The IUCN Red List assessment of aspidochirotid sea cucumbers and its implications

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Abstract

This article presents the results from the assessment of sea cucumbers in the order Aspidochirotida for the International Union for Conservation of Nature (IUCN) Red List of threatened species. The results were published by IUCN in June 2013. Of 377 species examined, 16 were classified as threatened with extinction (7 as endangered, 9 as vulnerable) based on standard IUCN methodology. We also summarise findings from a recent publication about the drivers of extinction risk in these sea cucumbers. The IUCN listing sends a stern message to resource managers for the conservation of threatened species. The IUCN Red List may also serve to guide future evaluation by CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) for listing some of the species on Appendix II or III in order to set conditions on the trade of those species. We discuss some issues of CITES listing for the Philippines, as a "hotspot" country, and recommend that sea cucumbers should be re-evaluated for listing on CITES Appendix II and III.

Introduction

Sea cucumbers were once considered a marginal invertebrate marine resource and only recently shown to be significant to global trade, livelihoods and marine ecosystems. Correspondingly, they have been the subject of increased worldwide interest for scientific knowledge, sustainable use and conservation purposes (Lovatelli et al. 2004; Bruckner 2006; Toral-Granda et al. 2008; Purcell et al. 2013).

Unlike the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the International Union for Conservation of Nature (IUCN) Red List is not a multilateral political agreement and does not impose trade or other conservation conditions on countries and states. However, the scientific process of conducting standardised and systematic species extinction risk assessments for the IUCN Red List is often subsequently used as an information tool for conservation planning within countries, and can serve as a guide for CITES listing. The IUCN Red List Categories and Criteria are the most widely

accepted system for classifying extinction risk at the species level. This article explains the IUCN Red List categories and the process of conducting species assessments, as well as presents the species now listed as threatened and the implications of this conservation tool.

An IUCN Red List workshop on sea cucumbers in the order Aspidochirotida (Echinodermata: Holothuroidea) was held in Cartagena, Colombia from 17–21 May 2010 (see details in Polidoro et al. 2011). The workshop brought together regional and international scientific experts to assess, for the first time, the conservation status and probability of extinction for all aspidochirotid species by applying the assessment methodology of the IUCN Red List Categories and Criteria (IUCN 2001; 2013).

IUCN Red List methodology

The IUCN Red List Criteria are standardised quantitative tools to determine each species' probability of extinction, expressed as a Red List category. IUCN Red List methodology is the most widely accepted standard for determining

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the impact of threats on species populations and conservation status. The IUCN Red List assessment process strives to provide the most up-to-date, peer-reviewed assessment of each species. For this reason, IUCN Red List assessments for complete taxonomic clades rely on extensive collaboration with scientific experts around the world. The process involves intensive species-specific data collection, review and updating of data (at least one workshop), subsequent external reviews and validation by experts, and several internal Red List consistency checks before publication on the IUCN Red List of Threatened Species (www.iucnredlist.org).

There are eight IUCN Red List categories: Extinct (EX), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC) and Data Deficient (DD).

A species qualifies for one of the three threatened categories (CR, EN, or VU) by meeting the threshold for that category for any one of five criteria (A–E). These are summarised as follows:

> *Criterion A* — population decline (thresholds: 30% for VU, 50% for EN, and 80% for CR) over a timeframe of more than 10 years or three generations.

> *Criterion B* — small geographic range size (extent of occurrence $< 20,000 \text{ km}^2$ or area of occupancy $< 2,000 \text{ km}^2$ to meet the lowest threshold for VU) combined with continued decline and habitat fragmentation.

> *Criterion C* — species with small population sizes, estimated to be less than 10,000 mature individuals, with continued decline.

> *Criterion D* — species with less than 1,000 mature individuals, or those with an area of occupancy $< 20 \text{ km}^2$, or those that are found in less than 5 locations as defined by a threat.

> *Criterion E* — species with extensive population information that allows for population declines to be appropriately modelled over time.

The category NT is assigned to species that come close to but do not fully meet all the thresholds or conditions required for a threatened category under any criterion, and the category LC is assigned if a species does not meet or come close to meeting any of the thresholds required of a threatened category. A species is listed as DD if there are insufficient data (e.g. on population declines or geographic range) to apply the Red List Criteria. This can apply to species that need taxonomic clarification, or that are only known from a few specimens or the holotype, as was the case for the majority of Aspidochirotida in this category. In some cases, relatively well-known species are listed as DD when significant threats are known but cannot be adequately quantified (IUCN 2013).

The order Aspidochirotida contains most of the sea cucumber species that are under threat from commercial exploitation. To conduct IUCN Red List assessments for all 377 known species in this order, data were compiled on each species' taxonomy, distribution, population trends, ecology, life history, past and existing threats, and conservation actions. The final comprehensive list of Aspidochirotida species was based primarily on species listed as valid on the World Register of Marine Species (www.marinespecies.org) as of December 2012, with subsequent refinement by taxonomic experts (Yves Samyn, pers. comm. 2012; Francisco Solis-Marin, pers. comm. 2012). Some species were omitted from the assessment, including a few that are commercially exploited in multiple countries (Purcell et al. 2012), because they were known only by common names and not yet described taxonomically (e.g. *Holothuria* spp. type "pentard"). We also note that there are other commercially important sea cucumber species (such as those in the family Cucumariidae, order Dendrochirotida) that were excluded in this taxonomically based assessment. The majority of Aspidochirotida species that met the threshold for a threatened category were assessed under Criterion A (Purcell et al. 2014). All maps of geographic ranges and related analyses (ecoregion, depth) were conducted in ArcGIS (v. 10.0), as detailed in Purcell et al. 2014.

Red List assessment results

In June 2013, the IUCN Red List for aspidochirotid holothuroids was published. The complete list of species along with each species' individual assessment account, or report, with all supporting data and references used for the assessment can be found by typing "Aspidochirotida" in the search term at the following site: http://www.iucnredlist.org/search

The search can be refined by Assessment, and selecting those Vulnerable and Endangered. The full assessment information can be found by clicking on the species names, and each species' digital distribution map can be found by clicking on the map icon. Additionally, the complete list of the 377 species assessed and other supporting information can be found in the supplemental online materials in Purcell et al. 2014.

Seven species were classified as "Endangered, or at a high risk of extinction", and nine species were classified as "Vulnerable, or at risk of extinction" (Table 1).

Table 1.   Species listed as "Endangered, or at a high risk of extinction", or "Vulnerable, or at risk of extinction".

	Scientific name	English common name	IUCN status	Population trend
Endangered, or at a high risk of extinction				
1	*Apostichopus japonicus*	Japanese spiky sea cucumber	Endangered A2bd ver 3.1	Decreasing
2	*Holothuria lessoni*	Golden sandfish	Endangered A2bd ver 3.1	Decreasing
3	*Holothuria nobilis*	Black teatfish [Indian Ocean]	Endangered A2bd ver 3.1	Decreasing
4	*Holothuria scabra*	Sandfish	Endangered A2bd ver 3.1	Decreasing
5	*Holothuria whitmaei*	Black teatfish [Pacific, SE Asia]	Endangered A2bd ver 3.1	Decreasing
6	*Isostichopus fuscus*	Brown sea cucumber	Endangered A2bd ver 3.1	Decreasing
7	*Thelenota ananas*	Prickly redfish	Endangered A2bd ver 3.1	Decreasing
Vulnerable, or at risk of extinction				
1	*Actinopyga echinites*	Deepwater redfish	Vulnerable A2bd ver 3.1	Decreasing
2	*Actinopyga mauritiana*	Surf redfish	Vulnerable A2bd ver 3.1	Decreasing
3	*Actinopyga miliaris*	Hairy blackfish	Vulnerable A2bd ver 3.1	Decreasing
4	*Apostichopus parvimensis*	Warty sea cucumber	Vulnerable A2bd ver 3.1	Stable
5	*Bohadschia maculisparsa*		Vulnerable D2 ver 3.1	Unknown
6	*Holothuria arenacava*		Vulnerable D2 ver 3.1	Unknown
7	*Holothuria fuscogilva*	White teatfish	Vulnerable A2bd ver 3.1	Decreasing
8	*Holothuria platei*		Vulnerable D2 ver 3.1	Unknown
9	*Stichopus herrmanni*	Curryfish	Vulnerable A2bd ver 3.1	Decreasing

Discussion

A recently published paper "The cost of being valuable: Predictors of extinction risk in marine invertebrates exploited as luxury seafood" (Purcell et al. 2014) used the Red List assessment results in conjunction with other data to assess various factors that could explain why some species are currently under threat. That study found that the main driver of extinction risk was high market value; in other words, high-value species face the greatest risk of extinction. Other important drivers were a shallow depth of occurrence, large geographic range, high human populations and poor economies in species' distribution range. That paper contains important electronic supplementary materials, such as the list of the 377 species examined, and details on data for factors used in the analyses.

It emerges that high-value species, particularly those living in shallow waters, urgently need rigorous regulatory measures for their exploitation. Because species-specific bans do not prevent serial depletion of other species further down the value chain, it might be advisable to set a shortlist of allowable species, which excludes threatened species and those important for ecosystem functions, and to implement capacity and effort limitations (e.g. short fishing seasons). These measures will be challenging to enforce because developing countries, where average per capita incomes are low, have many threatened species to manage (i.e. threats to biodiversity loss are most severe where capacity is weakest to manage them). International support (e.g. CITES listings) would be helpful but will require increasing research and capacity building in "conservation hotspots", including countries in the western Indian Ocean and Coral Triangle, that exhibit a combination of dense human populations, coastal poverty and a high number of threatened sea cucumber species (Purcell et al. 2014).

The Philippines is a conservation hotspot and offers an example of some of the challenges for implementing trade agreements such as CITES. The Philippines has 11 of the 16 threatened aspidochirotid species, all of which are caught and traded by small-scale fishers, in open-access, unregulated fishing grounds. Listing of these 11 species in CITES Appendix II or III would need to consider the flow-on effects to fisher livelihoods and would likely be met with resistance by middlemen and traders. The Department of Agriculture — Bureau of Fisheries is presently working to implement minimum legal size limits for dried beche-de-mer. In addition, the Philippines has invested in developing technology to culture sandfish (*Holothuria scabra*) (Gamboa et al. 2012) and release them in the wild for sea ranching, and stock restoration is explored (Juinio-Menez et al. 2013). Those initiatives to improve management

and recover stocks may help towards conservation and could be preferable to international trade restrictions. However, without strong enforcement and other regulatory measures, the effectiveness of size limits and restocking in safeguarding species from extirpation (local extinction) is rather questionable (Purcell et al. 2013).

While some endangered species are now being successfully raised in captivity, aquaculture does not necessarily safeguard extinction in the wild, unless explicit restoration measures are implemented. This is exemplified by intensive aquaculture production and sea ranching of *Apostichopus japonicus* in China, which has apparently not resulted in the recovery of wild populations (Purcell et al. 2014). The recent IUCN Red List assessment may offer advocacy for restocking programmes that aim to recover depleted wild populations because this is now a global conservation issue for many of the threatened species. Certain countries may move to require regulated permits for the collection of broodstock of threatened species for aquaculture programmes, and certification that exports are from cultured stocks.

Regional consultations and/or agreements among countries are now needed, given the geographical distribution of commercial species. International trade regulations have to take these results into account; species listed as Endangered should probably be listed on CITES Appendix II and those as Vulnerable should at least be on Appendix III. In the past, listing sea cucumber species on CITES has been encumbered by a deficiency of information tools to identify species in trade and some uncertainties regarding taxonomy and biology; these limitations, however, have been largely addressed in recent years. As only one species is presently listed in Appendix III, it is hoped that scientists will be given the opportunity to collaborate on a new process of CITES listing to conserve populations and species at risk.

In conclusion, the Red List classifications of sea cucumbers serve as a tool for biodiversity conservation and resource management. Fishing pressure on sea cucumber populations has been extraordinarily intense in recent decades across much of the world (Toral-Granda et al. 2008; Purcell et al. 2013), placing species and coastal livelihoods at risk. Preserving both into the future will ultimately depend on concerted local level regulatory measures by resource managers and international support.

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