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# AN INVENTORIZATION OF THE FAUNAL RESOURCES OF IMPORTANT COASTAL AND MARINE BIODIVERSITY AREAS (ICMBAs) OF GOA

## FINAL TECHNICAL REPORT



**Zoological Survey of India**  
**Western Regional Centre, Pune**





**AN INVENTORIZATION OF THE FAUNAL  
RESOURCES OF IMPORTANT COASTAL AND  
MARINE BIODIVERSITY AREAS  
(ICMBAs) OF GOA**

**FINAL TECHNICAL REPORT**

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Submitted to:

**Principal Chief Conservator of Forests,**

**Goa Forest Department, Govt. of Goa**

**Zoological Survey of India**

**(Ministry of Environment, Forests and Climate Change)**

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*July 2023*

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*Citation:*

Anonymous, 2023. AN INVENTORIZAION OF THE FAUNAL RESOURCES OF IMPORTANT COASTAL AND MARINE BIODIVERSITY AREAS (ICMBAs) OF GOA. Final Technical Report, Zoological Survey of India, Western Regional Centre, Pune.

*Published as Final Report of* “AN INVENTORIZAION OF THE FAUNAL RESOURCES OF IMPORTANT COASTAL AND MARINE BIODIVERSITY AREAS (ICMBAs) OF GOA” by Zoological Survey of India, for Goa State Forest Department, 2023.

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## *Project Summary*

- 1) **Title** : An Inventorization of the Faunal Resources of Important Coastal and Marine Biodiversity Areas (ICMBAs) of Goa
- 2) **Funding Agency** : Goa Forest Department, Govt. of Goa
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## *Summary*

The survey was carried out from September 2022 to March 2023 in all the three (03) Important Coastal and Marine Biodiversity Areas (ICMBAs) of Goa and documented coastal and marine faunal diversity along with other fauna of conservation importance including their collections of from the area. A total of 941 species of coastal and marine fauna and 16 species of mangroves have been reported/recorded through this study. Among the ICMBAs, Mandvi-Juary estuarine complex found to have more numbers in terms of species diversity, while Galgibag observed to be important for turtle nesting and mangroves. This is first of its kind of documentation and serves as baseline information on faunal accounts for Managers and Policy Makers while proposing for any kind of development within and outside the periphery of the ICMBAs of Goa. The faunal documentation from these three ICMBAs of Goa indicate the potential for bringing some of them under the umbrella of Protected Area Network of Government of India through legislation, in the form of Conservation Reserve or Community Reserves, which are still outside the preview of PA Network.

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## *Acknowledgements*

ZSI, WRC, Pune acknowledges the following:

- Principal Chief Conservator of Forest & Chief Wildlife Warden, Goa Forest Department, Govt. of Goa for permission for field work and also for collection of faunal samples from Protected Areas and Important Bird Areas of Goa.
- Dy. Conservator of Forests, Research & Utilisation Division, Margao for executing the work and routing the proposal and providing funding for the project work.
- Divisional Forest Officers, South Goa and North Goa Forest Divisions for accommodation and logistics during field work.
- The fund for the project is being provided by the Goa Forest Department, Govt. of Goa and ZSI, WRC, Pune acknowledges for the funding support.
- The Director, ZSI for her support and encouragement, Technical Section of ZSI HQ, Kolkata for administrative approval.
- Field staff for logistic and collection support during field work.

## Introduction

The Zoological Survey of India (ZSI) under the Ministry of Environment, Forest and Climate Change, Government of India was established on 1st July, 1916 to promote survey, exploration and research leading to the advancement in our knowledge of various aspects of exceptionally rich life. With the increasing interest in the life sciences and with the advent of country, the survey has established so far 16 Regional and Field Stations, and has developed into a major National Institution. ZSI has been providing regular services with regard to permissible limits of legal trading of faunal resources or derivatives thereof, monitoring services on population status of commercially important species and provides input for underutilized, culturable species both from terrestrial and aquatic systems. ZSI also provides timely warning on declining population of species of commercial importance to ensure sustainable use of components of biological diversity.

As per IUCN Red List (2022), India has 813 globally threatened faunal species, which is nearly 0.2% of the world's total number of threatened faunal species. Globally peoples have realized that maintenance of biodiversity is vital for the human well-being. The forests of India are represented by over 16 major forest types and 251 subtypes, and as per the latest estimate, the total forest of the country constitutes nearly 25% of the total geographical area (ISFR 2021). Against the prevailing global trend of decreasing forest cover, India by and large has been successful in stabilizing its area under forests over the years.

In India, the varied active interactions between physical and biological components resulted in variety of ecosystems which are spread over the different bio-geographic zones of India. The Indian Ecosystems and their diversity is usually represented by major natural habitats (Forests, Grasslands, Deserts, Wetlands [includes estuaries, mangroves, coral reefs and marine]); mountain ranges (Trans-Himalayas, North-West Himalayans, Eastern Himalayas including North East hill states of India). The multi-ethnic composition of India makes some of the ecosystems as a distinct microcosm of biodiversity. These ecosystems because of the rapid economic growth and limitations in integrating environmental concerns into development planning is leading to biodiversity loss. The land use change in the form of conversion of forest land into other land use types by way of building large number of dams and uncontrolled mutation of forest to crop or horticulture land are the major threats for the long-term survival of animal as well as plant species. Unsustainable land use practices, mass tourism and over subsistence dependence on forests and other areas are major challenges to biodiversity conservation.

The coast is the connection between landmass and ocean that measures about four percent of earth's total land mass and has provided livelihood to millions of people over thousands of years. Major ecosystems such as estuaries, mangroves, coral reefs, lagoons, seaweeds and seagrasses serve as nurseries for both inshore and offshore fish and other animals, many of which are commercially exploited. Habitats such as beaches, dunes, salt marshes, estuaries and mudflats

play an important role in the life cycle of fish and shellfish as well as turtles and migratory birds.

India is one among 12 mega-biodiversity countries and 25 hotspots of the richest and highly endangered eco-regions of the world. India has a variety of wetland ecosystems ranging from high altitude cold desert wetlands to hot and humid wetlands in coastal zones with its diverse flora and fauna. In terms of marine environment, India has a coastline of about 8000 km. The exclusive economic zone (EEZ) of the country has an area of 2.02 million km<sup>2</sup> comprising 0.86 million km<sup>2</sup> on the west coast, 0.56 million km<sup>2</sup> on the east coast and 0.6 million km<sup>2</sup> around the Andaman and Nicobar Islands. Adjoining the continental regions and the offshore islands are a very wide range of coastal ecosystems such as estuaries, lagoons, mangroves, backwaters, salt marshes, rocky coasts, sandy stretches and coral reefs, which are characterized by unique biotic and abiotic properties and processes. A network of 14 major, 44 medium and numerous minor rivers together with their tributaries cover practically the entire country except for the western arid region of the Rajasthan Desert. The total length of the rivers is estimated at over 40,000 km.

Indian coasts are endowed with different ecosystems such as mangrove swamps, coral reefs, sea grass beds, beaches, dunes, salt marshes, and mud flats along its 8100 km long stretch. Marine and coastal ecosystems play an important role in photosynthesis and productivity. The diversity of fauna and flora suggests that the number of species known could be more than 18,000 in the Indian coastal

and marine ecosystems. On contrary, marine and coastal habitats have been abruptly used for thousands of years for purposes such as harbors, oil platforms, fishing, recreation, waste dumping, etc. As a result of this, several marine and coastal species are under depletion and facing survival threats. Of the more than marine and coastal 18,000 species known from India, 998 species are protected as per the law, belongs to eight Phylum i.e. Porifera, Coelenterata, Arthropoda, Mollusca, Echinodermata, Pisces, Reptilia and Mammalia—are well protected under the legislation of different categories [Schedules I, II, III, IV, Wildlife (Protection) Act, 1972, prior to 2022 Amendments] as their natural stock is being depleted due to overexploitation. To safeguard nature and the marine biodiversity, 129 marine Protected Areas (including National Parks, Marine Sanctuaries, Community Reserves and Conservation Reserves) have been designated.

Nevertheless, besides existing PAs, potential areas of high biodiversity values are yet to be identified. As a step towards better conservation and management, a total of 106 sites have been identified and prioritized as IMPORTANT COASTAL AND MARINE BIODIVERSITY AREAS (ICMBAs) (Sivakumar et al. 2014) and of the 62 ICMBAs that have been identified along the west coast of India, 22 ICMBAs have been prioritized for immediate conservation actions. These sites are proposed for consideration of Protected Areas under various categories largely as Conservation or Communities Reserves.

There are three such sites identified as exists along the 105 km long coastline of Goa. These are Morjim, Mandovi-Zuari and Galgibagh.

Among the three identified locations, the Morjim comprises a long fine-sandy beach and the estuary of the Chapora River (around 28 km in length), where there is a mangrove swamp. Chapora Fort, at the village of Anjuna and fine-sandy beaches at the mouth of the estuary and at Anjuna are the important ecological features. The sand dunes, turtle nesting beaches, mangroves, mudflats and headlands are significant ecological features to be considered for conservation since they harbour rich coastal and marine biodiversity. The site has been proposed as a community/conservation reserve involving tour operators and the local fishing community.

Similarly, the Mandovi-Zuari estuarine complex and the interlinking Cambarjua canal are the largest coastal ecosystem of Goa. They comprise mudflats, swampy marshes, islets, etc. The nearly 62 km long Rachole or Mandovi River and the 91 km long Zuari River open to the Arabian Sea, forming a wide estuarine habitat at their confluence. The beach, sand spits, bay waters, isles, bird sanctuary, shipyard and fishing harbour are important features. The Salim Ali Bird Sanctuary and its surroundings are provided protection under the IWPA, 1972. Vessel traffic from the port and fishing harbour, oil spills resulting from maintenance at the shipyard, disturbance caused by tourism and construction of residential and industrial infrastructure pose significant threats to this fragile ecosystem and thus deteriorate its quality, as described by many reports. The site is adjacent to Carambolim Lake, which is also an Important Bird Area (IBA). The

site has been proposed as a community/conservation reserve involving the local fishing community jointly with National Institute of Oceanography (NIO).

Further, Galgibagh located in the southern part of Goa's coast has a long sandy beach interspersed with lateritic outcrops and the Talpona (11.2 km) and Galgibag (3.8 km) creeks backwaters, with fringing mangroves. The turtle nesting beach, mangrove-ringed creeks, offshore fishing grounds and lateritic headlands are the significant ecological features worth conserving. The site has also been proposed as a community/conservation reserve involving the state forest department and the tourism sector.

## **Rationale**

The attempt to conserve coastal and marine biodiversity (establishment of the MPAs), which aimed primarily at the conservation of marine and coastal resources, is also found to be inadequate in view of the management challenges of the region. Despite its existence over two decades, it is yet to evolve a congenial environment for the effective management of the Marine Protected Area in the absence of baseline information on the faunal resources of the area. In order to improve the conservation prospects of the unique flora and fauna of the Important Coastal and Marine Biodiversity Areas (ICMBAs) identified along the coast of Goa and proposed for declaring them as Community Reserve, long term solutions need to be anchored in several key areas: establishing a robust database on the biodiversity profile of the region as a foundation for informed decision making.



In this background, the Zoological Survey of India, Western Regional Centre, Pune has been assigned with funding support from Goa Forest Department, Govt. of Goa to carry out biodiversity inventorization of the three Important Coastal and Marine Biodiversity Areas (ICMBAs) along the Goa coast i.e. Morjim-Anjuna, Zuari-Mandovi and Galgibagh, with the following objectives:

## **Objectives**

1. Inventorization of biodiversity of the three proposed Community Reserve i.e. Morjim-Anjuna, Zuari-Mandovi and Galgibagh, also identified as Important Coastal and Marine Biodiversity Areas (ICMBAs)
2. Documentation of the coastal and marine fauna of conservation and protection priority.
3. Suggest suitable management strategies for conservation and management of marine faunal resources of the Important Coastal and Marine Biodiversity Areas (ICMBAs) along Goa coast.

## **Coastal and Marine Biodiversity of Goa**

In the context of Goa, even though it is a very small state in geographical area (3,70,200 ha), the fauna and flora of the state is extremely rich and diverse.

Goa is quite hilly, wedged between the Arabian Sea in the west and the Western Ghats (Sahyadri) in the east. Biogeographically the Goa is mainly divided in to three physical divisions viz. the coastal plains consists of 133 km long beaches, estuaries, mangrove forests, tidal mudflats, sand banks, paddy fields, saline and freshwater marshes; the Midlands consists of rugged hills between coastal plains and the Western Ghats with flat lateritic plateau (30-200m) consists mainly of scrub jungles, grasslands, cashew and other crop varieties; the Western Ghats in the east form an arc like mountains up to an elevation of 1000m with wet evergreen forests and moist deciduous forests.

Goa having a coastline of 105 km is rich in coastal and marine biodiversity due to the presence of coastal wetlands, wide sandy shore and sand dunes, rocky shore, mudflats, estuaries and mangroves. Among the intertidal coastal faunal, the benthic organisms of Goa coast are very well studied (Parulekar et al., 1980; Ansari, 1988). The macrobenthic organisms comprised of several groups of invertebrate phyla, dominated by Annelida, Crustacean and Mollusca. Among them, nearly 90 species of polychaeta are reported from Goa. Equally, there are several important benthic bivalves and gastropods. About 86 gastropoda and 19 bivalves have been reported. Among bivalves 6 species i.e. *Perna viridis*, *Villorita cyprinoides*, *Meretrix casta*, *Paphia malabarica*, *Crassostrea gryphoides* and *Polymesoda erosa* are common. The crustacean fauna is dominated by shrimp, crab, stomatopoda, and hermit crab. The shrimps and crabs represented by 17 species and 51 species respectively. Among the crustacean *Metapenaeus dobsoni*, *M. affinis*, *Parapeneopsis stylifera*, and *P. merguinensis* have been reported to be

dominant catch. Similarly, the crab diversity is due to the presence of species *viz.* *Portunus pelagicus*, *P. sanguinolentus*, *Charybdis* sp. and *Scylla cerreta*. Altogether, about 51 species of Brachyuran crabs have been reported from Goa. Similarly, the benthic echinodermata include starfish, brittle star, sea urchin and holothurian. Other important meiobenthos includes nematode, benthic copepod, tardigrada, turbellaria, gastrotricha, foraminifera, polychaete, oligochaete and kinorhyncha, which forms rich biodiversity of coastal and marine fauna of Goa.

In terms of marine vertebrates, the coastal and marine fauna includes several species of commercially important fishes. There are 224 species of fishes recorded from Goa coast. Due to this, fisheries contribute about 2.5% of the total GDP of Goa and play an important role in the socio-economic development. The fisheries comprised and contributed by pelagic and demersal catches. The pelagic group contributes about 53% of the total fish and remaining constituted by demersal fishes. The pelagic fish recorded from Goa are mainly contributed by Oil Sardine (*Sardinella longiceps*) and Indian Mackerel (*Rastrelliger kanagurta*), seer fishes, tuna and ribbon fishes (*Trichiurus lepturus*). Similarly, the demersal resources are mainly shrimps, pomfrets, scaenids and flat fishes. Goa coast is also rich in ornamental fishes such as *Abudefduf* sp., *Chaetodon collaris*, *Heniochus acuminatus* etc. The fish species like *Carcharhinus hemiodon*, *C. limbatus*, *C. melanopterus*, *Galeocerdo cuvieri*, *Hippocampus kuda*, *Rhinodontypus* sp., *Rhynchobatus djiddensis* are threatened species reported from Goa and have been placed under the category of IUCN critically endangered or near threatened.

There are atleast 15 species of mangrove reported from Goa, among them dominated species of *Rhizophora* and *Avicinnia* forms the major mangrove forests in Goa. These mangroves are mostly present in the estuarine areas of Mandovi and Zuari rivers with a healthy growth along the stretch of Cumbarjua canal. These mangroves are shelter for many species viz. crocodiles, lizard, turtle and mud skipper. Roots, stems and tree, hollows of mangrove plant are occupied by varied group of organisms. Roots and lower part of stem have algae, barnacles, oysters attached. The pulmonate molluscs, crabs are found with stem and littorinid gastropods are attached with leaves. Corals have been reported from Grande Island of Goa. About 24 varieties and three species of azooxanthellate scleractinian corals have been reported from Goa.

However, detailed and comprehensive biodiversity exploration including listing the species and species of conservation importance and priority are yet to be undertaken and warrant for surveys and inventorization. In order to improve the conservation prospects of the unique flora and fauna, it is vital to document the biodiversity especially the Important Coastal and Marine Biodiversity Areas (ICMBAs) identified along the coast of Goa.

Accordingly, field surveys were conducted by scientists of ZSI, WRC, Pune for which field work was carried out from September 2022 to January 2023 covering all the IBAs of the Goa state.

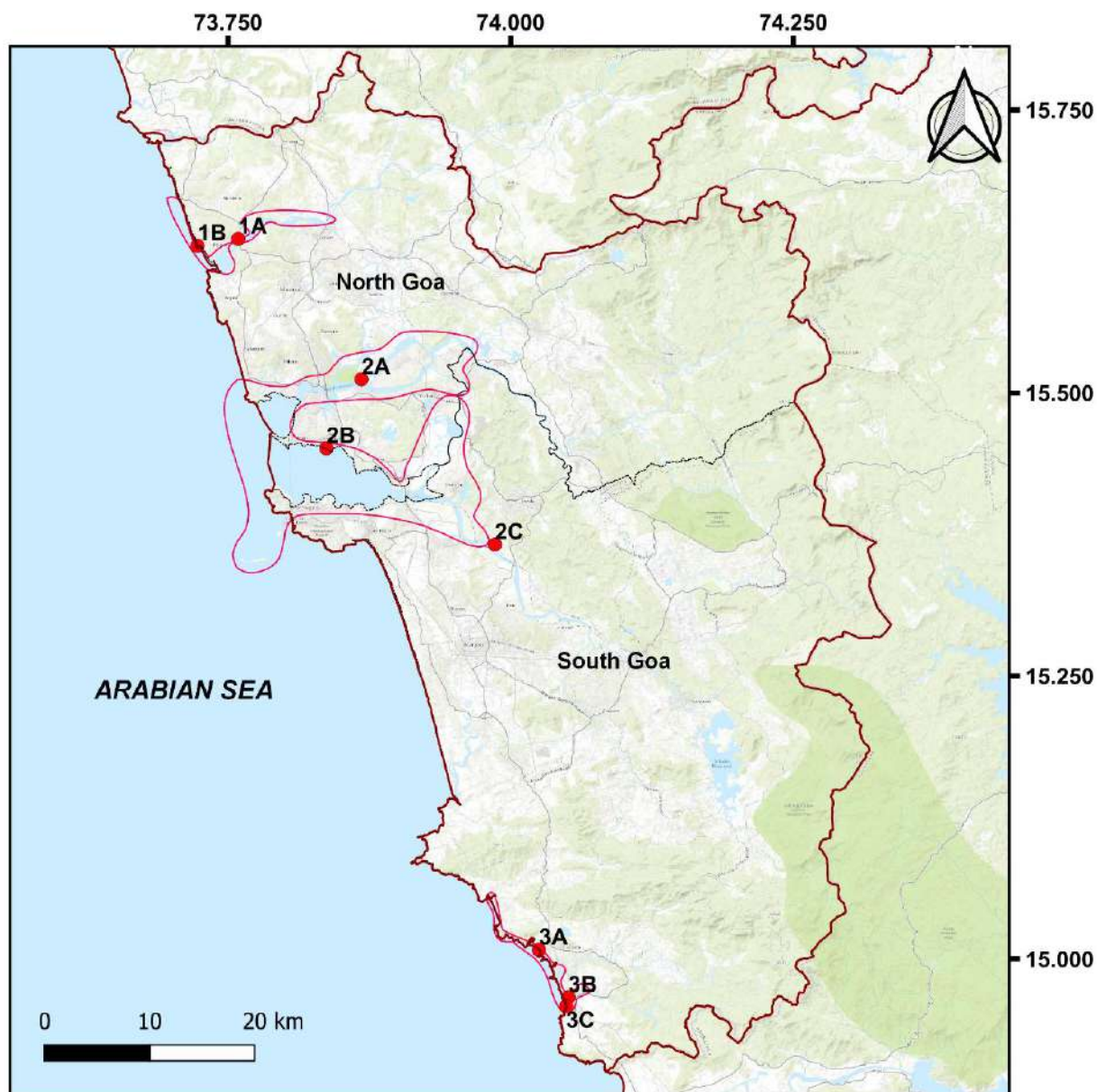
## Methodology

For each of the ICMBAs site, information collated secondary sources from Goa state forest department, institutions and NGOs and was compiled. Subsequently, field surveys were carried out from September 2022 to January 2023, which was aimed to make a ground truthing of the three ICMBAs of Goa. The survey and data collections were done from inter tidal zone (by beach/shore/reef walk) to the continental shelf area (sub-tidal), following method as suggested by English et al. (1997) and Hill & Wilkinson (2004). The data on the geo-coordinates of the site were collected using hand-held Global Positioning System (Garmin Inc, H-72). Each survey site was photographed using a digital camera (Nikkon P 1000/ Nikkon P 900) for prevailing habitat and identification, distribution and abundance pattern of underwater/intertidal fauna. Representative samples for physical verifications were collected by hand picking from their sites of occurrence and brought to the laboratory at WRC, ZSI, Pune to make them as part of the National Zoological Collections of ZSI for future studies. The details are locations surveyed during the field work conducted in the month of September and December 2022 is presented in table 1.

**Table 1. Details of surveyed localities of the ICMBAs of Goa**

CODES	LOCALITY	DISTRICT	LATITUD	LONGITUD
			E (° N)	E (° E)
1A	Chapora River, Chopdem	North Goa	15.636	73.759
1B	Morjim Beach	North Goa	15.630	73.723
2A	Dr. Salim Ali Bird Sanctuary, Chorao Island	North Goa	15.512	73.868

2B	Cacra Beach	North Goa	15.451	73.837
2C	Zuari River, Bori-Sanquar	North Goa	15.366	73.986
3A	Palolem	South Goa	15.008	74.025
3B	Galgibag River, Galgibag	South Goa	14.966	74.051
3C	Galgibag Beach	South Goa	14.958	74.049



**Fig. 1. Map of surveyed localities of the ICMBAs of Goa**  
(Refer below table for locality codes)

### ICMBAwise description details, observations and findings:

#### 1. Morjim-Anjuna, North Goa district

Site name	: Morjim-Anjuna
District	: North Goa
Geo-coordinates	: 15°37'019" N, 73° 44'007" E
Area	: 11 Sq.km
Habitat type	: Beach and estuarine mangrove

Among the three identified locations, the Morjim comprises a long fine-sandy beach and the estuary of the Chapora River (around 28 km in length), where there is a mangrove swamp. Chapora Fort, at the village of Anjuna and fine-sandy beaches at the mouth of the estuary and at Anjuna is the important ecological features. The sand dunes, turtle nesting beaches, mangroves, mudflats and headlands are significant ecological features to be considered for conservation since they harbour rich coastal and marine biodiversity. The site has been proposed as a community/conservation reserve involving tour operators and the local fishing community.

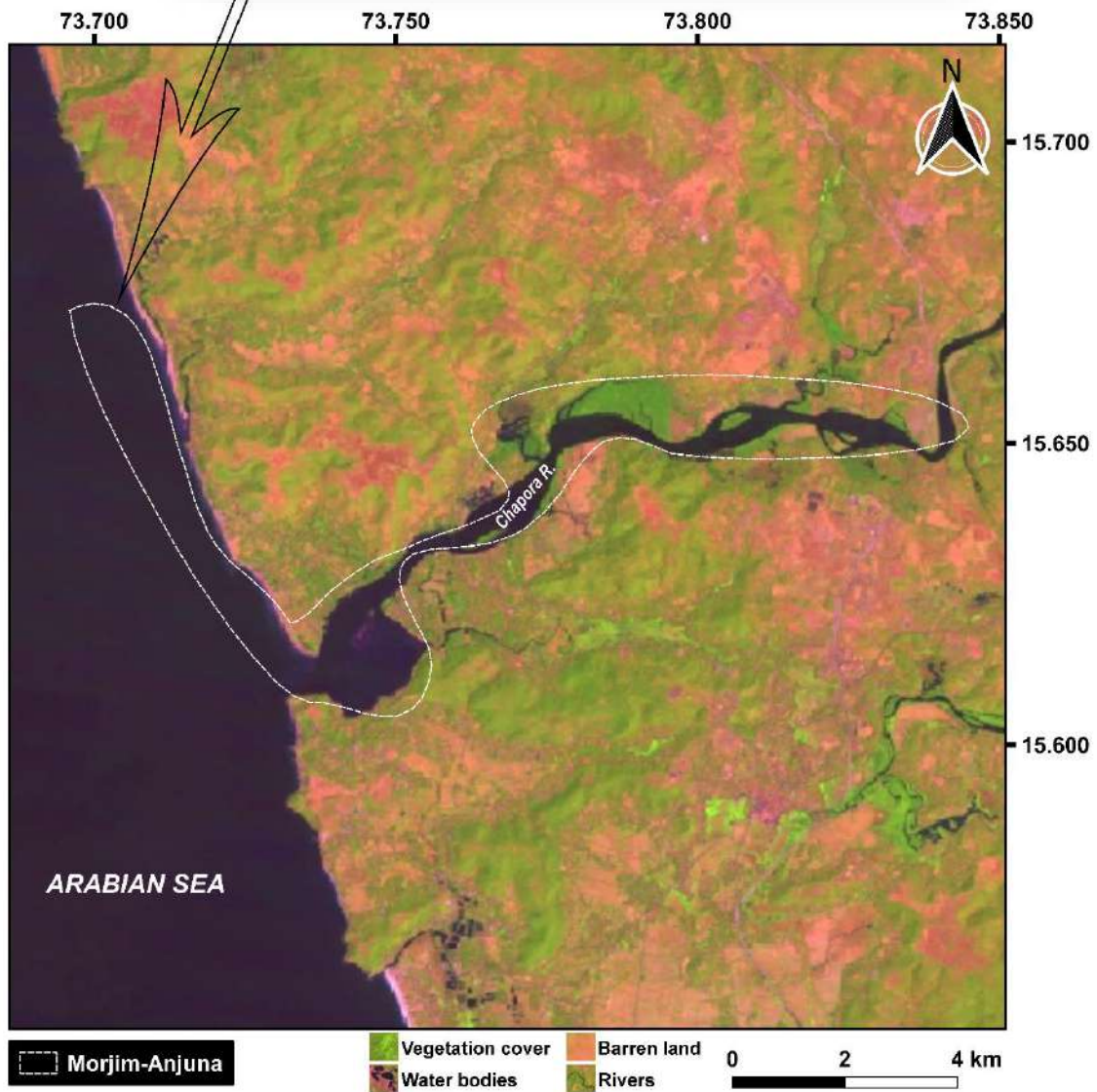
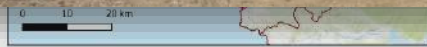
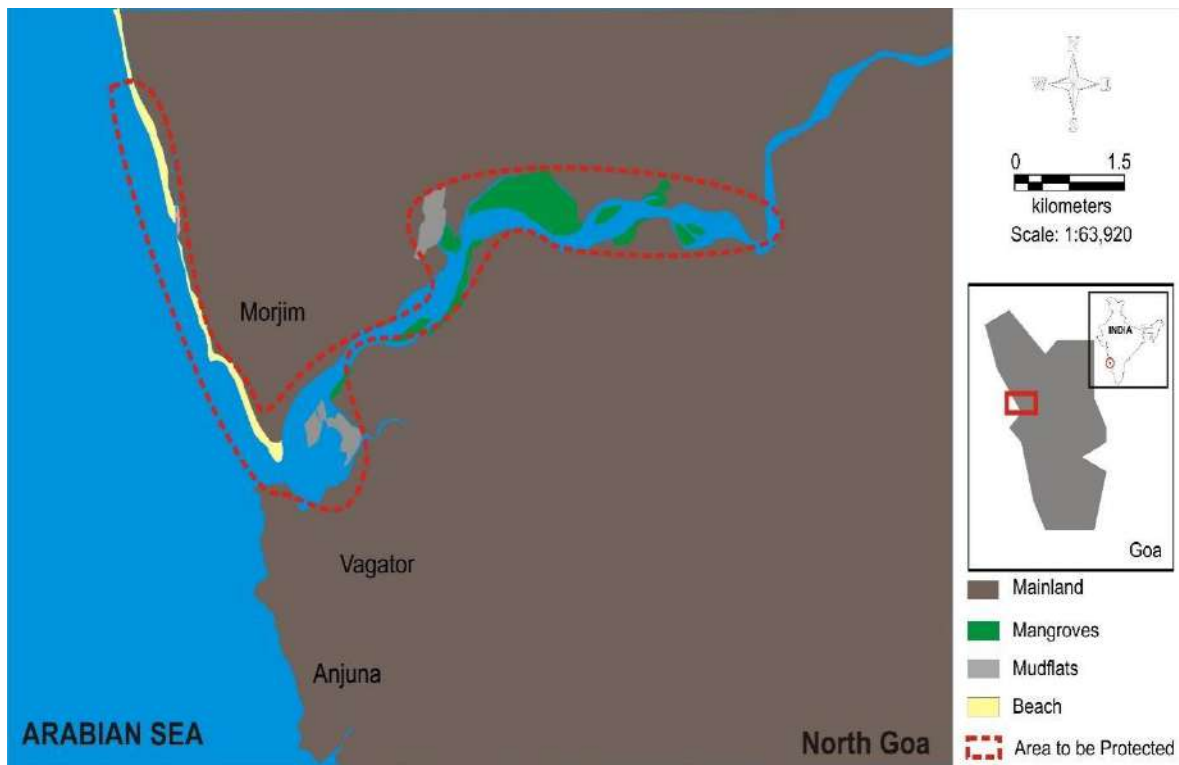


Fig. 2. Map of Morjim – Anjuna ICMBA





**Fig. 3. Map of North of Goa showing Morjim- Anjuna**

### **1A. Chapora River, Chopdem**

Riverine mangrove areas of the Chapora river at Chopdem has been surveyed for the faunal elements. Good stretch of mangroves was seen all along the river dominated by *Avicennia marina*, *Sonneratia caseolaris* and *Bruguiera cylindrica*. A good population of sessarimid crabs and fiddler crabs were found in the locality. Also noticed the presence of large green mud crabs (*Scylla serrata*) in the muddy areas of the shores. A few molluscs specimens were also collected from the area. Birds such as Common Sandpiper, Little Egret, Alexandrine Parakeet, Indian Pond Heron, White-breasted Waterhen Black Kite, Brahminy Kite, Little ringed Plover and Brahminy Kite were observed during the survey.



### **The riverine Mangrove of Chopdem area**

#### **1B. Morjim Beach**

In ZSI field survey team surveyed the beach areas of Morjim – Anjuna by walking along the stretch of the beach for almost two km, covering the rocky shores, sand banks and the estuarine areas of the beach. The rocky pools and shores are enriched with good population of barnacles, molluscs and crabs. Large number of ghost crabs (ocypods) also noticed in the sandy beach area. Many flocks of migratory shorebirds were observed during the survey. A roosting population of more than 100 shorebirds were seen on the rocks dominated by Lesser Sand Plover. A few Greater Sand Plover, a pair of Terek Sandpiper, Kentish Plover and Common Sandpiper were also observed among the mixed flock. Other bird species observed were Lesser Crested Tern, Brown Headed Gull, Heuglin’s Gull, White-bellied Sea Eagle, Brahminy Kite, Black Kite, etc.



### **The rocky and sandy patch of Morjim Beach at Siridao**

The survey team of ZSI explored the riverine areas of Chapora, the long sandy beaches of Morjim during the survey. The details of the observations and the faunal samples collected during the survey is listed in Annexures.

#### **Socio-economic values:**

Tourism and tourism related services and business are the livelihood options for the local dwellers for these sites.

#### **Conservation status:**

The State Forest Department has established hatcheries for nesting sea turtles and keeps a watch on the entire beach areas during breeding season of turtles and

also stringent rule are in place at Morjim beach for vehicular movements or other adverse activities by tourists. Also local volunteers are involved in monitoring the coastline for any deleterious activities that pose threat to the beach.

**Threats:**

Unattended tourism disturbances, camping and beach games are some of the minor threats exist around this site.

**Site Significance:**

Sand dunes, turtle nesting beach, mangroves, mudflats, sea-front headland are significant ecological features deserves conservation since these ecosystems known to harbour rich coastal and marine biodiversity.

**Criteria and Indicators for identifying the site as ICMBAs (As per WII, 2013):**

Criteria / Indicators	A	B	C	D	E	F	G	H
Ecosystem resilience								
Ecosystem functions								
Biodiversity uniqueness								
Socio-Cultural significance								
Socio-Economic potential								
Land tenure								



## 2. Mandovi-Zuari, North Goa

<b>Site name</b>	: Mandovi-Zuari estuary
<b>District</b>	: South Goa
<b>Geo-coordinates</b>	: 15°27'989"N, 73° 48'297"E
<b>Area</b>	: 84.5 Sq.Km.
<b>Habitat type</b>	: Estuarine complex with mangroves

The Mandovi-Zuari estuarine complex and the interlinking Cambarjua canal are the largest coastal ecosystem of Goa. They comprise mudflats, swampy marshes, islets, etc. The nearly 62 km long Rachole or Mandovi River and the 91 km long Zuari River open to the Arabian Sea, forming a wide estuarine habitat at their confluence. The beach, sand spits, bay waters, isles, bird sanctuary, shipyard and fishing harbour are important features.



The Salim Ali Bird Sanctuary and its surroundings are provided protection under the IWPA, 1972. Vessel traffic from the port and fishing harbour, oil spills resulting from maintenance at the shipyard, disturbance caused by tourism and construction of residential and industrial infrastructure pose significant threats to this fragile ecosystem and thus deteriorate its quality, as described by many reports.

The site is adjacent to Carambolim Lake, which is also an Important Bird Area (IBA). The site has been proposed as a community/conservation reserve involving the local fishing community jointly with National Institute of Oceanography (NIO).



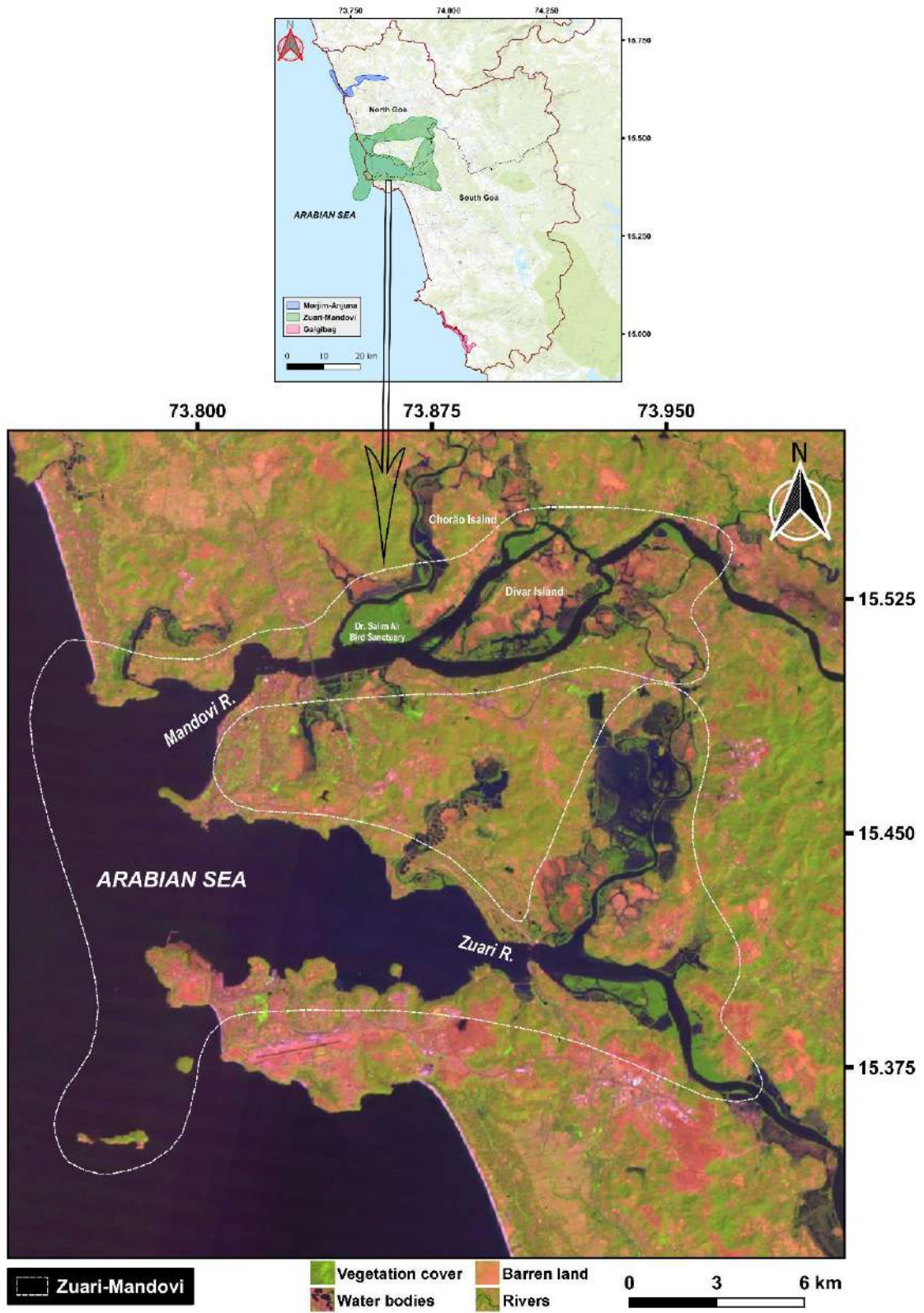


Fig. 4. Map of Mandovi- Zuari Complex ICMBAs



**Fig. 5. Map showing the ICMBAs part of Mandovi- Zuari complex**

## **2A. Dr. Salim Ali Bird Sanctuary, Chorao Island**

Surveyed the beautiful Chorao Island on during September and again during December 2022. The entire shoreline of the island is covered with mangrove plants like *Avicennia marina*, *Avicennia officinalis*, *Bruguiera cylindrica*, *Bruguiera gymnorhiza*, *Rhizophora mucronata*, *Sonneratia caseolaris* and *Kandelia candel*. We walked all along the Sanctuary. Entire area of the sanctuary is abundant with various species of crabs. At least 5 species of sessarimid crab species were observed from the area. Molluscs species dominated with *Telescopium telescopium* and other neritid and cerithidia species. The significant bird species observed from the area were Osprey, White-bellied Sea Eagle, Lesser Pied Kingfisher, Stork-billed Kingfisher, Common Redshank, Common Sandpiper, Common Greenshank, Lesser Sand Plover, Curlew Sandpiper, Brahminy Kite, Black Kite, Gull-billed Tern, Whiskered Tern, etc. Good population of Mud skippers (*Periophthalmus* sp) also noted.



## **Dr. Salim Ali Bird Sanctuary, Chorao Island – a distant view**

### **2B. Cacara Beach**

The Cacara beach is an important part of Mandovi – Zuari ICMBA complex. The beach is entirely of rocky nature covered with sea grasses and other algal mat. Many numbers of brachyuran crabs and molluscs were observed from the rocky pools and depressions during the survey. Migratory shorebirds such as Whimbrel, Common Sandpiper, Lesser Sand Plover, Common Greenshank, Ruddy Turnstones were sighted during the survey. Other bird species observed were Reef Heron, Indian Pond Heron, Jungle Myna, Common Myna, Brahminy Kite, Black Kite, etc.





**The rocky beach of Cacra, north Goa**

## **2C. Zuari River, Bori-Sanquar**

ZSI team surveyed the entire stretch of Bori- Sanquar part of the Zuari river on 5<sup>th</sup> December 2022. The mangrove backwater swamp of the area is dominated with huge *Avicennia marina* trees. Other mangrove species represented in the area are *Avicennia officinalis*, *Bruguiera cylindrica*, *Bruguiera gymnorrhiza*, *Rhizophora mucronata*, *Excoecaria agallocha*, *Kandelia candel* and *Acanthus ilicifolius*. Mangrove associated plants like *Dolichandrone spathacea*, *Volkameria inermis*, *Thespesia populnea*, *Hibiscus tiliaceus*, *Ipomoea companulata*, *Derris trifoliata*, etc were also occur here. As the *Bruguiera* plants are with flowers many sunbirds

and insects were observed during the survey. A total of 21 species of birds were observed including Grey Heron, Spotted Redshank, Common Redshank, White-bellied Sea Eagle, Little Spider Hunter, Striated Heron, Purple rumped Sunbird, Purple Sunbird, Greenish Leaf Warblers, Blyth's Reed Warbler, Grey-breasted Prinia, Ashy Prinia, Common Sandpiper, Little Cormorant, Indian Cormorant, etc. Interestingly, a small troop of Black-footed Gray Langur was also seen feeding on the tender leaves of *Avicennia marina*.



### **The riverine mangrove areas of Zuari river at Bori-Sanquar**

Good population of sesarmid and other crab species were observed. Local people are collecting large Mud Crabs (*Scylla tranquebarica*) from the area. Fishing activities were also noted at many places. 13 species of butterflies and 4 species of Odonata were also recorded from the locality.

## **Mandovi River, Old Goa**

The riverine area of Mandovi river was surveyed for field collections. The mangrove fringed shoreline of the river is rich in sesarmid crabs, Fiddler crabs and molluscs. We also spotted Blue spotted Mudskipper along the marsh-edges. Birds observed from the area are Ashy Prinia, Common Kingfisher, Brahminy Kite, Grey-breasted Prinia, Little Egret, Intermediate Egret, Great Egret, Indian Pond Heron, Common Kingfisher, White-bellied Sea Eagle, etc.

## **Siridao**

ZSI team surveyed the Siridao stretch of beaches on during September and December 2022 field visits. The long stretch of beaches is mixed with rocky and sandy areas. Large numbers of screw shells were noticed in the beach. Many swarms of young crabs were noted all along the beach. Good growth of sponges and barnacles were also observed on the rocky substratum. A roosting population of more than 100 Lesser Sand Plovers and Great Sand Plovers were seen on the rocks. Other bird species observed were Ruddy Turnstone, Common Sandpiper, Brahminy Kite, Black Kite, White-bellied Sea Eagle, Indian Pond Heron, Night heron etc. A roosting population of House crows were also noted at the beach. The collections made from the Siridao beach is listed in Table presented in the Annexures.

## **Socio-economic values**

Traditional fishermen community depend this site largely for their fishery resources exploitation from the River and also tourism operation in Mandovi-Juary river estuary is found to be excellent livelihood option for them during winter season. The water-way services and mariculture practices also yield good revenue.

## **Conservation status**

The Goa Shipyard, Port Authority, National Institute of Oceanography, Tourist Operators and Volunteers as well as NGOs/CBOs are involved at various stake in protecting the site. The State Forest Department also monitoring the vital habitats to check for pollution and other reclamation activities. The Salim Ali Bird Sanctuary is designated Protected Area under the Wildlife (Protection) Act, 1972 of Govt. of India.

## **Threats**

Vessel traffic from Port and Fishing Harbor, oil spills from maintenance and shipyard, tourism disturbances, construction of residential and industrial infrastructures pose threat to the fragile ecosystem and thus deteriorates the aquatic biodiversity of the area.

## **Site Significance**

The site is adjacent to the Carambolim Lake which is identified as a Important Bird Area of Goa. The dynamic beach, open estuarine habitats,

mangrove islets, mudflats are vital ecological features of this site worth conserving the landscape and waterscape.

**Criteria and Indicators for identifying the site as ICMBAs (As per WII, 2013):**

<b>Criteria / Indicators</b>	A	B	C	D	E	F	G	H
Ecosystem resilience	■	■	■	■	■			
Ecosystem functions	■	■	■	■				
Biodiversity uniqueness		■					■	■
Socio-Cultural significance			■	■				
Socio-Economic potential	■	■		■				
Land tenure	■							

**3. Galgibag, South Goa**

**Site name** : Galgibagh  
**District** : South Goa  
**Geo-coordinates** : 14°57'877"N, 74° 03'201"E  
**Area** : 3.5 Sq.Km.  
**Habitat type** : Beach

The Galgibag ICMBAs is located in the southern part of Goa coast. It has a long sandy beach interspersed with lateritic outcrops and the Talpona (11.2 km) and Galgibag (3.8 km) creeks backwaters, with fringing mangroves. The turtle nesting beach, mangrove-fringed creeks, offshore fishing grounds and lateritic



headlands are the significant ecological features worth conserving. The site has also been proposed as a community/conservation reserve involving the state forest department and the tourism sector.

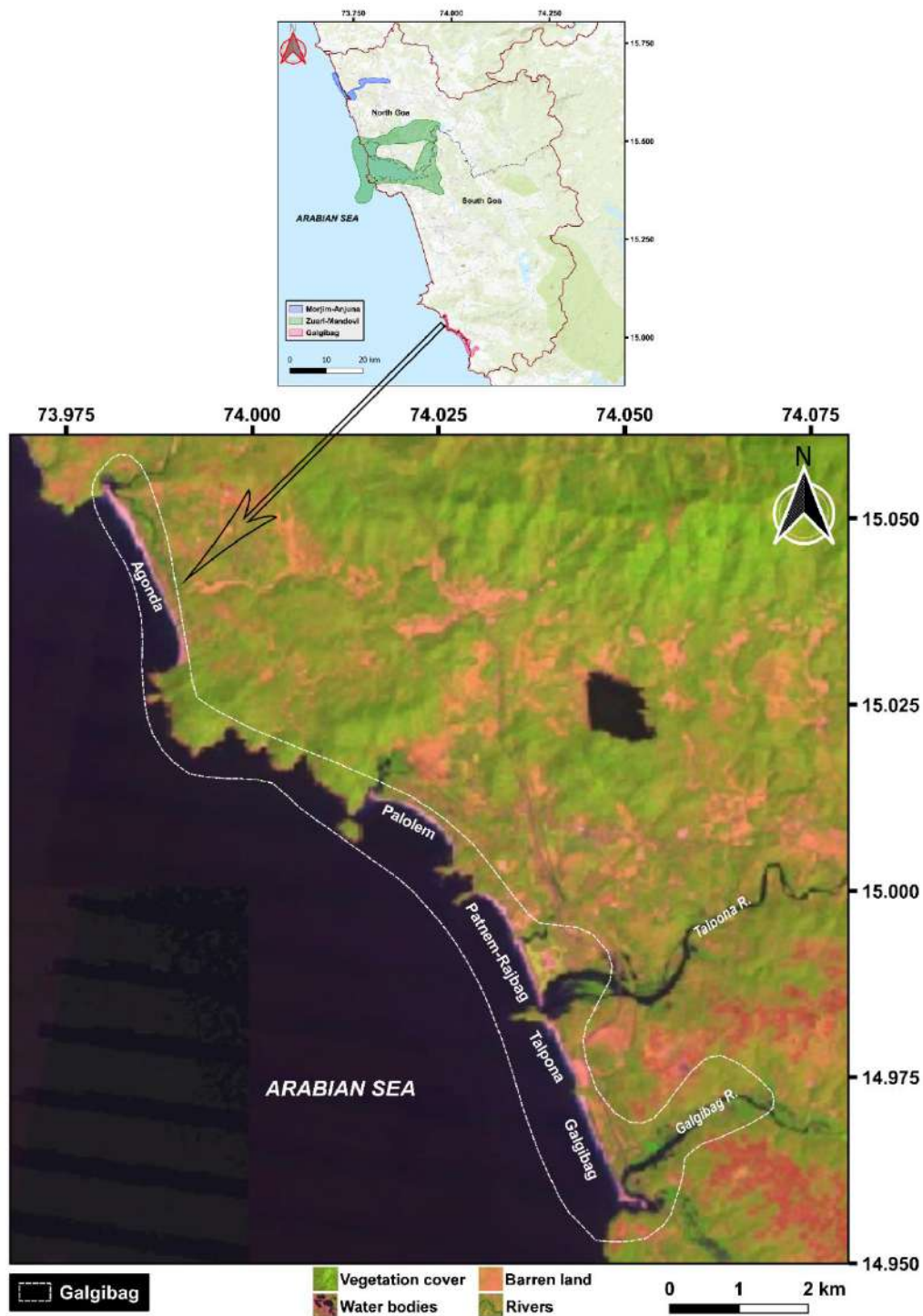


Fig. 6. Map of Galgibag ICMBA



Map showing the ICMBIA part of Galgibag, South Goa



Galgibag beach, South Goa



### 3A. Palolem

The Palolem beach area was surveyed both during September and December 2022. The long stretch beach was mainly of sandy nature interspersed with hill ranges touching the beaches. The mangrove area of the creek is mainly consisting of *Avicennia marina*, *Rhizophora mucronata* and *Excoecaria agallocha*. A few climbers like *Ipomoea campanulata*, *Ipomoea pescaprae*, *Derris terifoliata*, and *Caesalpinia* sp were also noted from the area. Other plant species lined with the beaches are *Thespesia populnea*, *Casuarina* and *Premna* sp. Good number of bivalve molluscs were note at the intertidal area of the beach. Good population of cerithid molluscs and fiddler crabs were noted at the mangrove areas. Birds such as Brahminy kite, House Crow, Cattle Egret, Stork-billed Kingfisher, White -throated Kingfisher, Indian Pond Heron, Little Egret, Reef heron, and the Common Kingfisher, were observed during the survey. A breeding pair of White -bellied Eagle also observed during the survey.

### 3B. Galgibag River, Galgibag

ZSI ream visited the riverine area of Galgibag river on 8<sup>th</sup> December 2022. The backwater mangrove and creeks were surveyed for faunal elements. The mangrove vegetation represented in the area are *Avicennia marina*, *Avicennia officinalis*, *Rhizophora mucronata*, *Sonneratia alba* and *Excoecaria agallocha*. It was low tide and we could observe many crabs and mollusc species. Jelly like egg masses and barnacles were found in good numbers. Many species of sessarimid crabs, graspid crabs, fiddler crabs and mud crabs (*Scylla tranquebarica*) were

observed from the area. Large number of gastropods like *Telescopium telescopium* and *Cerithidia cingulata* were also noted during the survey. Birds such as Common Sandpiper, Wood Sandpiper, Red-wattled Lapwing, Common Kingfisher, White-throated Kingfisher, Intermediate Egret, Little Egret, Indian Pond Heron, White-breasted Waterhen, Asian Koel, Brahminy Kite and Black Kite were observed.



### **Backwaters near Palolem**

Near the riverine paddy field, we could also observe good number of shorebirds including Wood Sandpiper (30++ numbers), Common Sandpiper (8), Little Stint (3), Red-wattled Lapwing (6), Green Sandpiper (2), Little Ringed Plover (4), Marsh Sandpiper (2), Common Greenshank (2), actively feeding from the freshly ploughed field. Other birds observed from the area were Brahminy Kite,

Oriental Honey Buzzard, Barn Swallow, Red-rumped Swallow, Ashy Drongo, Greater Coucal, etc.



**The riverine mangroves area of Galgibag**

### **3C. Galgibag Beach**

The wide stretch of Galgibag beach starting from Talpona river estuary to Galgibag area was surveyed for faunal elements. The beach is very wide lined with exotic Casuarina and coconut plantations. The backwater swamp associated with the estuarine area is lined with mangrove vegetation like *Rhizophora mucronata*, *Avicennia marina* and *Avicennia officinalis*. Sand dune flora is very sparse but covered with species such as *Ipomoea pescaprae* and *Merritima* sp. We sighted a Smooth-coated Otter near the backwater swamp mangrove. A few Local people were found collecting fishes, bivalves (Clams) and green mussels (*Perna viridis*)

from the area. We collected good number of molluscs and crabs from the area. Exceptionally good number of Ghost crabs (*Ocypode ceratophthalmus*) were noted in the beach in the evening. Roost flights of Little Cormorant (20+), Cattle Egrets (20+), Brahminy Kite (10+), Black Kite (12+) were noted. Other bird species observed from the area were Heuglin's Gull, Lesser Sand Plover, Greater Sand Plover, Kentish Plover, Cattle Egret, White-bellied Sea Eagle, Pond Heron and Lesser Crested Tern.



**The wide stretch of sandy beach at Galgibag**

### **Agonda beach**

Agonda is one of the beautiful beach in the area, interspersed with forest claded hill ranges meeting with the sea. The vast sandy beaches, rocky outcrops,

and mangrove fringed creeks provided good habitat for marine and non-marine fauna. Mangrove vegetation consists mainly of *Avicennia officinalis*, *Avicennia marina*, *Excocaria agallocha*, *Hibiscus tiliaceus*, *Clerodendron inerme*, *Premana latifolia*, etc. The rocky areas are covered with lush growth of algae and other vegetation with good population of crabs, barnacles, molluscs and other marine animals. Small flocks of Lesser Sand Plover were noted at the rocky area of the Beach. Other bird species observed were Common Sandpiper, Brahminy Kite, Black Kite, White-bellied Sea Eagle, Shikra, Green Bee-eater, Night Heron, etc. A dead specimen of juvenile Green Sea Turtle was observed at the intertidal area of the beach, evidently killed by the propeller of the fishing boats. Good population (more than 20 numbers) of *Tholymis tillagra* dragonflies were seen feeding at the rocky patches of the beach flying very close to the sea. Interestingly, a small troop of Black-footed Hanuman Langur (*Semnopithecus dussumieri*) and the Bonnet Macaque (*Macaca radiata*) were also noted at the beach side. The collections made during the survey at the Agonda beach side is listed below

### **Patnem-Rajbag**

The area was surveyed on during September and December 2022. The vast beach side is fringed with Casuarina and coconut plantations. We walked up to Talpona estuary, southern most side of the beach, about a distance of 1.5 km. A good population of shorebirds were found feeding at the intertidal area of the beach. The flock consists of more than 100 Lesser Sand plovers, Curlew Sandpiper (6 nos.), Great Sand Plover (5 nos.), Kentish Plover (2 nos.), Sanderling (2 nos.),

Broad-billed Sandpiper (1 no.), and the Common Ringed Plover (1 no.). A roosting population of more than 100 Brahminy Kites and 120 Black kites were also seen flying towards southern side. Plenty of marine molluscs and crabs were collected from the area. The details of collection made from the area as well as checklist of fauna documented are provide in Annexures.

### **Socio-economic values**

Fishing and tourism are the two main activities for earning revenue by the local community for Galgibag coastal hemlets.

### **Conservation status**

The State Forest Department with the help of local Administration and other volunteers are involved in sea turtle conservation and monitoring, through hatchery and *in-situ* protection of nests. Since turtle attracts national and international tourists, few tourism operating agencies are also involved in awareness creation and protection of nesting beaches at Galgibag and Agonda beach.

### **Threats**

Reclamation of mangrove area for residential infrastructure, unregulated tourism disturbances and related activities, sand quarrying are main threat to this ecosystem.

## Site Significance

The turtle nesting beach, mangrove ringing creeks, offshore fishing ground, lateritic headlands are the significant ecological features worth conservation and protection measures for Galgibag and Agonda.

### Criteria and Indicators for identifying the site as ICMBAs (As per WII, 2013):

Criteria / Indicators	A	B	C	D	E	F	G	H
Ecosystem resilience								
Ecosystem functions								
Biodiversity uniqueness								
Socio-Cultural significance								
Socio-Economic potential								
Land tenure								



## Landscapes and habitats of the ICMBAs of Goa



Morjim (River mouth)



Morjim (Estuarine area with mangrove)



Mandovi River, Old Goa



Anjuna (Intertidal area)



Anjuna (expose rocky shore during low tide)



Mandovi River, Old Goa (with mangrove)



Siridao (Sandy beach)



Intertidal region of Siridao



Intertidal region of Siridao



## Landscapes and habitats of the ICMBAs of Goa



Agonda (Intertidal region)



Agonda



Palolem (during low tide)



Palolem (riverside area with mangrove)



Patnem-Rajbag beach



Talpona River



Galgibag beach



Galgibag beach



## Faunal collection, observation and photography in the ICMBAs of Goa



Faunal collections in the mangroves of Chapora River



Faunal collections in Zuari River



Faunal collections in the mangroves of Zuari River



Faunal collections and observation near Zuari River



Faunal collections from the rocky intertidal area of Cakra



Faunal collections in the mangroves of Galgibag River



Photography and observation



Aquatic collection in Galgibag River



## Fauna of the ICMBAs of Goa



Marine worm (Polychaeta)



Hermit crabs (Anomura)



Barnacles, *Chthamalus* sp.



Barnacles, *Amphibalanus amphitrite*



Snapping shrimp (Alpheidae)



Snapping shrimp (Alpheidae)



Snapping shrimp (Alpheidae)



Caridean shrimp



## Fauna of the Important Coastal and Marine Biodiversity Areas of Goa



Sea anemone



Marine crab, *Austruca annulipes*



Marine crab, *Grapsus albolineatus*



Marine crab, *Scylla tranquebarica*



Marine crab, *Dotilla* sp.



Barnacles, *Amphibalanus amphitrite*



Barnacles, *Chthamalus* sp.



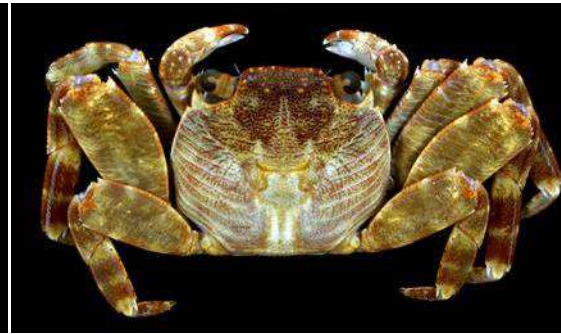
Barnacles, *Megabalanus tintinnabulum*



Marine crustaceans of ICMBAs of Goa



*Dotilla myctiroides* (H. Milne Edwards, 1852)  
(Decapoda: Brachyura: Dotillidae)



*Grapsus albolineatus* Latreille, in  
Milbert, 1812  
(Decapoda: Brachyura: Grapsidae)



*Metopograpsus cannicci* Innocenti et al., 2020  
(Decapoda: Brachyura: Grapsidae)



*Ryphila cancellus* (Herbst, 1783)  
(Decapoda: Brachyura: Leucosiidae)



*Schizophrys aspera* (H. Milne Edwards, 1831)  
(Decapoda: Brachyura: Majidae)



*Matuta victor* (Fabricius, 1781)  
(Decapoda: Brachyura: Matutidae)



*Menippe rumphii* (Fabricius, 1798)  
(Decapoda: Brachyura: Menippidae)



*Myomenippe hardwickii* (Gray, 1831)  
(Decapoda: Brachyura: Menippidae)



*Sphaerozius scaber* (Fabricius, 1798)  
(Decapoda: Brachyura: Menippidae)



*Austruca annulipes* (H. Milne Edwards, 1837)  
(Decapoda: Brachyura: Ocypodidae)



*Gelasimus vocans* (Linnaeus, 1758)  
(Decapoda: Brachyura: Ocypodidae)



*Ocypode ceratophthalmus* (Pallas, 1772)  
(Decapoda: Brachyura: Ocypodidae)



*Epixanthus frontalis* (H. Milne Edwards, 1834)  
(Decapoda: Brachyura: Oziidae)



*Ozius rugulosus* Stimpson, 1858  
(Decapoda: Brachyura: Oziidae)





*Ozius tuberculatus* H. Milne Edwards, 1834  
(Decapoda: Brachyura: Oziidae)



*Glabropilumnus laevis* (Dana, 1852)  
(Decapoda: Brachyura: Pilumnidae)



*Charybdis feriata* (Linnaeus, 1758)  
(Decapoda: Brachyura: Portunidae)



*Charybdis goaensis* Padate et al., 2010  
(Decapoda: Brachyura: Portunidae)



*Charybdis hellerii* (A. Milne-Edwards, 1867)  
(Decapoda: Brachyura: Portunidae)



*Portunus pelagicus* (Linnaeus, 1758)  
(Decapoda: Brachyura: Portunidae)



*Portunus sanguinolentus* (Herbst, 1783)  
(Decapoda: Brachyura: Portunidae)



*Portunus segnis* (Forskål, 1775)  
(Decapoda: Brachyura: Portunidae)



*Scylla olivacea* (Herbst, 1794)  
(Decapoda: Brachyura: Portunidae)



*Scylla tranquebarica* (Fabricius, 1798)  
(Decapoda: Brachyura: Portunidae)



*Thranita crenata* (Rüppell, 1830)  
(Decapoda: Brachyura: Portunidae)



*Clistocoeloma lanatum* (Alcock, 1900)  
(Decapoda: Brachyura: Sesarmidae)

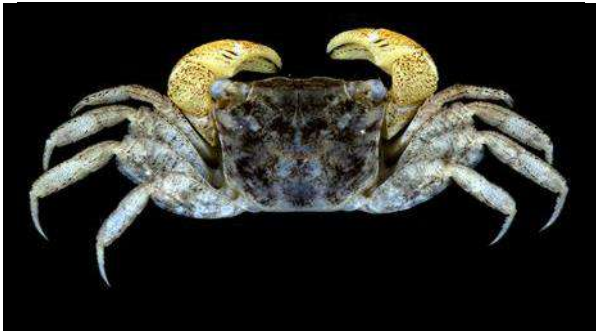




*Nanosesarma batavicum* (Moreira, 1903)  
(Decapoda: Brachyura: Sesarmidae)



*Parasesarma bengalense* (Davie, 2003)  
(Decapoda: Brachyura: Sesarmidae)



*Parasesarma plicatum* (Latreille, 1803)  
(Decapoda: Brachyura: Sesarmidae)



*Perisesarma dusumieri* (H. Milne Edwards, 1853)  
(Decapoda: Brachyura: Sesarmidae)



*Pseudosesarma glabrum* Ng et al., 2017  
(Decapoda: Brachyura: Sesarmidae)



*Varuna yui* Hwang & Takeda, 1986  
(Decapoda: Brachyura: Varunidae)

Marine Crustaceans of ICMBAs of Goa



*Leptodius affinis* (De Haan, 1835)  
(Decapoda: Brachyura: Xanthidae)



*Alpheus cf. lobidens* De Haan, 1849  
(Decapoda: Caridea: Alpheidae)



*Penaeus monodon* Fabricius, 1798  
(Decapoda: Penaeidae)



*Amphibalanus amphitrite* (Darwin, 1854)  
(Balanomorpha: Balanidae)



*Megabalanus tintinnabulum* (Linnaeus,  
1758)  
(Balanomorpha: Balanidae)



*Chthamalus challengerii* Hoek, 1883  
(Balanomorpha: Chthamalidae)



## Crabs of the ICMBAs of Goa



*Grapsus albolineatus* Latreille, in Milbert, 1812 (Grapsidae)



*Metopograpsus cannicci* Innocenti, Schubart & Fratini, 2020 (Grapsidae)



*Ryphila cancellus* (Herbst, 1783) (Leucosiidae)



*Matuta victor* (Fabricius, 1781) (Matutidae)



*Austruca annulipes* (H. Milne Edwards, 1837) (Ocypodidae)



*Ocypode ceratophthalmus* (Pallas, 1772) (Ocypodidae)



*Epixanthus frontalis* (H. Milne Edwards, 1834) (Oziidae)



*Ozius rugulosus* Stimpson, 1858 (Oziidae)

## Crabs of the ICMBAs of Goa



*Glabropilumnus laevis* (Dana, 1852)  
(Pilumnidae)



*Scylla tranquebarica* (Fabricius, 1798)  
(Portunidae)



*Portunus sanguinolentus* (Herbst, 1783) (Portunidae)



*Portunus pelagicus* (Linnaeus, 1758)  
(Portunidae)



*Charybdis (Charybdis) feriata*  
(Linnaeus, 1758) (Portunidae)



*Charybdis (Charybdis) hellerii* (A. Milne-Edwards, 1867) (Portunidae)



*Thranita crenata* (Rüppell, 1830)  
(Portunidae)



*Leptodius affinis* (De Haan, 1835)  
(Xanthidae)



Crabs of the ICMBAs of Goa



*Clistocoeloma lanatum* (Alcock, 1900)  
(Sesarmidae)



*Nanosesarma batavicum* (Moreira, 1903) (Sesarmidae)



*Neosarmatium malabaricum*  
(Henderson, 1893) (Sesarmidae)



*Parasesarma bengalense* (Davie, 2003) (Sesarmidae)



*Parasesarma plicatum* (Latreille, 1803) (Sesarmidae)



Mangrove crab (Sesarmidae)



Mangrove crab (Sesarmidae)



Mangrove crab (Sesarmidae)



## Mollusca of the ICMBAs of Goa



Telescope snail (Potamididae)



Tropical periwinkle (Planaxidae)



Rock shells (Muricidae)



Rock shells (Muricidae)



Windowpane oyster (Placunidae)



Hooded oyster (Ostreidae)



Green mussel (Mytilidae)



Mussel (Mytilidae)



## Fauna of the ICMBAs of Goa



Maine bivalve, *Donax* sp.



Maine bivalve, *Perna viridis*



Maine bivalve, *Saccostrea cucullata*



Maine gastropod, *Cellana radiata*



Marine gastropod, *Indothais lacera*



Marine gastropod, *Planaxis sulcatus*



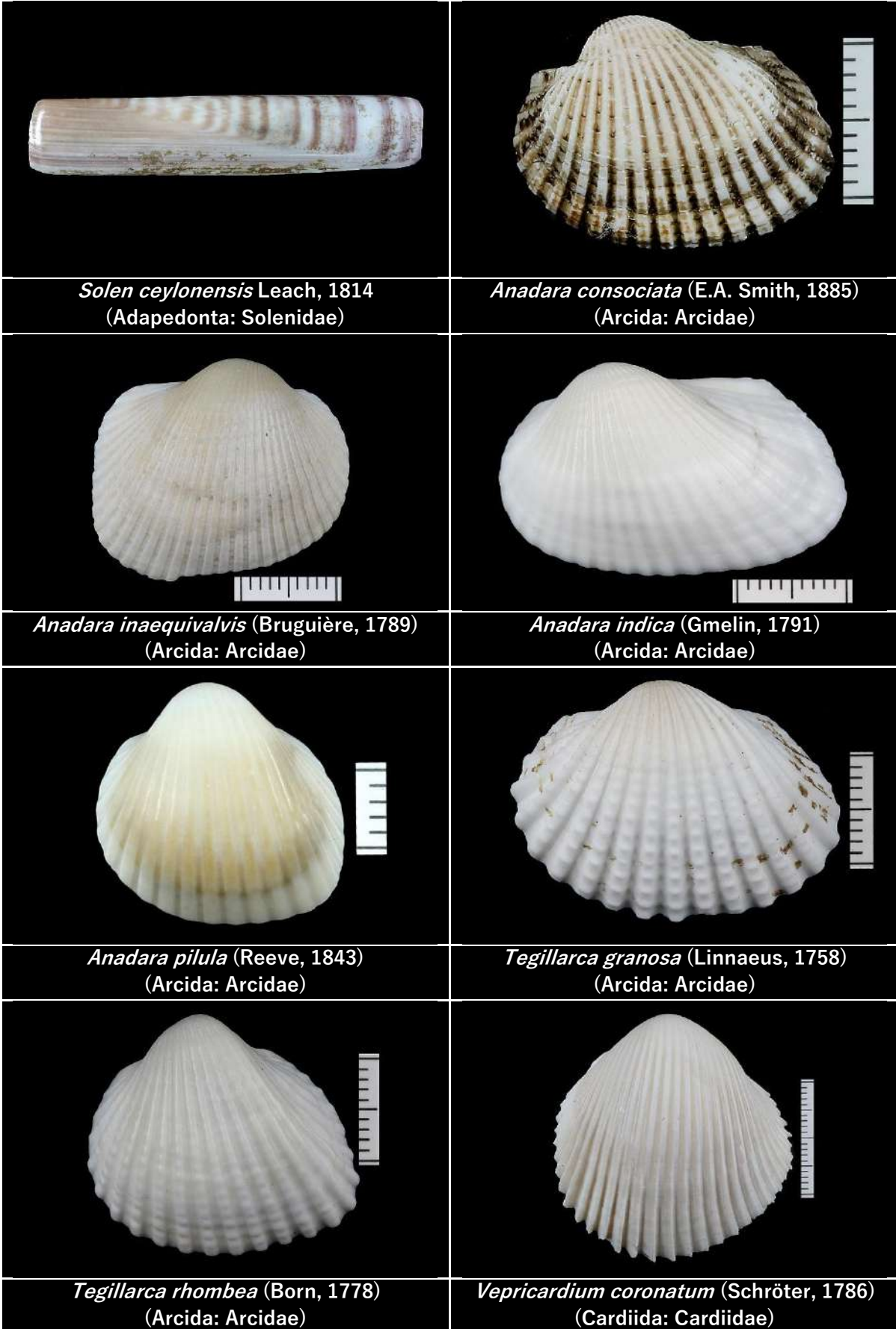
Marine gastropod, *Nerita* sp.



Blue-spot mudskipper,  
*Boleophthalmus boddarti*



Marine Mollusca (Bivalves) of ICMBAs of Goa





*Donax lubricus* Hanley, 1845  
(Cardiida: Donacidae)



*Hecuba scortum* (Linnaeus, 1758)  
(Cardiida: Donacidae)



*Latona cuneata* (Linnaeus, 1758)  
(Cardiida: Donacidae)



*Hiatula diphos* (Linnaeus, 1771)  
(Cardiida: Psammobiidae)



*Semele carnicolor* (Hanley, 1845)  
(Cardiida: Semelidae)



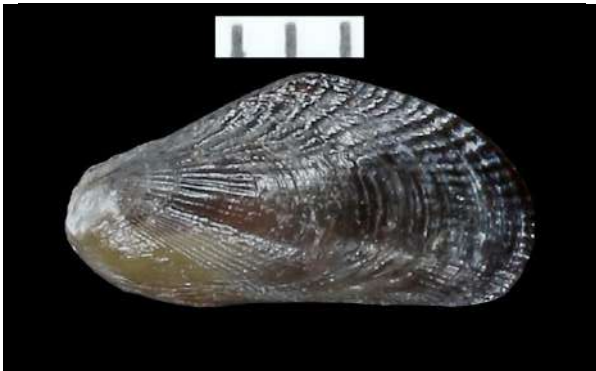
*Tellinimactra edentula* (Spengler, 1798)  
(Cardiida: Tellinidae)



*Cardites bicolor* (Lamarck, 1819)  
(Carditida: Carditidae)



*Arcuatula senhousia* (Benson, 1842)  
(Mytilida: Mytilidae)



*Brachidontes undulatus* (Dunker, 1857)  
(Mytilida: Mytilidae)



*Modiolus gubernaculum* (Dunker, 1856)  
(Mytilida: Mytilidae)



*Perna viridis* (Linnaeus, 1758)  
(Mytilida: Mytilidae)



*Crassostrea cuttackensis* (Newton & Smith, 1912)  
(Ostreida: Ostreidae)



*Saccostrea cucullata* (Born, 1778)  
(Ostreida: Ostreidae)



*Placuna placenta* (Linnaeus, 1758)  
(Pectinida: Placunidae)



*Geloina expansa* (Mousson, 1849)  
(Venerida: Cyrenidae)



*Mactra aequisulcata* G.B. Sowerby III, 1894  
(Venerida: Mactridae)





*Mactra luzonica* Reeve, 1854  
(Venerida: Mactridae)



*Mactra violacea* Gmelin, 1791  
(Venerida: Mactridae)



*Mactrinula subplicata* (Lamarck, 1818)  
(Venerida: Mactridae)



*Callista erycina* (Linnaeus, 1758)  
(Venerida: Veneridae)



*Dosinia cretacea* (Reeve, 1850)  
(Venerida: Veneridae)



*Gafrarium divaricatum* (Gmelin, 1791)  
(Venerida: Veneridae)



*Marcia opima* (Gmelin, 1791)  
(Venerida: Veneridae)



*Meretrix casta* (Gmelin, 1791)  
(Venerida: Veneridae)



*Meretrix meretrix* (Linnaeus, 1758)  
(Venerida: Veneridae)



*Paratapes textilis* (Gmelin, 1791)  
(Venerida: Veneridae)



*Pelecyora excisa* (Röding, 1798)  
(Venerida: Veneridae)



*Sunetta solanderii* (Gray, 1825)  
(Venerida: Veneridae)



*Timoclea imbricata* (G.B. Sowerby II, 1853)  
(Venerida: Veneridae)

Marine Mollusca (Gastropoda) of ICMBAs of Goa



*Batillaria angulifera* (G.B. Sowerby II, 1866)  
([unassigned]: Batillariidae)



*Clypeomorus batillariaeformis* Habe &  
Kosuge, 1966  
([unassigned]: Cerithiidae)



*Clypeomorus bifasciata* (G.B. Sowerby II,  
1855)  
([unassigned]: Cerithiidae)



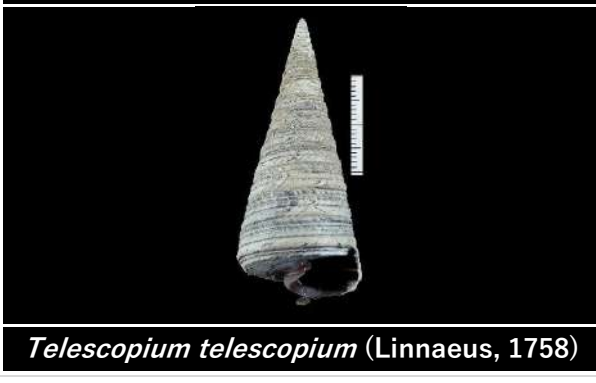
*Cellana radiata* (Born, 1778)  
([unassigned]: Nacellidae)



*Planaxis sulcatus* (Born, 1778)  
([unassigned]: Planaxidae)



*Pirenella cingulata* (Gmelin, 1791)  
([unassigned]: Potamididae)



*Telescopium telescopium* (Linnaeus, 1758)



*Turritella attenuata* Reeve, 1849

([unassigned]: Potamididae)

([unassigned]: Turritellidae)

Marine gastropods of ICMBAs of Goa



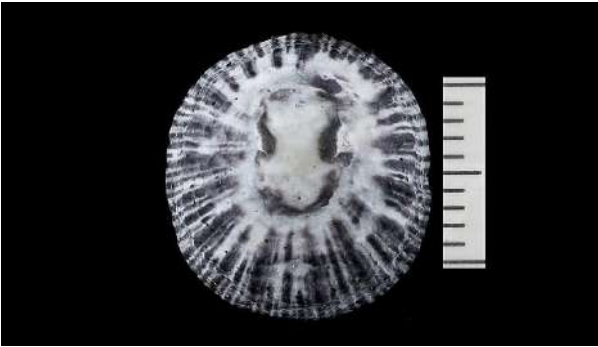
*Turritella duplicata* (Linnaeus, 1758)  
([unassigned]: Turritellidae)

*Clithon oualaniense* (Lesson, 1831)  
(Cycloneritida: Neritidae)



*Neripteron violaceum* (Gmelin, 1791)  
(Cycloneritida: Neritidae)

*Nerita oryzarum* Récluz, 1841  
(Cycloneritida: Neritidae)



*Nerita undata* Linnaeus, 1758  
(Cycloneritida: Neritidae)

*Clypidina notata* (Linnaeus, 1758)  
(Lepetellida: Fissurellidae)

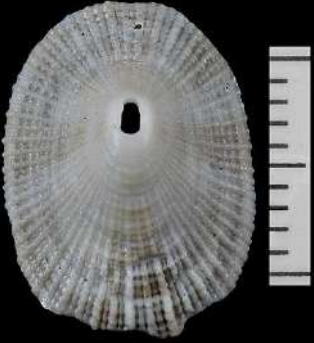









*Diodora lentiginosa* (Reeve, 1850)  
(Lepetellida: Fissurellidae)









*Diodora singaporensis* (Reeve, 1850)  
(Lepetellida: Fissurellidae)



Marine gastropods of ICMBAs of Goa

	
<p><i>Diodora ticaonica</i> (Reeve, 1850) (Lepetellida: Fissurellidae)</p>	<p><i>Bufonaria echinata</i> (Link, 1807) (Littorinimorpha: Bursidae)</p>
	
<p><i>Gyrineum natator</i> (Röding, 1798) (Littorinimorpha: Cymatiidae)</p>	<p><i>Echinolittorina vidua</i> (Gould, 1859) (Littorinimorpha: Littorinidae)</p>
	
<p><i>Littoraria scabra</i> (Linnaeus, 1758) (Littorinimorpha: Littorinidae)</p>	<p><i>Littoraria undulata</i> (Gray, 1839) (Littorinimorpha: Littorinidae)</p>
	
<p><i>Mammilla melanostoma</i> (Gmelin, 1791) (Littorinimorpha: Naticidae)</p>	<p><i>Neverita didyma</i> (Röding, 1798) (Littorinimorpha: Naticidae)</p>

Marine gastropods of ICMBAs of Goa

	
<p><i>Paratectonatica tigrina</i> (Röding, 1798) (Littorinimorpha: Naticidae)</p>	<p><i>Tibia insulaechorab</i> Röding, 1798 (Littorinimorpha: Rostellariidae)</p>
	
<p><i>Babylonia spirata</i> (Linnaeus, 1758) (Neogastropoda: Babyloniidae)</p>	<p><i>Turricula javana</i> (Linnaeus, 1767) (Neogastropoda: Clavatulidae)</p>
	
<p><i>Volegalea cochlidium</i> (Linnaeus, 1758) (Neogastropoda: Melongenidae)</p>	<p><i>Indothais blanfordi</i> (Melvill, 1893) (Neogastropoda: Muricidae)</p>
	
<p><i>Indothais lacera</i> (Born, 1778) (Neogastropoda: Muricidae)</p>	<p><i>Orania subnodulosa</i> (Melvill, 1893) (Neogastropoda: Muricidae)</p>

Marine gastropods of ICMBAs of Goa



*Purpura bufo* Lamarck, 1822  
(Neogastropoda: Muricidae)



*Semiricinula konkanensis* (Melvill, 1893)  
(Neogastropoda: Muricidae)



*Tenguella granulata* (Duclos, 1832)  
(Neogastropoda: Muricidae)



*Nassarius stolatus* (Gmelin, 1791)  
(Neogastropoda: Nassariidae)



*Oliva caerulea* (Röding, 1798)  
(Neogastropoda: Olividae)



*Euchelus asper* (Gmelin, 1791)  
(Seguenziida: Chilodontaidae)



*Peronia verruculata* (Cuvier, 1830)  
(Systellommatophora: Onchidiidae)

Marine gastropods of ICMBAs of Goa



*Clanculus scabrosus* (Philippi, 1850)  
(Trochida: Trochidae)

*Trochus radiatus* Gmelin, 1791  
(Trochida: Trochidae)

*Umbonium vestiarium* (Linnaeus, 1758)  
(Trochida: Trochidae)

*Turbo bruneus* (Röding, 1798)  
(Trochida: Turbinidae)

Polyplacophora of ICMBAs of Goa



*Acanthochitona mahensis* Winckworth, 1927  
(Chitonida: Acanthochitonidae)

Vertebrate fauna of the ICMBAs of Goa



## Mudskippers



Mudskipper



Mudskipper

## Sea turtles



Green turtle  
(*Chelonia mydas*)



Leatherback turtle  
(*Dermochelys coriacea*)

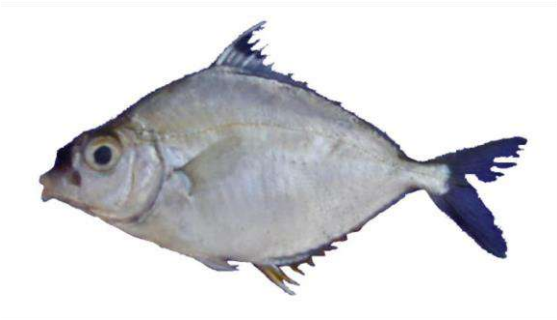


Olive ridley turtle  
(*Lepidochelys olivacea*)

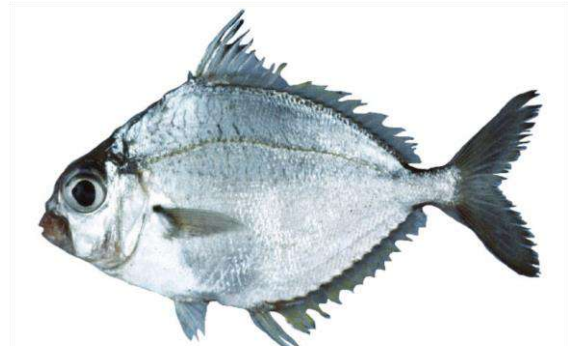


Hawksbill turtle  
(*Eretmochelys imbricata*)

Fishes of the ICMBAs of Goa



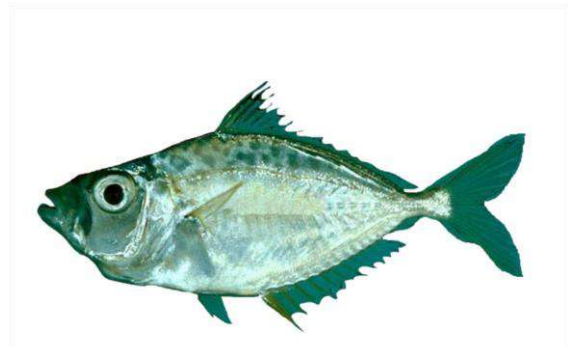
*Karalla daura* (Cuvier, 1829)



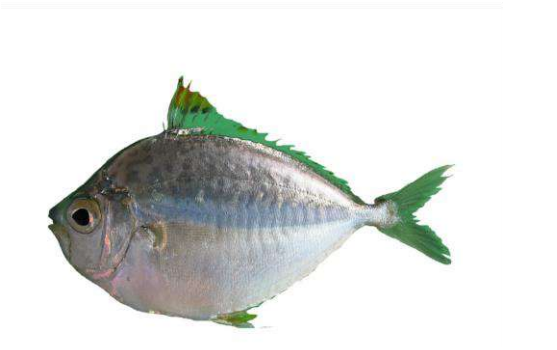
*Leiognathus splendense* (Cuvier,



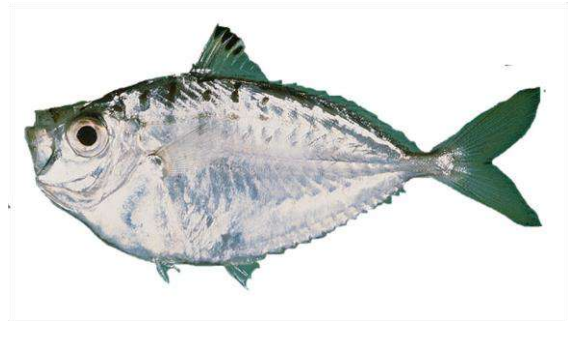
*Leiognathus equalla* (Forsk., 1775)



*Gazza minua* (Bloch, 1795)



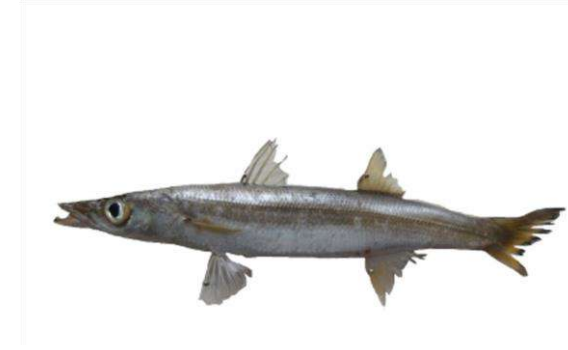
*Photopectoralis* sp



*Secuter insidiator* (Bloch, 1787)



66 *Scatophagus argus* Linnaeus, 1766



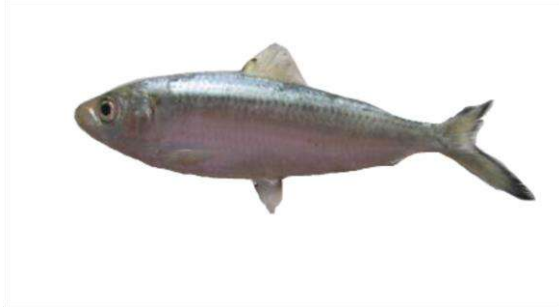
ZSI - GOA | *Sphyrna jello* Cuvier, 1829



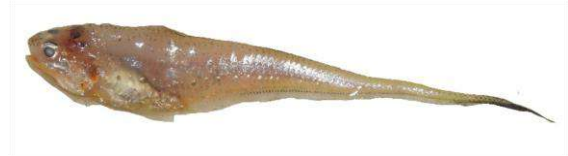
*Terapon puta* Cuvier, 1829



*Escualosa thoracata* (Valenciennes,



*Sardinella longiceps* Valenciennes, 1847



*Coilia dussumieri* Valenciennes, 1848



*Mugil cephalus* (Linnaeus 1758)



*Ambasis ambasis* (Laceped, 1802)



*Hemiramphus lutkei* Valenciennes,



*strongylura leiura* (Bleeker, 1850)





*Alepes djedaba* Fabricius, 1775)



*Caranx ignobilis* (Forsk., 1775)



*Caranx sexfasciatus* Quoy & Gaimard, 1825



*Megalapsis cordyla* Linnaeus, 1758



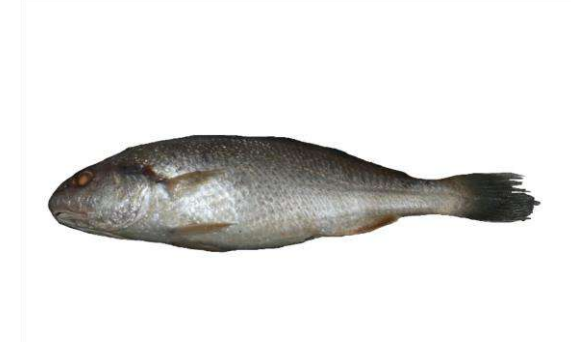
*Scomberoides commersonianus* Lacepede, 1801



*Scolopsis Vosmeri* (Bloch, 1792)



*Lutjanus argentimaculatus* (Forsk., 1775)



*Johnius dussumieri* (Cuvier, 1830)

## Birds of the ICMBAs of Goa



Indian Pond Heron



Reef heron



Common Redshank



Terek Sandpiper



Ruddy Turnstone



Whimbrel



A flock of Shorebirds at Morjim Beach



## Birds of the Important Coastal and Marine Biodiversity Areas of Goa



Lesser sand plover



Greater sand plover



Ruddy turnstone



Common ringed plover



Whimbrel



Common sandpiper



Curlew sandpiper



Terek sandpiper



## Birds of the Important Coastal and Marine Biodiversity Areas of Goa



Indian pond heron



Reef heron



White-bellied sea eagle



Black kite



Common kingfisher



White-browed wagtail



Indian pond heron



Purple heron





Bronze winged jacana



Intermediate egret



Lesser whistling duck



Grey-headed Swamphen



Darter



Little Cormorant



Brahminy kite



Malabar grey hornbill

## Coastal communities depending on ICMBAs of Goa



Fishermen at Galgibag Beach



Fishermen at Galgibag River



Local people collecting green mussels



Fisherman catching mud crabs from Zuari River



## Anthropogenic threats in ICMBAs of Goa



Unmanaged tourism on Palolem beach



Vehicular movement in Agonda beach



Feral or stray dogs in Galgibag beach



Sand mining at Siridao beach



Plastic pollution in Galgibag River



Infrastructure and sewage at Anjuna beach



Juvenile green turtle in Gangibag



Dead mangroves (*Avicennia marina*)

## Threats in ICMBAs of Goa



Anthropogenic activities



Reclamation of Mangroves



Plastic pollution



Developmental activities



## ICMBAwise faunal diversity and distribution

Detail of ICMBAwise faunal diversity and distribution is provided in the Annexure. However, a detailed diversity is also represented in Table 2.

Among the coastal and marine fauna documented and or reported from ICMBAs of Goa, the sponges belonging to 19 genera and 19 species. The sea anemones diversity reported to be 12 species in 10 genera. Similarly, there are at least four species of four genera. There are well documented marine nematodes from ICMBAs and 16 species belonging to 11 genera are known. The marine annelid worms having a diversity of 66 species belonging to 54 genera and 30 families. Among Arthropods, Copepods having eight species belonging to six genera recorded from ICMBAs of Goa. Equally, shrimps/snapping shrimps/Prawns reported from ICMBAs belonging to 18 species and nine genera. The intertidal and subtidal species of arthropods i.e. Hermit crabs/Mole crabs/Porcelain crabs/Squat lobsters having a distribution of 25 species belonging to 13 genera. The Brachyuran crabs having highest number in terms of crustacean diversity with 99 species belonging to 59 genera. Equally, Marine pillbugs, Mantis shrimps and Barnacles with two, three and six species reported from ICMBAs. Among the Molluscan diversity, Gastropods having 109 species and Bivalves with 85 species recorded along with one species of Chiton and 10 species of Cephalopods. Likewise, Starfish/Sea lilies/Sea urchins/Sea cucumbers/Brittle stars under the family Echinodermata having 15 species belonging to 14 genera reported from Goa as well as from the ICMBAs.

The largest among vertebrate diversity belonging to Pisces, recorded from ICMBAs of Goa with 228 species of estuarine and marine fishes, which also included Elasmobranchii/Teleostei. The reptile diversity in the coastal and marine environment and are sea snakes and sea turtles. A total of eight species of reptiles (four species of sea turtles and four species of sea snakes) have been reported from Goa and likely to occur in the ICMBAs. The mammal diversity documented to be 29 species in Goa with confirm presence of Smooth Coated Otter and others viz. Dolphins and Whales. There are atleast 16 species of mangroves recorded from ICMBAs of Goa. The number and diversity of fauna represent here could be conservative figures, since the numbers represented are based on time bound surveys and only through anecdotal publications and literature. Intensive and long-term surveys in these ICMBAs will fetch more species diversity for Goa as well as for these important coastal and marine biodiversity areas.

## **Discussion**

The level of threat to coastal and marine biodiversity is often linked with the physical, economical and technical resources available for biodiversity conservation, and so careful prioritization efforts are required. The major ecological threat to coastal and marine environment identified primarily due to degradation and habitat loss along with anthropogenic pressures. So far Goa state is concern, there are pristine beaches and coastal and marine habitats. However, because of human encroachment, deteriorating activities, unmanaged tourism and

other anthropogenic disturbances, the coastal habitats are under stress and thereby the species are getting threatened in their natural habitats.

Out of the three Important Coastal and Marine Biodiversity Areas of Goa, only one is part of the Protected Areas i.e. Salim Ali Bird Sanctuary. However, other areas are openly accessible, although the Forest and Wildlife Department has some restrictions on the beach, for the purpose of sea turtle nesting. An array of information through secondary sources as well as ground truthing data collected by the ZSI survey team reveal that all the three ICMBAs have significantly important in terms of biodiversity due to presence of either threatened species in the area, strategic location from conservation point of view due to biodiversity uniqueness. Nevertheless, the land ownerships may be a primary issue while considering these sites under any kind of protection by the state government. In view of this, under the recent resigm of Wildlife (Protection) Act, 1972, there should be provisions for considering these three sites as Community Reserve or Conservation Reserve (Refer Table 3). Such effort indeed will increase of total Protected Area coverage of the country, especially in the coastal and marine ecosystems. This will also promote intensive research opportunities targeting different habitats and species along with promotion of income generating opportunities for local communities and agencies from ecotourism and related activities. Unlike other Protected Area framework and policy for the county, Important Coastal and Marine Biodiversity Area (ICMBAs) of Goa should not be done on the same way as there are multi stakeholders on the resources.

No conservation effort has seen success without the involvement of local community and or stakeholders depending on the resources. Therefore, confidence of local community should be taken while initiating conservation and protection measures for the Community Reserves/Conservation Reserves. If, the perception and willingness of the resource users were not been taken into consideration as these are vital for any typical conservation planning, any effort will be futile and not sustainable in achieving long term goal. It is also equally important to creat alternate livelihood options for community those depending on the coastal and marine resources for their sustainance in the ICMBAs. Scientific invervention is similarly necessary for any conservation planning such as hatchery management for sea turtles by the Forest Department, Mangrove plantations, Dolphin watch and Whale watch programmes etc. Tourism management should be aimed at high value, low volumes and least impact based.



**Table 2. Diversity and distribution of fauna in ICMBAs of Goa**

Group Name	Phylum	Class	Order	Number of families	Number of Genera	Number of Species			
				ICMBAs	ICMBAs	ICMBAs	Morjim-Anjuna	Zuari-Mandovi	Galgibag
Sponges	Porifera	Demospongiae	8	14	14	19		19	
Sea anemones	Cnidaria	Hexacorallia	Actiniaria	8	10	12			
Stony corals	Cnidaria	Hexacorallia	Scleractinia	2	4	4			
Siphonophores	Cnidaria	Hydrozoa	Siphonophorae	3	8	8			
Nematodes	Nematoda	2	5	9	11	16			
Marine annelid worms	Annelida	Polychaeta	5	30	54	66		38	
Copepods	Arthropoda	Copepoda	Calanoida	6	6	8		8	
Shrimps/Snapping shrimps/Prawns	Arthropoda	Malacostraca	Decapoda	4	9	18		2	
Hermit crabs/Mole crabs/Porcelain crabs/Squat lobsters	Arthropoda	Malacostraca	Decapoda	5	13	25	4	13	
Brachyuran crabs	Arthropoda	Malacostraca	Decapoda	27	59	99	15	46	24
Marine pillbugs	Arthropoda	Malacostraca	Isopoda	1	1	2			
Mantis shrimps	Arthropoda	Malacostraca	Stomatopoda	2	3	3			
Barnacles	Arthropoda	Thecostraca	2	3	5	6	3	2	2

Bivalves	Mollusca	Bivalvia	9	19	56	85	14	16	30
Gastropods	Mollusca	Gastropoda	8	36	75	109	27	33	30
Chitons	Mollusca	Polyplacophora	1	1	1	1			1
Squids/Octopuses/Cuttlefish	Mollusca	Cephalopoda	3	3	6	10			
Starfish/Sea lilies/Sea urchins/Sea cucumbers/Brittle stars	Echinodermata	5	11	12	14	15			1
Marine fishes	Chordata	Elasmobranchii/Teleostei	31	73	138	228		21	
Birds	Chordata	Aves	18	43	107	170			
Reptiles	Chordata	Reptilia	2	5	8	8			
Mammals	Chordata	Mammalia	Artiodactyla	6	19	29			
			<b>TOTAL =</b>	<b>312</b>	<b>621</b>	<b>941</b>	<b>63</b>	<b>198</b>	<b>88</b>
Mangroves					<b>15</b>	<b>16</b>			

**Table 3. ICMBAs of Goa – Suggestions of Conservation and Management**

ICMBAs	Potential habitats and association														Suggestions of Conservation and Management
	Beach	Sand dune	Mudflat	Rocky shoreline	Lake	Estuary/Creek	Mangroves	Seagrass	Corals	Backwater	Salt pans	Islets	Marine area	Offshore waters	
Morjim-Anjuna	P	P	P	P		P	P			P				P	Cons. / Comm. Reserve
Zuari-Mandovi estuarine complex	P	P	P	P		P	P			P					Cons. / Comm. Reserve
Galgibagh	P	P	P	P		P	P			P					Cons. / Comm. Reserve

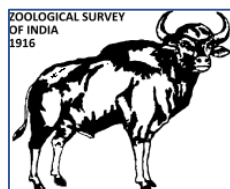
## Conclusion

The survey carried out from September 2022 to March 2023 in all the three Important Coastal and Marine Biodiversity Areas (ICMBAs) of Goa and documented coastal and marine faunal diversity along with other fauna of conservation importance including their collections of from the area, revealed vital information pertaining to coastal and marine biodiversity conservation of Goa. A total of 941 species of coastal and marine fauna and 16 species of mangroves have been reported/recorded through this study. Among the ICMBAs, Mandvi-Juary estuarine complex found to have more numbers in terms of species diversity, while Galgibag observed to be important for turtle nesting and mangroves. This is first of its kind of documentation and serves as baseline information on faunal accounts for Managers and Policy Makers while proposing for any kind of development within and outside the periphery of the ICMBAs of Goa. The faunal documentation from these three ICMBAs of Goa indicate the potential for bringing some of them under the umbrella of Protected Area Network of Government of India through legislation, in the form of Conservation Reserve or Community Reserves, which are still outside the preview of PA Network.



## Selected Readings

- BALASUBRAMANIAN, T. AND AJMAL KHAN, S. (EDS). 2002. Mangroves of India State of the art report. ENVIS Publication Series 2: 146pp.
- JAGTAP, T.G. AND SINGH, C. 2004. Mangroves – nursery for fishes. In: Untawale, A.G. (Ed) Know our shore: Goa. WWF for Nature – India, 47-56p.
- NAGI, H.M.H. 2008. Environmental studies on mangrove cover changes in Goa and its resident *Crossostrea* population. Ph.D. Thesis, Goa University, 70pp.
- RAGUNATHAN C, REGHURAMAN R, CHOWDHURY S. 2019. Coastal and marine biodiversity of india. Challenges for conservation. Coastal management- global challenges and innovation. Academic Press, p. 201-250.
- RODGERS, W.A., PANWAR, H.S. & MATHUR, V.B. 2000. Wildlife Protected Area Network in India: A Review. Wildlife Institute of India, Dehradun, 44 pp.
- SARAVANAN KR, SIVAKUMAR K, CHOUDHURY BC. 2013. Important coastal and marine biodiversity areas of India. Sivakumar K, editor. Coastal and marine projected areas in India: Challenges and way forward, ENVIS bulletin; Wildlife and Protected areas 2013; 15:134-88.
- SINGH, H.S. 2003. Marine protected areas in India. Indian Journal of Marine Sciences 32: 226-233.
- USMANI, ZAID & AHMAD ANSARI. 2000. Status of Coastal Marine Biodiversity of Goa and Challenges for Sustainable Management - An Overview. Journal of Ecophysiology and Occupational Health, 222–231.
- VENKATARAMAN, K. & WAFAR, M. 2005. Coastal and marine biodiversity of India. *Indian Journal of Marine Sciences*, 34: 57- 75.



## **ZOOLOGICAL SURVEY OF INDIA**

**MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE,  
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