification of larvae is difficult because they differ greatly from adults. Only a small proportion of Australian fish and invertebrate species have described larvae. There is a great need for research to enable larvae to be identified and to provide modern, interactive identification tools for fishery biologists and other users.

3. The extent of larval dispersal of fishery species needs to be known for effective management of the industry. A major unanswered question in marine ecology today is the spatial scale over which marine populations are connected (Leis et al., 2011). This is essential information for fishery managers because the spatial scale of connectivity is the natural scale over which each population operates and over which it must be managed. For bottom-living (i.e., demersal) species, this connectivity scale largely follows the scale of larval dispersal. Determining the scale of larval dispersal requires research into the behaviour of the larvae, combined with numerical modelling. To have credibility, however, the predictions of the modelling must be ground-truthed by cutting edge marking and genetic methods pioneered by Australian researchers (eg, Jones et al., 1999; Almany et al., 2007; Jones et al., 2009). Much more research is required in this area, particularly into the role of marine reserves in replenishing the fished populations outside their borders. We also need to understand how larval dispersal will change as our climate changes (eg, Munday et al., 2009).

4. Knowledge of the life history of fishery species is fundamental for effective management. The life histories of many of Australia's important fishery species are incompletely known. Understanding life histories of marine animals is made difficult because most have complex life histories including a dispersive larval stage, and there is frequently migration between different habitats with individual growth and development. Natural history museums contain a huge amount of potential information on animal life histories derived from collection-based research. Questions that can be answered from natural-history collections include: where do these species occur; how do species distributions change seasonally or with the age of the animal; what parasites infect the species; what do these species eat? Further, museum experts acquire a wealth of knowledge about the life histories of the species they curate and study that can be productively applied to many fishery and conservation issues, but only if it can be made available through collaborations between museum experts and fishery and conservation biologists.

5. The prey and other species co-occurring with fishery species need to be known to accurately understand the biology of the species under fishery management. Crustaceans and molluscs are often significant prey for predatory commercial fishes, and need to be accurately identified.

6. Knowledge of the nearest relatives of fishery species can provide valuable insights into the target species. An understanding of the phylogenetic relationships of species is the basis for comparative biology, including predicting many unknown aspects of the biology and ecology of a species based on knowledge of closely related species. This can include reproductive biology, parasite/disease susceptibility and invasive potential. Yet, the relationships of many groups of Australian species are inadequately understood, requiring more research using modern methods.

CONTRIBUTORS TO THIS SUBMISSION

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REFERENCES

AHYONG, S.T. & WILKENS, S. 2011. Aliens in the Antipodes: non-indigenous Crustacea in New Zealand and Australia. In: B.S. Galil, P.F. Clark, & J.T. Carlton (eds), *In the Wrong Place: Alien Marine Crustaceans – Distribution, Biology and Impacts*, Vol. 6 (pp. 451-485): Springer Verlag.

ALMANY, G. R., M. L. BERUMEN, S. R. THORROLD, S. PLANES, and G. P. JONES. 2007. Local replenishment of coral reef fish populations in a marine reserve. Science. 316:742-744.

BURTON, T.E., & DAVIE, P.J.F. 2007. A revision of the shovel-nosed lobsters of the genus *Thenus* (Crustacea: Decapoda: Scyllaridae), with descriptions of three new species. *Zootaxa*, 1429: 1-38.

FASTS. 2007. Proceedings of the National Taxonomy Forum, 4-5 October, 2007, Australian Museum, Sydney.

HOESE, D. F., D. J. BRAY, G. R. ALLEN, and J. R. PAXTON. 2006. Fishes. Zoological Catalogue of Australia (ABRS & CSIRO Publishing). 35:1-2178.

JONES, G. P., G. R. ALMANY, G. R. RUSS, P. F. SALE, R. S. STENECK, M. J. H. VAN OPPEN, and B. L. WILLIS. 2009. Larval retention and connectivity among populations of corals and reef fishes: history, advances and challenges. Coral Reefs. 28:307-326.

JONES, G. P., M. J. MILICICH, M. J. EMSLIE, and C. LUNOW. 1999. Self-recruitment in a coral reef fish population. Nature. 402:802-804.

KEENAN, C.P., DAVIE, P.J.F. & MANN, D.L. 1998. A revision of the genus *Scylla* de Haan, 1833 (Crustacea: Decapoda: Brachyura: Portunidae). *Raffles Bulletin of Zoology*, 46: 217-245.

LAI, J.C.Y., NG, P.K.L. & DAVIE, P.J.F. 2010. A revision of the *Portunus pelagicus* (Linnaeus, 1758) species complex (Crustacea: Brachyura: Portunidae), with the recognition of four species. *Raffles Bulletin of Zoology*, 58: 199-237.

LEIS, J. M., M. F. GOMON, and H. K. LARSON. 2007. Australian fish taxonomists – an endangered species. AMSA Bulletin. 176:32-33.

LEIS, J. M., L. VAN HERWERDEN, and H. M. PATTERSON. 2011. Estimating connectivity in marine fish populations: what works best? Oceanography and marine biology: an annual review. 49:193-234.

MILLER, B. S., and A. W. KENDALL. 2009. Early life history of marine fishes. University of California Press, Berkeley.

MUNDAY, P. L., J. M. LEIS, J. M. LOUGH, C. B. PARIS, M. J. KINGSFORD, M. L. BERUMEN, and J. LAMBRECHTS. 2009. Climate change and coral reef connectivity. Coral Reefs. 28:379-395.

WARD, R. D., F. O. COSTA, B. H. HOLMES, and D. STEINKE. 2008. DNA barcoding of shared fish species from the North Atlantic and Australasia: minimal divergence for most taxa, but *Zeus faber* and *Lepidopus caudatus* each probably constitute two species. Aquatic Biology. 3:71-78.

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