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SPECIAL FEATURE SEACUKES: a database

by M.L. Deng Palomares, Vasiliki Karpouzi and Daniel Pauly

CITES has been considering how it might assist with managing the international trade in sea cucumbers. Partly as a result, sea cucumbers became the first group for which the *Sea Around Us* project created a biodiversity database. This database includes taxonomic and distributional information on more than 1700 nominal species (of which more than 1400 are valid: Smiley 1994; Kerr and Kim 2001) of sea cucumbers (Holothuroidea, Echinodermata) distributed in more than 200 genera and 25 families.

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Biology of sea cucumbers

Sea cucumbers belong to the marine invertebrate group of Echinoderms (Class: Holothuroidea) and inhabit benthic environments from shallow intertidal zones to the depths of ocean ridges and trenches (Kerr and Kim 2001). Species diversity for this group increases significantly towards the equatorial belt (Kerr et al.1993), though they occur from the Barents Sea to the Amundsen Sea off the coast of Antarctica.

Sea cucumbers are slow-moving animals usually found lying on the substrate, sometimes in sand or mud burrows. The shallow water forms are also found in hard bottoms under crevices, beneath rock or stones or among algae, notably near large macroalgal holdfasts (Rupert and Barnes 1991). A few pelagic species occur in the deep and/or offshore seas (Miller and Pawson 1990). Their modified mouths, consisting of a circle of tentacles, filter suspended particles in the water or sweep the bottom for deposited particles.

The use of sea cucumbers

Sea cucumbers, consumed dried, raw, boiled or pickled, have long been exploited in Southeast Asia and the South Pacific. Early 19th century explorers observed Malay fishers harvesting sea cucumbers in the Timor Islands (Peron 1807-1816) and traders in the Northern Territory of Australia processing 'trepang' (Dumont d'Urville 1841-1854). Available estimates of bêche-de-mer (the dried form of trepang; see Robertson et al. 1987) exported from Fiji to China in 1828-1852 amounted to 1000-1500 t per year (Dalzell 1998; Ward 1972). Adams (1988) suggested that these stocks were depleted when records showed that a fleet of 100 canoes harvested only 32 t in 1852.

Conand and Byrne (1993) suggest that sea cucumber fisheries are based on only about 12 species from two families and 5 genera. However, this is probably an underestimate due to the species not being differentiated out by fishers, exporters and importers. There is growing concern about the exploitation of sea cucumbers as the bulk of populations are slow growing, slow moving animals, subject to 'boom and bust' fisheries. As a consequence, management of international trade in sea cucumbers will be discussed at a CITES technical workshop in Malaysia in March 2004.

Coverage of sea cucumber biodiversity in the *Sea Around Us* project database

Data on sea cucumbers have been gathered over a period of 4 months in an Access database . The data included here were extracted from over 100 published sources and the names were checked against the Integrated Taxonomic Information System (http://www.itis.usda.gov/) and the species database of UNEP/WCMC (www.unep-wcmc.org/species/index.htm). Table 1 presents a comparison of the coverage of our database with that in Kerr (2000). Based on these figures, we can assume that our sea cucumber database covers the bulk of species so far described worldwide.

An important aspect of this exercise was assigning the occurrence of species to countries and FAO fisheries statistical zones. We were able to assign 720 species from 145 genera and 24 families to 150 countries using the over 2100 occurrence records extracted from more than 30 published sources (mostly local checklists and reports of species

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occurrences at a particular locality). These countries occur in 19 of the 21 fisheries/maritime zones categorized by the FAO. Table 2 presents a preliminary analysis of this dataset and shows that sea cucumbers are concentrated in FAO areas 71 (Western Central Pacific) and 27 (Northern Eastern Atlantic). Table 2 also implies that about 51% of sea cucumber species occur in tropical and sub-tropical zones, e.g., FAO areas 31, 34, 37, 51, 57, 71 and 77. This leaves about 29% in northern waters, 6% in southern waters, and just over 3% in Arctic and Antarctic seas. These results, therefore, corroborate earlier statements that the bulk of sea cucumber biodiversity occurs circumglobally along the tropical belt (see Conand and Byrne 1993).

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Lessons learned

This exercise was initially a challenge to create a 'geographically enhanced' global taxonomic database for a group of species. Given that most libraries are now searchable through the Internet and that many locality-specific Internet resources are freely available, gathering the information required for such a database was straightforward. Thus, we were successful in creating a searchable biodiversity database with the minimum information on scientific and English local names and in assigning these species to countries and FAO areas. As stated above, we can claim that we have covered all described species of sea cucumbers and that we have included the bulk of scientific literature dealing with the occurrence of these species in different countries and FAO areas.

We are currently working on including additional information on the habitat (type of bottom, depth), biology (growth parameters and natural mortality) and catch statistics (by country and also including import and export values). The database will also be regularly updated. Thus, we would appreciate inputs from colleagues who might have literature which we still haven't processed (note that we are also keeping hard copies of all the references we have so far used and would appreciate receiving print or pdf copies of additional references).

Acknowledgements

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Table 1. *Number of sea cucumber species by Order obtained from the* Sea Around Us *project's database compared to estimates reported by Kerr (2000).*

Subclass	Order	Species		Genera		Familes	
		This study	Kerr (2000)	This study	Kerr (2000)	This study	Kerr (2000)
Apodacea	Apolida	270	269	33	32	3	3
Apodacea	Molapdiida	84	95	17	11	4	4
Aspidochirotacea	Aspidochirotida	404	340	27	35	3	3
Aspidochirotacea	Elasipodida	104	141	25	24	5	5
Dendrochirotacea	Dactylochirotida	38	35	8	7	3	3
Dendrochirotacea	Dendrochirotida	570	550	79	90	7	7
	Totals	**1470**	**1430**	**189**	**199**	**25**	**25**

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Table 2. *Distribution of over 2100 records of sea cucumber species assigned to countries included in the* Sea Around Us *database by FAO fisheries statistical areas.*

	FAO Area	Species
18	Arctic Sea	2
21	Atlantic, Northwest	50
27	Atlantic, Northeast	431
31	Atlantic, Western Central	74
34	Atlantic, Eastern Central	156
37	Mediterranean and Black Sea	207
41	Atlantic, Southwest	43
47	Atlantic, Southeast	9
48	Atlantic, Antarctic	29
51	Indian Ocean, Western	109
57	Indian Ocean, Eastern	80
58	Indian Ocean, Antarctic	30
61	Pacific, Northwest	79
67	Pacific, Northeast	59
71	Pacific, Western Central	333
77	Pacific, Eastern Central	130
81	Pacific, Southwest	31
87	Pacific, Southeast	36
88	Pacific, Antarctic	11
-	Unassigned	243

Quantitative Ecosystem Indicators for Fisheries Management

The programme for the International Symposium, "Quantitative Ecosystem Indicators for Fisheries Management" (March 31 - April 4, 2004, Paris, France) has now been finalized (www.ecosystemindicators.org/program.htm). This important symposium aims to review existing indicators that have been developed to support ecosystem approaches to managing fisheries (e.g. mean trophic level of landings), as well as to develop new indicators reflecting the exploitation and state of marine ecosystems. It is also aimed at evaluating the utility of indicators relative to specific objectives.

Several members of the *Sea Around Us* team will attend. Villy Christensen is one of the two co-convenors of the symposium (with Philippe Cury of the Centre de Recherche Halieutique Méditerranéenne et Tropicale, France). Villy will present a joint paper with Carl Walters, entitled "Ecosystem structure erosion under myopic management", which shows, through the use of ecosystem models that have been calibrated with long-term historical datasets, that widespread application of single-species MSY policies would in general cause severe deterioration in ecosystem structure, in particular loss of most top predator species.

Daniel Pauly will present two papers: "Mapping indicators of the state of the world's marine ecosystems" and, with Deng Palomares, "A biodiversity-based data quality indicator for fisheries catch statistics and its socio-economic correlates". *Sea Around Us* project graduate student, Vasiliki Karpouzi, with Reg Watson and Daniel Pauly, will present the results of her research on "Seabird population dynamics as indicators of ecosystem change".

The symposium aims to review existing indicators that have been developed as well as to develop new indicators

The Paris Symposium represents the final meeting for the Intergovernmental Oceanographic Commission/Scientific Committee on Oceanographic Research (IOC/SCOR) Working Group 119, the first of which was "Quantitative Ecosystem Indicators for Fisheries Management" held in Reykjavik, Iceland in 2001 (see www.ecosystemindicators.org/wg/reykjavik/wg119report1001.pdf).

The objective of the Working Group is to develop theory to evaluate changes in marine ecosystems (both states and processes) from environmental, ecological and fisheries perspectives.