

EXECUTIVE SUMMARY

Introduction

The Biodiversity Conservation Prioritisation Project, India undertook a prioritisation exercise for species, sites and strategies for conservation. The Endangered Species Subgroup selected the Conservation Assessment and Management Plan Workshop Process and the IUCN Red List Criteria (Revised, 1994) for assessing conservation status of species.

A Conservation Assessment and Management Plan (C.A.M.P.) Workshop was conducted for 176 taxa of mangroves of India and its associated fauna and flora (algae, fish and invertebrates) to assess their status in the wild. The Workshop took place from 21 – 25 July, 1997 in Goa hosted by the National Institute of Oceanography. Mangrove Society of India was the other local collaborator. Forty-eight participants from 25 institutions with expertise ranging from field biology to forest management attended the workshop.

All mangrove plants were assessed at the workshop. The workshop participants referred extensively to the checklist of Indian mangrove species prepared by the National Institute of Oceanography. The checklist was scrutinised at the workshop and only those species or subspecies that were known to have occurred or occurring in India were evaluated. There were some additions and deletions to the checklist based on the participants' views.

In total 176 taxa (including species and subspecies) were evaluated at the workshop. The selection of species for assessment was not a problem in the case of mangroves because the plan of action involved firstly assessment of all endemic taxa followed by the assessment of non-endemic taxa, depending on availability of time. The workshop was a success in that the participants assessed 60 mangrove plants, 23 algae, 51 marine fishes and 42 invertebrates occurring in Indian mangroves in the stipulated 5 days.

The expertise available at the workshop included reputed field biologists with years of field experience both in the past and currently. Participants worked in five working groups for five days. Information for every taxa was entered on "Taxon Data Sheets" in which details of the taxon distribution, population numbers, habitat structure, threats affecting the taxa, population decline and the quality of data provided for the taxa are entered. This information was used to assess the status of every taxon and assign a category of threat according to the IUCN Red List categories. Taxon specific recommendations were also made after categorisation for use in conservation action planning.

CAMP methodology

The Conservation Assessment and Management Plan process is a methodology for rapid assessment of taxa in the wild. This methodology is a rational and objective method of assigning threat categories and deriving recommendations for conservation action plans through participatory group inputs from many stakeholders. A CAMP process is a platform for a congregation of 10 to 40 experts from related fields such as field biologists, ecologists, habitat experts, wildlife managers, forest officials, captive managers, university researchers, academicians, non-governmental organisations, policy makers and other relevant stakeholders. The CAMP Workshop is organised and conducted by objective facilitators who do not have a professional or personal stake in the outcome of the assessments.

The assessment is also followed by research and conservation recommendations for every taxon. CAMPs provide a rational and comprehensive means of assessing priorities for intensive management

within the context of the broader conservation needs of threatened taxa.

The Conservation Breeding Specialist Group developed the CAMP process methodology first for identifying priorities in captive management planning for the global zoo community, which needed to know the *in situ* conservation status of species in their care. The methodology, however, has proved so effective for assessing status in the wild that it has been recognised by IUCN SSC Specialist Groups, governmental and non-governmental agencies, conservation action planners and policy makers all over the world. The CAMP methodology is emerging as an effective means of conducting biodiversity inventory, identification and monitoring, thus satisfying Agenda item 7 in the Conservation on Biological Diversity.

The CAMP process is a flexible process that allows much need-based variations to be incorporated in its conduct. Before the workshop, preliminary Taxon Data Sheets called "Biological Information Sheet" was sent in advance to all known reptile researchers in India and all other people listed in the invitee list. Along with the Biological Information Sheet was also mailed the CAMP Manual to help the respondents in understanding the concept and objective of the workshop and the IUCN categories. The Biological Information Sheet is a modified Taxon Data Sheet that is more self-explanatory and does not require the help of an interpretive manual while answering. This exercise helped in gathering information from different areas about different taxa before hand and the sheets were also utilised extensively at the workshop by participants for information that was not available within the context of the workshop. The sheets therefore provided the means of representation for participants who could not attend the workshop for some reason.

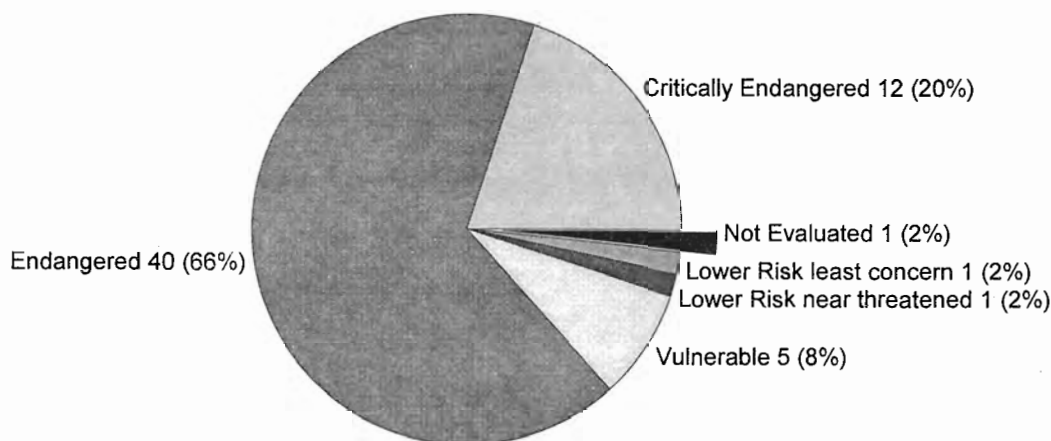
Report

The mangrove ecosystem is an interphase between terrestrial forests and aquatic (marine) ecosystems and includes diversified macrohabitats such as mangrove dominated forests, litter laden forest floors, mudflats, adjacent coral reefs (in Andaman and Nicobar islands) and contiguous water courses which may be rivers, bays, intertidal creeks and channels and, backwaters. Thus, this ecosystem offers innumerable microhabitats for a diversity of faunal and floral species. Indian mangroves can be broadly divided into two kinds – east coast deltaic and west coast non-deltaic mangroves. Apart from these, there are mangroves in the Andaman and Nicobar Islands. Mangrove plants were assessed by 2 groups of participants – west coast group and east coast group. The east coast group also assessed mangrove taxa of the Andaman and Nicobar islands. Totally 58 mangrove plants and 1 species of sea grass were assessed at the workshop. Sixty-seven percent of the assessed mangrove plants are Endangered, while 97% of all mangrove plants assessed are threatened.

Separately, in other working groups, marine algae, mangrove invertebrates and marine fishes were assessed simultaneously. The respective groups evaluated 23 algae, 51 fishes and 42 invertebrates.

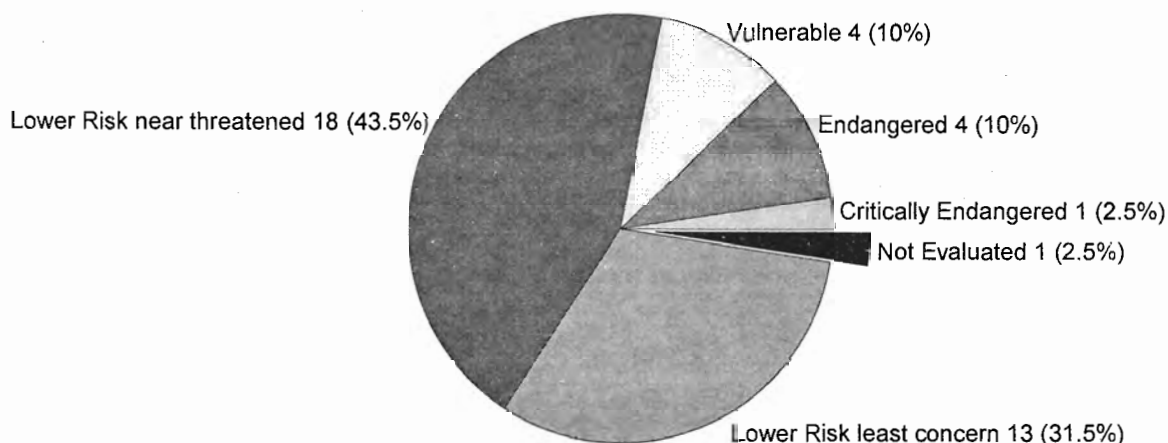
About 500 species of invertebrates have been reported from Indian mangroves out of which little more than 50% are insects and 20 % are zooplankton species. Amongst the remaining, molluscs and crustaceans are dominated (45%) in number of species followed by polychaetes. The majority of insect fauna reported so far are visitors. However, very recently 276 species of insects have been reported from the mangals of Andaman and Nicobar Islands out of which 197 species are herbivores, 36 species are predators and 43 species of parasitoids. At this workshop, only invertebrates which spend a majority of their adult lives in mangroves were assessed.

Status of Indian mangrove plants



Number of mangrove plants assessed = 60
Number of threatened mangroves = 57

Status of assessed invertebrates



Number of invertebrates assessed = 41
Number of threatened invertebrates = 9

In recent years, there is a global awareness for increased fish production under capture and culture conditions of coastal waters, estuaries, backwaters and mangrove swamps which constitute one of the most valuable and vulnerable natural resources of a nation's economy. The biodiversity of the various finfish species in the above ecosystems affects the natural resources. Marine finfishes based on finfish catch data, threats to mangroves and over exploitation of stocks were evaluated at the workshop. Though detailed information was not available, it was realised that from the fish catch data, a distinct decreasing trend was noticeable in finfish populations.

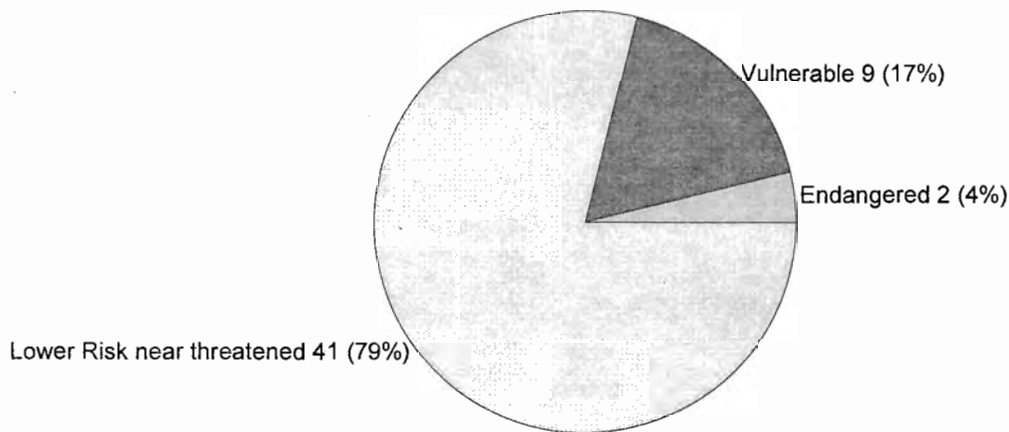
Altogether 624 species of marine macro-algae occur along the Indian coast. In India, forty-eight marine algal species are reported from the mangrove swamps. At the workshop, 23 algal species were assessed, which belong to 3 major groups such as Chlorophyta - green algae; Phaeophyta - brown algae and Rhodophyta - red algae. Mangrove regions in the tropics have been observed to harbor a number of economically/ commercially important algae such as *Monostroma oxyspermum* (high nutritional value), *Gracilaria verrucosa*

(agarophyte), *Catnella impudica*, *Caloglossa leprieurii* (dyes and food vale) and *Caulerpa* sp. (bioactive substance), etc.

The marine algal distribution in this region, along the Indian coast has so far been restricted to the taxonomical level, i.e. taxonomic identification and geographical occurrence. Actual availability of these species (in terms of biomass) still remains doubtful. Some estuaries along Central west coast of India are studied extensively by Jagtap and Untawale *et al.* However, from the east coast meager data is available (except for Sunderban) the species are mentioned along with the open coast intertidal algae; some times without monitoring the habitat.

Categorisation of taxa was done according to the 1994 IUCN Red List categories. For a taxon to be threatened, any one of the five criteria within the categories has to be satisfied. These criteria or factors that are used in a categorisation of threat are 1. Population reduction; 2. Restricted distribution; 3. Population estimates; 4. Restricted population and 5 Probability of extinction. The degree of threat

Status of assessed marine fishes



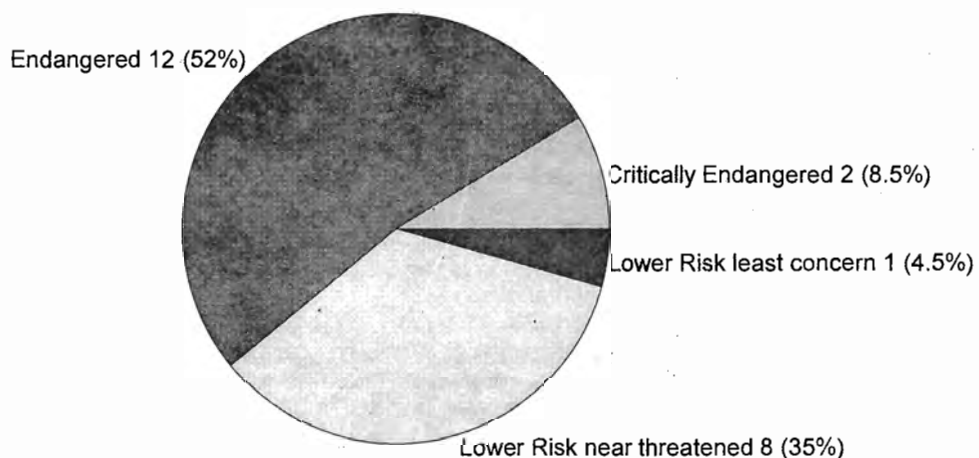
Number of marine fishes assessed = 52
Number of threatened marine fishes = 11

depending on each or any of these five criteria determines the threat category.

One of the major outcomes of this workshop was the post-assessment research and management recommendations for every mangrove taxon. Participants identified lacunae areas that need prioritisation and this is indicated in the recommendation section. Survey, monitoring and habitat management are the most frequently recommended research and management tools for understanding distribution and trends of mangroves. The workshop was also an ideal forum to discuss controversial issues such as taxonomy and nomenclature of Indian

mangrove fauna and flora. There is some confusion about classification of mangroves, which has led to confusion among field biologists. Unfortunately, due to lack of time, no special issue working groups could be convened to formally discuss classification of mangroves. However, it was felt that most of the biologists were happy to be able to discuss those issues within their working groups while assessing the status. It was also felt that a need for a network to identify and bring together reptile researchers in and around India required urgent action.

Status of assessed marine algae



Number of marine algae assessed = 23
Number of threatened marine algae = 14

Alphabetical list of mangroves assessed at the workshop

Taxon	Family	IUCN	Criteria used
<i>Acanthus ebracteatus</i>	Acanthaceae	CR	(B1, 2c)
<i>Acanthus ilicifolius</i>	Acanthaceae	EN	(B1, 2c)
<i>Acanthus volubilis</i>	Acanthaceae	CR	(B1, 2c)
<i>Acrostichum aureum</i>	Pteridaceae (Fern)	LRlc	---
<i>Aegialitis rotundifolia</i>	Plumbaginaceae	EN	(B1, 2c)
<i>Aegiceras corniculatum</i>	Myrsinaceae	EN	(B1, 2c)
<i>Aeluropus lagopoides</i>	Poaceae	EN	(B1, 2b)
<i>Aglaia cuculata</i>	Meliaceae	EN	(B1, 2c)
<i>Arthrocnemum indicum</i>	Chenopodiaceae	VU	(A1ab)
<i>Avicennia alba</i>	Avicenniaceae	CR	(A1ac)
<i>Avicennia marina</i> var. <i>acutissima</i>	Avicenniaceae	EN	(A1cd)
<i>Avicennia marina</i> var. <i>resinifera</i>	Avicenniaceae	CR	(B1, 2bcd; D)
<i>Avicennia officinalis</i>	Avicenniaceae	EN	(B1, 2b)
<i>Brownlowia tersa</i>	Tiliaceae	EN	(B1, 2c)
<i>Bruguiera cylindrica</i>	Rhizophoraceae	EN	(A1cd, 2d; B1, 2c)
<i>Bruguiera gymnorrhiza</i>	Rhizophoraceae	CR	(A1cd)
<i>Bruguiera parviflora</i>	Rhizophoraceae	CR	(A1cd)
<i>Bruguiera sexangula</i>	Rhizophoraceae	VU	(B1, 2cd)
<i>Cenchrus ciliaris</i>	Poaceae/ Panicoideae/ Paniceae	EN	(B1, 2c)
<i>Cerbera manghas</i>	Apocynaceae	EN	(B1, 2c)
<i>Ceriops decandra</i>	Rhizophoraceae	EN	(A1cd, 2d; B1, 2c)
<i>Ceriops tagal</i>	Rhizophoraceae	EN	(B1, 2ac)
<i>Clerodendrum inerme</i>	Verbenaceae	EN	(B1, 2c)
<i>Cynometra ramiflora</i>	Fabaceae	EN	(B1, 2c)
<i>Derris heterophylla</i>	Fabaceae	EN	(B1, 2c)
<i>Derris trifoliata</i>	Fabaceae	EN	(B1, 2c)
<i>Excoecaria agallocha</i>	Euphorbiaceae	VU	(B1, 2c)
<i>Finlaysonia obovata</i>	Asclepiadaceae	CR	(B1, 2c)
<i>Halophila beccarii</i>	Hydrocharitaceae	EN	(B1, 2cd)
<i>Heretiera fomes</i>	Sterculiaceae	EN	(B1, 2bc)
<i>Heretiera kanikensis</i>	Sterculiaceae	CR	(B1, 2c; C2b; D)
<i>Heretiera littoralis</i>	Sterculiaceae	EN	(A2bcd; B1, 2cd)
<i>Kandelia candel</i>	Rhizophoraceae	EN	(B1, 2c)
<i>Lumnitzera littorea</i>	Combretaceae	CR	(B1, 2c)
<i>Lumnitzera racemosa</i>	Combretaceae	EN	(B1, 2c)
<i>Myriostachya wightiana</i>	Poaceae	EN	(B1, 2c)
<i>Nypa fruticans</i>	Areaceae	EN	(B1, 2abc)
<i>Phoenix paludosa</i>	Areaceae	EN	(B1, 2c)
<i>Porteresia coarctata</i>	Poaceae	VU	(B1, 2c)
<i>Rhizophora annamalayana</i>	Rhizophoraceae	NE	---
<i>Rhizophora apiculata</i>	Rhizophoraceae	EN	(A2bd)
<i>Rhizophora lamarckii</i>	Rhizophoraceae	CR	(B1, 2c; C2a)
<i>Rhizophora mucronata</i>	Rhizophoraceae	VU	(A2cd; B1, 2c)
<i>Rhizophora stylosa</i>	Rhizophoraceae	CR	(B1, 2c)
<i>Salicornia brachiata</i>	Chenopodiaceae	LRnt	---
<i>Scyphiphora hydrophyllacea</i>	Rubiaceae	EN	(B1, 2c)
<i>Sesuvium portulacastrum</i>	Aizoaceae	EN	(B1, 2c)
<i>Sonneratia alba</i>	Sonneratiaceae	EN	(A2cd)
<i>Sonneratia apetala</i>	Sonneratiaceae	EN	(A2bcd; B1, 2c)
<i>Sonneratia caseolaris</i>	Sonneratiaceae	EN	(A2bcd; B1, 2c)
<i>Sonneratia griffithii</i>	Sonneratiaceae	CR	(B1, 2c)
<i>Sporobolus virginicus</i>	Poaceae	EN	(B1, 2c)
<i>Suaeda maritima</i>	Chenopodiaceae	EN	(B1, 2bc)
<i>Suaeda monoica</i>	Chenopodiaceae	EN	(B1, 2abc)
<i>Suaeda nudiflora</i>	Chenopodiaceae	EN	(B1, 2ac)
<i>Tamarix troupii</i>	Tamaricaceae	EN	(B1, 2bcd)
<i>Urochondra setulosa</i>	Poaceae	EN	(B1, 2c)
<i>Xylocarpus granatum</i>	Meliaceae	EN	(A1acd, 2bcd; B1, 2ac)
<i>Xylocarpus mekongensis</i>	Meliaceae	EN	(B1, 2c)
<i>Xylocarpus moluccensis</i>	Meliaceae	EN	(B1, 2c)

Alphabetical list of marine algae assessed at the workshop

Taxon	Family	IUCN	Criteria used
<i>Bostrychia tenella</i>	Polysiphonaceae	EN	(B1, 2a)
<i>Caloglossa leprieurii</i>	Catnellaceae	EN	(B1, 2c)
<i>Catnella impudica</i>	Catnellaceae	EN	(B1, 2c)
<i>Catnella repens</i>	Catnellaceae	EN	(B1, 2c)
<i>Chaetomorpha linum</i>	Cladophoraceae	EN	(B1, 2abc)
<i>Codium fragile</i>	Codiaceae	EN	(B1, 2c)
<i>Colpomenia sinuosa</i>	Colpomeriaceae	LRnt	--
<i>Dichotomosiphon salina</i> *	Codiaceae	CR	(B1, 2bcd)
<i>Dictyota indica</i>	Dictyotaceae	EN	(B1, 2a)
<i>Enteromorpha clathrata</i>	Ulvaceae	LRlc	---
<i>Enteromorpha intestinalis</i>	Ulvaceae	LRnt	---
<i>Gracilaria verrucosa</i>	Gracilariaceae	EN	(B1, 2bc)
<i>Hypnea musciformis</i>	Hypnaceae	LRnt	---
<i>Monostroma oxyspermum</i>	Monostromataceae	EN	(B1, 2c)
<i>Padina tetrastrum</i>	Dictyotaceae	LRnt	---
<i>Rhizoclonium eiperium</i>	Rhizocloniaceae	EN	(B1, 2c)
<i>Rhizoclonium kernerii</i>	Rhizocloniaceae	LRnt	---
<i>Rhizoclonium kochianum</i>	Rhizocloniaceae	LRnt	---
<i>Sargassum ilicifolium</i>	Sargassaceae	LRnt	---
<i>Spatoglossum asperum</i>	Dictyotaceae	LRnt	---
<i>Ulva patengans</i>	Ulvaceae	CR	(B1, 2c)
<i>Ulva reticulata</i>	Ulvaceae	EN	(B1, 2c)
<i>Vaucheria prescottii</i>	Vaucheriaaceae	EN	(B1, 2c)

Alphabetical list of mangrove invertebrates assessed at the workshop

Taxon	Family	IUCN	Criteria used
<i>Atacira flaviluna</i>	Noctuidae	LRlc	---
<i>Attacus mcMulleni</i> *	Sauriidae/ Lepidoptera	LRlc	---
<i>Bactronophorus thoracites</i>	Teredonidae	LRlc	---
<i>Balanus amphitrite</i>	Balanidae	LRlc	---
<i>Bankia campanellata</i>	Teredonidae	LRlc	---
<i>Bankia carinata</i>	Teredonidae	LRlc	---
<i>Bankia rochi</i>	Teredonidae	LRlc	---
<i>Cardisoma carnifex</i>	Gecarcinidae	CR	(A1c)
<i>Crassostrea gryphoides</i>	Ostreidae	LRnt	---
<i>Dicathifer manni</i>	Teredonidae	LRlc	---
<i>Dotilla myctiroides</i>	Ocyropodidae	LRnt	---
<i>Geloma erosa</i>	Geloniidae	EN	(B1, 2c)
<i>Gonodontis clelia</i>	Geometridae	LRlc	---
<i>Lyrodus pedicellatus</i>	Teredonidae	LRlc	---
<i>Macrophthalmus depressus</i>	Ocyropodidae	LRnt	---
<i>Macrophthalmus convexus</i>	Ocyropodidae	EN	(B1, 2c)
<i>Martesia striata</i>	Pfolladiidae	LRlc	---
<i>Meretrix casta</i> *	Veneridae	VU	(A1cd)
<i>Metapenaeus dobsoni</i>	Unknown	LRnt	---
<i>Modiolus striatulus</i>	Mytilidae	LRnt	---
<i>Nausitora dunlopei</i>	Teredonidae	LRlc	---
<i>Nausitora hedleyi</i>	Teredonidae	LRlc	---
<i>Ocyropode ceratophthalma</i>	Ocyropodidae	LRnt	---
<i>Penaeus camiliculatus</i>	Palaemonidae	VU	(B1, 2c)
<i>Penaeus indicus</i>	Palaemonidae	LRnt	---
<i>Penaeus japonicus</i>	Palaemonidae	VU	(B1, 2c)
<i>Penaeus merguensis</i>	Palaemonidae	LRnt	---
<i>Penaeus monodom</i>	Palaemonidae	LRnt	---
<i>Penaeus semisulcatus</i>	Palaemonidae	LRnt	---
<i>Perna viridis</i>	Mytilidae	LRnt	---
<i>Pilodius nigrocristatus</i>	Xanthidae	EN	(B1, 2c)
<i>Polyura schreiber</i> *	Nymphalidae	NE	---
<i>Saccostrea cucullata</i>	Ostreidae	LRnt	---
<i>Scylla serrata</i>	Portunidae	LRnt	---

Taxon	Family	IUCN	Criteria used
<i>Sesarma taeniolata</i>	Grpsidae	VU	(B1, 2c)
<i>Sphaeroma terebrans</i>	Sphagomidae	LRlc	---
<i>Thalassina anomala</i>	Thalassinidae	LRnt	---
<i>Uca dussumieri</i>	Ocypodidae	LRnt	---
<i>Uca lactea</i>	Ocypodidae	LRnt	---
<i>Uca tetragonon</i>	Ocypodidae	EN	(B1, 2c)
<i>Uca vocans</i>	Ocypodidae	LRnt	---

Alphabetical list of marine fishes assessed at the workshop

Taxon	Family	IUCN	Criteria used
<i>Alecis indicus</i>	Carangidae	LRnt	---
<i>Ambassis commersoni</i>	Ambassidae	LRnt	---
<i>Anguilla bicolor</i>	Anguillidae	LRnt	---
<i>Anodentestoma chacunda</i>	Clupidae	LRnt	---
<i>Arius subrostratus</i>	Ariidae	VU	(A1acd)
<i>Boleophthalmus boddari</i>	Gobiidae	VU	(A1ac, 2c)
<i>Boleophthalmus dussumieri</i>	Gobiidae	EN	(B1, 2c)
<i>Carangoides ciliaris</i>	Carangidae	LRnt	---
<i>Caranx ignobilis</i>	Carangidae	LRnt	---
<i>Caranx sexfasciatus</i>	Carangidae	LRnt	---
<i>Chanos chanos</i>	Chanidae	LRnt	---
<i>Dasyatis uarnak</i>	Trygonidae	VU	(B1, 2c)
<i>Elopes machnata</i>	Elopidae	VU	(A1acd)
<i>Epinephelus tauvina</i>	Serranidae	LRnt	---
<i>Etroplus suratensis</i>	Chichillidae	LRnt	---
<i>Glossogobius giurus</i>	Gobiidae	LRnt	---
<i>Hilsa kelee</i>	Clupeidae	LRnt	---
<i>Lates calcarifer</i>	Centropomidae	LRnt	---
<i>Leiognathus splendens</i>	Leiognathidae	VU	(A1b, 2b)
<i>Lethrenus nebulosus</i>	Lethrenidae	LRnt	---
<i>Liza dussumieri</i>	Mugilidae	LRnt	---
<i>Liza macrolepis</i>	Mugilidae	LRnt	---
<i>Liza parsia</i>	Mugilidae	LRnt	---
<i>Lobotes surinamensis</i>	Lobotidae	LRnt	---
<i>Lutjanus argentimaculatus</i>	Lutjanidae	LRnt	---
<i>Lutjanus fulviflammus</i>	Lutjanidae	LRnt	---
<i>Lutjanus johni</i>	Lutjanidae	LRnt	---
<i>Lutjanus russelli</i>	Lutjanidae	LRnt	---
<i>Lutjanus sebae</i>	Lutjanidae	LRnt	---
<i>Megalops cyprinoides</i>	Megalopidae	LRnt	---
<i>Mugil cephalus</i>	Mugilidae	LRnt	---
<i>Muraena macrura</i>	Muraenidae	LRnt	---
<i>Muraenesex cinereus</i>	Muraenidae	LRnt	---
<i>Muraenichthys schultzei</i>	Muraenidae	VU	(B1, 2c)
<i>Nematalosa nasus</i>	Clupidae	LRnt	---
<i>Osteomugil cunensis</i>	Mugilidae	LRnt	---
<i>Otolithus ruber</i>	Sciaenidae	LRnt	---
<i>Periophthalmus koelreuteri</i>	Gobiidae	VU	(A1ac)
<i>Plotosus canius</i>	Plotosidae	LRnt	---
<i>Pomadasydys hasta</i>	Pomadasydidae	LRnt	---
<i>Polynemus indicus</i>	Polynemidae	LRnt	---
<i>Psammoperca waigaensis</i>	Centropomidae	VU	(A1acd)
<i>Scartelaos viridis</i>	Gobiidae	EN	(A1ac; B1, 2c)
<i>Secutor ruconius</i>	Leiognathidae	VU	(A1a, 2b)
<i>Siganus canaliculatus</i>	Siganidae	LRnt	---
<i>Siganus javus</i>	Siganidae	LRnt	---
<i>Sillago sihama</i>	Sillaginidae	LRnt	---
<i>Sphyrnaena barracuda</i>	Sphyrnaidae	LRnt	---
<i>Tenualosa ilisha</i>	Clupidae	LRnt	---
<i>Therapon jarbua</i>	Teraponidae	LRnt	---
<i>Therapon puta</i>	Teraponidae	LRnt	---
<i>Trypauchen vagina</i>	Trypauchenidae	LRnt	---