



Technical Bulletin No. 49

# Catch Trends in Major Marine Fisheries Resources of Goa



**Sreekanth G. B.**

**Manju Lekshmi N.**

**Narendra Pratap Singh**



**ICAR-ICAR RESEARCH COMPLEX FOR GOA**  
(INDIAN COUNCIL OF AGRICULTURAL RESEARCH)

ELA, OLD GOA -403402, GOA, INDIA

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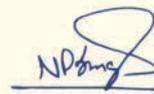
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# FOREWORD

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Fish assumes greater significance to the people of Goa and it forms an integral part of Govan life and culture as it forms the cheapest source for protein for more than 90% per cent of population. Goa is the state with a coast line of 104 km with numerous bays and headlands. The fisheries sector contributes to about 2.5% of the total GDP (third position after West Bengal and A.P.) and 17.1% of the agricultural GDP of Goa. Moreover, Goa contributes to about 1.85% of the total marine fish landings of our country. Marine fisheries provides livelihood to a large number of people in Goa with more than 5% of total working population is engaged in fishing and allied activities. Moreover, fisheries industry including fishing, marketing and processing forms the second largest industry both in terms of employment and income. The state holds a huge scope for fisheries development, particularly through brackish water and marine fish production. The validations of Potential Fishing Zone advisories show that there is huge scope for the precision fishing based on satellite based chlorophyll and sea surface temperature data. The ecosystem based fishery management is the best choice for replenishment of the degraded demersal ecosystem as well as fishery resources. In this line, the artificial fish habitats in near shore waters can augment the fish biodiversity and fishery. These structures will help to establish an ecosystem, breeding grounds and spawning grounds for aquatic flora and fauna. Apart from these, participatory approach in fishery regulations by employing co-management will also help in maintaining the sustainability of marine fisheries in the state. The State along with large number of calm bays and lagoons offer good scope to develop mariculture/sea farming. Presently, coastal farming is confined to green mussels as well recently initiated finfish cage culture of cobia and seabass in coastal areas. There is a need for improvisation, intensification and dissemination of the technology to the beneficiaries.

The present technical report on the catch trends in major marine fisheries resources of Goa will definitely serve as a guide to policy makers, developmental agencies, scientific organisations, researchers and students. I compliment the authors for the excellent work carried out and for consolidating the information into a brief technical report. I am sure that this will illuminate the fishery researchers to conduct strategic research initiatives on marine fisheries resources.



**Narendra Pratap Singh**  
*Director*



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# An Introduction into Fisheries Sector of Goa

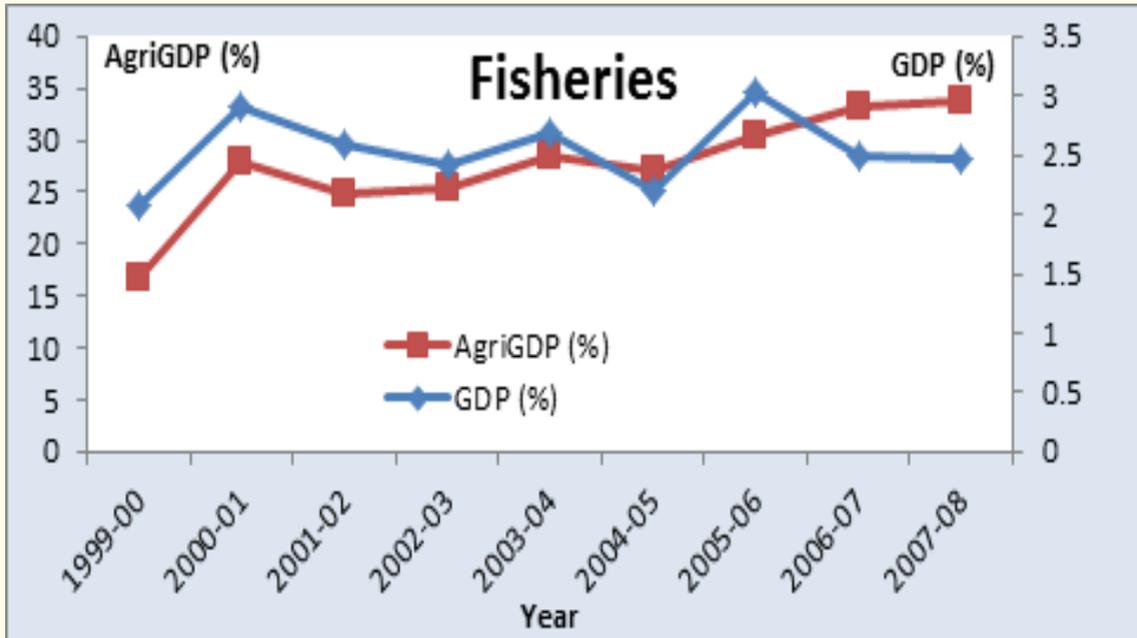
In India, contribution of marine fisheries to the Indian economy is very significant which is shown by the huge employment opportunities that it creates in primary, secondary and tertiary sectors, foreign exchange and meeting the food security. The Indian fisheries industry contributes to about 1-1.4% of the total GDP. The value of the marine fish landings at the point of first sale- 29, 372 crores and 46,710 crores at the point of last sales (CMFRI, 2014). Price of a product is definitely depends on it demand. Both supply and demand together decides the marketability.

Fishing is the activity of trying to catch fish and other aquatic animals such as gastropods, bivalves, cephalopods, crustaceans and echinoderms. Fish assumes greater significance to the people of Goa and it forms an integral part of Goan life and culture as it forms one of the most important items of

the food of more than 90% percent of population. Goa is the state with a coast line of 104 kms (1.28% of Indian coast line of 8117 km) with numerous bays and headlands. The continental shelf area of Goa extends to about 10,000 km<sup>2</sup> of about 100 fathoms depths.

The fisheries sector contributes to about 2.5% of the total GDP of the state (third position after West Bengal and A.P.) and 17.1% of the agricultural GDP of the State (Fig. 1). Thus fishing industry of Goa plays a vital role in socio-economic development of Goa by contributing substantially towards Net State Domestic Product through Export and Domestic trade annually.

In India fish eating population is about 56% of total population (Planning Commission, Govt. of India); Per capita fish consumption is about 8.49 kg. Goa contributes to about 1.85% of the total marine fish landings of our country (CMFRI, 2013)



**Figure 1. Contribution of fisheries sector to total as well as agricultural GDP**

The contribution of fisheries sector to the total GDP of Goa is found to be 2.46% and there is a decline in the contribution of the fisheries sector to the GDP. On the other hand, the fisheries sector has improved its contribution to the agricultural GDP in the last decade from 16.85% in 1999-2000 to 33.91% in 2007-08. Thus the fisheries sector plays a significant role in the agricultural sector of the state.

Marine fishery sector provides livelihood to a large number of people in Goa. Altogether more than 5% of the total working population is engaged in fishing and allied activities. Moreover, Fisheries industry forms the second largest industry both in terms of

employment and income. Besides the actual process of fishing, a number of ancillary and subsidiary activities like marketing, processing and small scale vending will also create livelihood for a number of people. The fishing in Goan waters occurs mainly from September to March which is the post monsoon and pre summer periods. The monsoon season extends from June to August is not favourable for fishing activities because of the rough weather conditions prevailing in the sea. The fish is in great demand in the whole state especially the marine fish, which forms 97% of the total fish production in Goa. In lean seasons, the fish is imported from neighbouring states.



## Marine Fisheries sector of Goa

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Goa holds a huge scope in the fisheries development, particularly through brackish water and marine production. Marine fishing is the major activity which is carried out for a period of about nine months in a year. The marine fishing season starts from the mid of August till the end of May. The monsoon trawl ban which is the temporal fishery regulation is from June to Middle of August in Goa. Fisherman prepares themselves for the fishing season during this closure period by mending their nets, maintenance of the fishing vessels, boats and preparing new nets.

The total fishermen population in Goa is about 10545 (Marine Fisheries Census of CMFRI, 2010) of which South Goa and North Goa contributes about 64% and 36% respectively. The total number of fishermen families in Goa is calculated to be 2189 with 1388 families are in South Goa and 801 families are in North

Goa. The artisanal fishermen families are 2147 in number and South and North Goa have 1363 and 784 families respectively. The sex ratio (Number of females/1000 males) of fishermen in Goa is found to be 925 and the same in South and North Goa was found to be 930 and 916 respectively. The active fisher folks in Goa were estimated to be 2370 with South and North Goa contributing 1595 and 775 respectively. There was not a single person associated with the fish seed collection. There were about 1481 engaged in fish marketing with 953 and 528 from South and North Goa respectively. The women have shown their dominance in fish marketing with a total of 1427 which is 96% of the total fishermen engaged in the activity. The fisherwomen engaged in fish marketing from South and North Goa was 924 and 503 respectively. The number of categorized fishing crafts in the fishery is given in table. The trend in the fishery

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shows that, there is a continuous increase in the number of mechanized trawlers, canoes and non-mechanized crafts from 1960's to 2010.

The pelagic fisheries potential of EEZ (Exclusive Economic Zone) of Goa is about 69000 tonnes for the inshore area and 8000 tonnes for the oceanic area (Parulekar, 1989). The sustainable pelagic yield is projected as 46,560 tons per annum. Similarly, the potential demersal resources of EEZ are estimated to be 1, 12, 600 tonnes with a sustainable yield of 67,500 tonnes per year (Mohanta and Subramanian, 2001). Therefore, the total sustainable yield for both pelagic and demersal fisheries of Goa is projected to be 1, 14, 060 tonnes annually. The marine fish catch of Goa was 20,000 tonnes in 1960's which was mainly coming from traditional country crafts and some motorized boats. There were no mechanized vessels available during that period. Further, the marine fish production began to rise from 20,000 tonnes in 1960's to 40,000 in 1970's. This might have been attributed to the entry of shrimp trawlers as well as liners in to the fishery. Following

the pace, the production has reached about 54,000 tonnes during 1990's and which further advanced to 97,000 tonnes in 1997-98. The introduction of more (about 1000) mechanized boats in to the fishery has improved the production during this period. The growth in fisheries has faced a setback during 1999-2000 as the marine fishery yielded only 60,000 tonnes during the same period. It is assumed that the setback might have been attributed to the long dry spells and pollution. The fishery has reached its maximum yield during the year 2005-06 in which, it touched the 1 lakh mark in fishery output.

The major marine fish landing centres of Goa include Malim and Chapora from North Goa and Vasco, Cutbona, Talpona and Betul from South Goa. The medium marine fish landing centres in Goa includes Siridao, Siolim, Morjim and Arambol from North Goa and Cansaulim, Colva, Baina, Cortalim, Velsao, Agonda, Benaullim and Palolem from South Goa. The geographical position of the major and medium landing centres are displayed in Map 1 and Map 2.

**Map 1. The major and medium landing centres of North Goa**



**Map 2. The major and medium landing centres of South Goa**





## Trends in overall marine fishery growth

The trends in the marine fish catch along Goa clearly show that the total production has followed the trend of pelagic fish production. The trend in fish production of Goa can be divided into 3 clear phases namely 1) 1985-1995 2) 1996-2001 3) 2002-2012 (Fig. 2). The average catch and percentage contribution of different groups of resources during the three phases has shown in table 1-2.

### First phase

The first phase from 1985-1995 is characterized by the 'M' shape trend with two significant ups and downs in the fishery which terminated towards the lower side at the end of the phase. The average pelagic and crustacean catch was found to be high in comparison with others in the first phase. Their proportion in the total catch was also significant in this phase.

### Second phase

The second phase from 1996-2001 is characterized by the significant decline in pelagic and crustacean resource catch which trimmed the average total catch from 75773 t in first phase to 52154 t in the second phase (Fig. 3). Molluscan resource has shown a marked increase from an average catch of 1330 t in the first phase to 2193 t in the second phase which has also reflected in their percentage contribution.

### Third phase

The third phase has really shown signs of improvement in the fishery triggered by the hike in pelagic fish production. The average contribution of pelagic group in this phase has risen to 79.2% in comparison with 66.6% in the second phase. The average pelagic catch was doubled in this phase in comparison with the previous phase. Crustacean

and molluscan resources followed a continuous decline in this phase while the average demersal catch increased to 11717 t from 8345 t in the second phase. The revival of the fishery was only due to the increase in pelagic catch which may be attributed to the full-fledged operation of

purse-seiners along the Goan coast. The purse seines contributed to 82% of the total catch in Goa during 2012. Though the demersal fishery resources have shown a high average catch in the third phase, the quality and quantity of the catch were decreasing in the recent past.

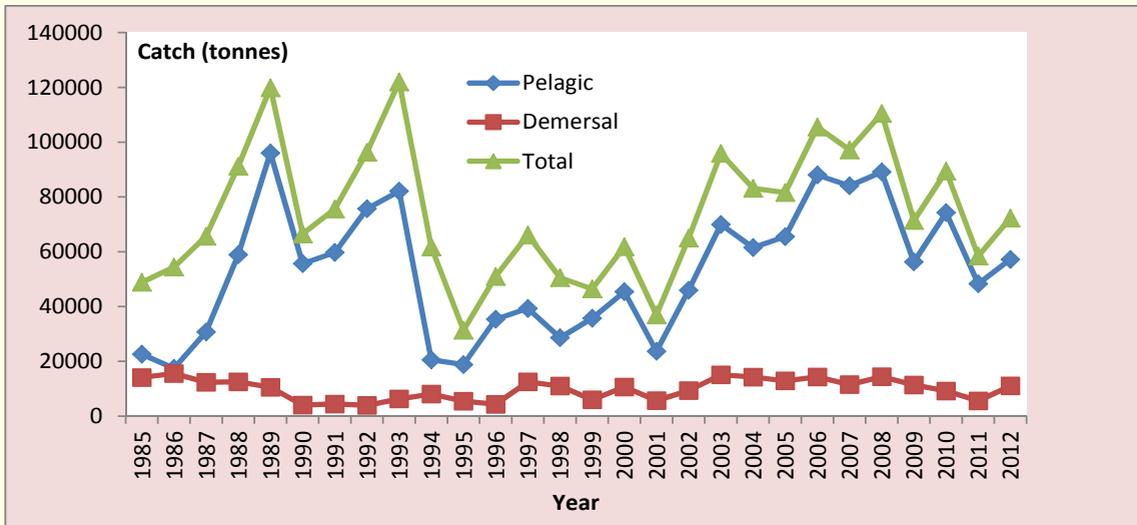


Figure 2. The comparison of trend in Pelagic, demersal and total fish production in Goa



Figure 3. Average fish catch during the three phases along Goa

**Table 1. Resource wise Average fish catch (t) in Goa during the three phases.**

<b>Phase</b>	<b>Pelagic</b>	<b>Demersal</b>	<b>Crustacean</b>	<b>Mollusc</b>
1 (1985-1995)	48937	8834	16672	1330
2 (1996-2001)	34673	8345	6943	2193
3 (2002-2012)	67291	11717	4774	800

**Table 2. Resource wise average percentage contribution to the total catch in Goa during the three phases.**

<b>Phase</b>	<b>Pelagic</b>	<b>Demersal</b>	<b>Crustacean</b>	<b>Mollusc</b>
1 (1985-1995)	61.07	13.66	23.61	1.65
2 (1996-2001)	66.61	15.75	13.18	4.46
3 (2002-2012)	79.28	13.85	5.89	0.97



## 4 Chapter

# Catch trends in the major marine fishery resources

The major marine fisheries resources of Goa includes Indian oil sardine, Indian mackerel, cat fish, Sharks, seer fish, shrimps, pomfrets, cephalopods (cuttle fish and squid), tuna, ribbon fish, reef cod, white sardine, silver bellies, flat fish, Silver bar, crabs, croakers and butter fish. However, the key resources which dominate the marine fishery of Goa are Indian oil sardine, *Sardinella longiceps* and Indian mackerel, *Rastrelliger*

kanagurta.

They contribute about 48% of the total marine fishery of Goa. Indian oil sardine contributes to about 33.6% of the total marine fisheries resource landings in Goa (mean value during 2001-2012) and Indian mackerel contributes about 15.7% of the total marine fisheries resource landings in Goa. The average contribution of the major marine fishery resources in Goa are given in table 3.

**Table 3. The species/group wise contribution of major marine fisheries resources of Goa during 2001-2012.**

Species/group (local name)	Percentage contribution		
Indian oil Sardine (Tarlo)	33.58	Flat fish (Lepo)	2.31
Indian Mackerel (Bangdo)	15.75	Cat fish (Sangot)	1.99
Shrimps (Sungtam)	8.32	Cuttle fish (Manki)	1.31
Seer fish (Wiswan)	4.05	Sharks (Mori)	1.72
Ribbon fish (Balle)	3.08	Tuna (Bokdo)	1.57
Silver bellies (Kampi)	2.88	Crabs (Kurlio)	1.11
Croakers (Dodiario)	2.75		

*Source: Directorate of Fisheries, Govt. of Goa (2009-13).*

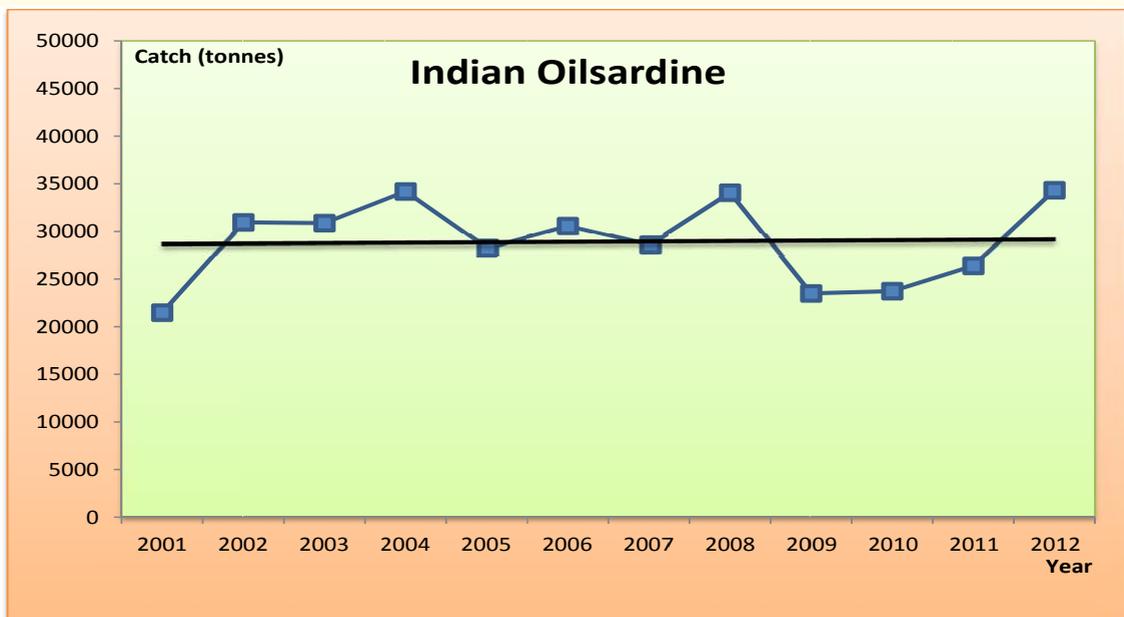
## 1) Indian oil sardine, *Sardinella longiceps*

**Local name: Tarlo**

**Resource type: Pelagic**



Indian oil sardine is the largest single species fishery in India as well as in Goa. The total landings of the Indian oil sardine along Indian coast amounts to 7 lakh tonnes/ annum (CMFRI, 2013). The species contributes to about 33.6% of the total marine fishery resource landings in Goa. The average annual catch of Indian oil sardine along Goa during 2001-2012 was 28, 907 tonnes. This species has a major role in the protein supply and income generation to the artisanal fishermen who operate in the inshore waters of Goa.



Source: Directorate of Fisheries, Govt. of Goa (2012-13)

**Figure 4. Catch trend for Indian oil Sardine during 2001-2012 along Goa coast**

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The catch trend in Indian oil sardine along Goa coast shows a declining trend in the last decade. However, a maximum catch of 34329 tonnes was observed in 2012 after a decline in during 2009-10. The oil sardine has increased from 21470 tonnes in 2001 to 34203 tonnes in 2004. The period from 2001-2004 was showing a yearly increase in the catch. The period from 2005-2010 was showing a declining trend in the catch except a local maximum in 2008. The minimum catch of 21470 tonnes was observed in 2001 during this period. The resource is mainly landed by purse seine, ring seine, gill net, beach and boat seines. Though the resource is showing a declining trend in its landings, the resource has immensely contributed the livelihood of the traditional and motorised fishermen.

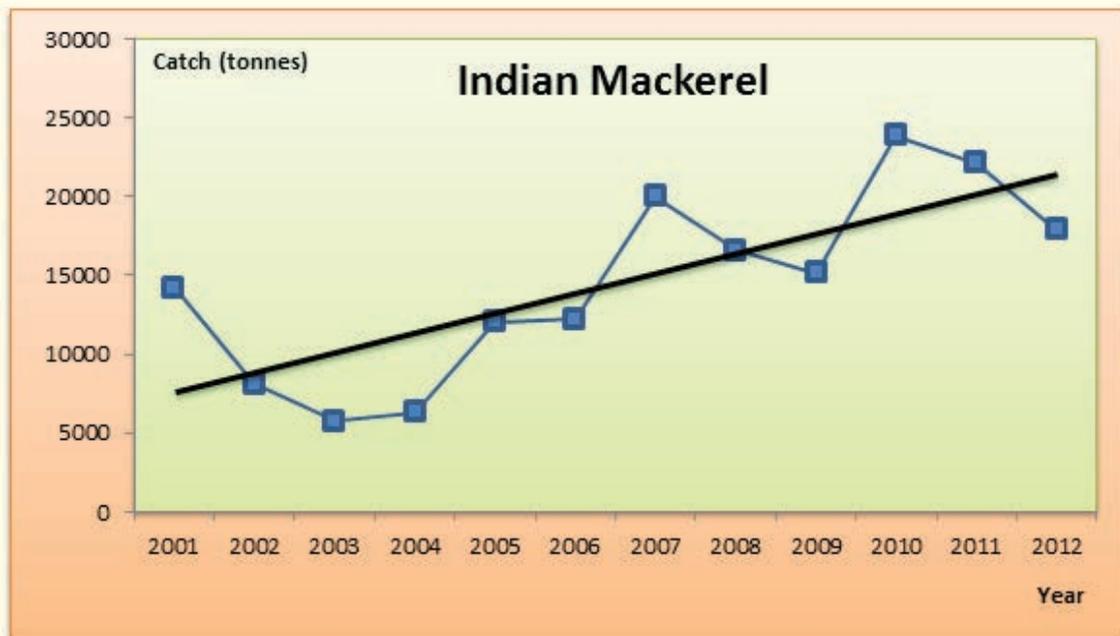
## 2) **Indian mackerel, *Rastrelliger kanagurta***

**Local name: Bangdo**

**Resource type: Pelagic**

Indian mackerel is the second largest single species fishery in India as well as in Goa. The total landings of the Indian mackerel along Indian coast amounts to 2 lakh tonnes/ annum (CMFRI, 2013). The species contributes to about 15.75% of the total marine fishery resource landings in Goa. The average annual catch of Indian mackerel along Goa during 2001-2012 was 14,517 tonnes. This species has also a major role in the protein supply and income generation to the artisanal fishermen who operate in the inshore waters of Goa. Moreover, this species is the most preferred fish by rich, medium and poor classes of the people in Goa.





*Source: Directorate of Fisheries, Govt. of Goa (2012-13)*

**Figure 5. Catch trend for Indian mackerel during 2001-2012 along Goa coast**

The catch trend of Indian mackerel along Goa coast shows an increasing trend in the last decade. A maximum catch of 23831 tonnes was observed in 2010 and a minimum catch of 5779 tonnes was observed in 2003. The catch has decreased initially from 14,204 tonnes in 2001 to 6303 tonnes in 2004 and further increased to 19980 tonnes in 2007. Further the catch has declined from 2007 to 2009 followed by steep increase in 2010. The resource was showing the expected trend that the flat declining trend of oil sardine is parallel to the increasing trend in mackerel catch along Goa during 2001. The resource is mainly landed by purse seine, ring seine, gill net, beach and boat seines. Nowadays trawlers especially the mid water trawlers bring good catches of big sized mackerel in their operations. The management of this resource is necessary as this contributes to the nutritional security with regard to good quality protein of the majority of the population in Goa.

### 3) Shrimps

**Local name: Sungtam/jinga**

**Resource type: Crustaceans**

Shrimps are one of the major resources which have got immense demand in the domestic as well as foreign markets. This fetches very high unit price of about 3-4 US\$ in the foreign markets. The dominant species of shrimps landed in Goa includes Black tiger shrimp, *Penaeus monodon*; Indian white shrimp, *Fenneropenaeus indicus*; Flower tail prawn, *Metapenaeus dobsonii*; *Metapenaeus monoceros* and *Solenocera hextii* etc. The unit value/kg will also depend upon the size grade of the shrimp landed and species. The major chunk of the catch is utilised as fresh, dried and transported to interior and distant markets. The shrimp is exported to foreign market basically in the form of frozen shrimps. The total landings of the shrimps along Indian coast amounts to 3-4 lakh tonnes/ annum (CMFRI, 2013). The group contributes to about 8.32% of the total marine fishery resource landings in Goa. The average annual catch of shrimps in Goa during 2001-2012 was 7327 tonnes. This is a major commercial fishery resource for India as well as Goa which holds a specific demand in the foreign markets.



*Fenneropenaeus indicus*



*Penaeus monodon*



*Metapenaeus dobsonii*



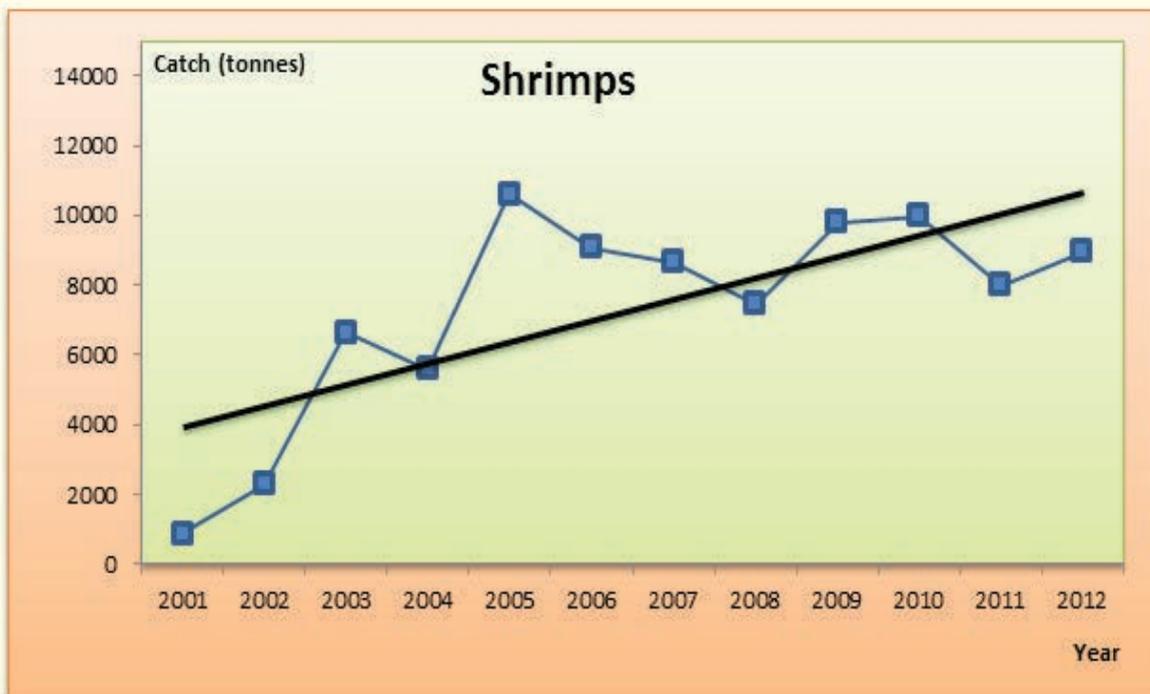
*Metapenaeus monoceros*



*Fenneropenaeus merguensis*



*Marsupenaeus japonicus*



Source: Directorate of Fisheries, Govt. of Goa (2012-13)

**Figure 6. Catch trend for shrimps during 2001-2012 along Goa coast**

The shrimp resources have shown a positive increasing trend in the last decade. Though there were isolated fluctuations in the resource landings, overall increasing trend was observed from 2001-2012. The maximum and minimum catch during the period was 10599 tonnes in 2005 and 874 tonnes in 2001. This also indicates there is a scope for improvement in the fishery along Goa coast.

#### 4) Seer fish

**Local name: Viswan**  
**Resource type: Pelagic**

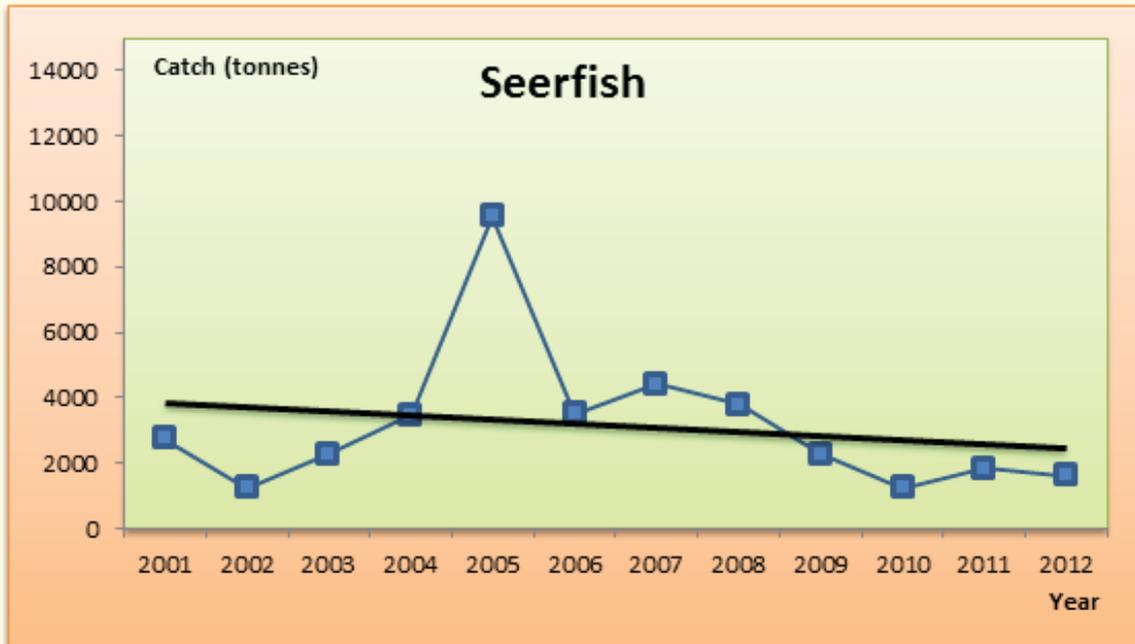
Seerfishes are one of the major commercial resources which have got immense demand in the domestic market for fresh consumption. The flesh is of very good quality protein and it is delicacy along the Indian coast. This fetches high average unit price of about Rs. 250/kg at the landing point and Rs. 500-600/kg at the point of last sales. The major species of seer fishes landed along Goa are the King seer, *Scomberomorus commerson* and the spotted seer, *Scomberomorus guttatus*. The major chunk of the catch is utilised as fresh and iced for transport to distant places. This fish is handled hygienically at each point of marketing and distribution because of the economic value. The total landings of the seer fish along the Indian coast is about 0.5 -0.6 lakh tonnes/ annum (CMFRI, 2013). The group contributes to about 4.05% of the total marine fishery resource landings in Goa. The average annual catch of seer fish along Goa during 2001-2012 was 3164 tonnes. This is a major commercial fishery resource for India as well as Goa which holds a huge demand in domestic market.



*Scomberomorus commerson*



*Scomberomorus guttatus*



*Source: Directorate of Fisheries, Govt. of Goa (2012-13)*

**Figure 7. Catch trend for seerfish during 2001-2012 along Goa coast**

The seer fishes have shown a fluctuating catch trend in the last decade. The catch was gradually declining from 9556 tonnes in 2005 to 1616 tonnes in 2012. The maximum and minimum catch during the period was 9556 tonnes in 2005 and 1229 tonnes in 2010. The decline in landings for the fishery should be a subject of concern as the management advisories are necessary for the fishery. This fish is landed mainly by the gill nets and hook and lines. Some quantity is also landed by the trawlers and most of them are juveniles. This may be also a reason for the decline in the landings of the group. So proper stock assessment and management advisories are required for sustainable exploitation of this resource.

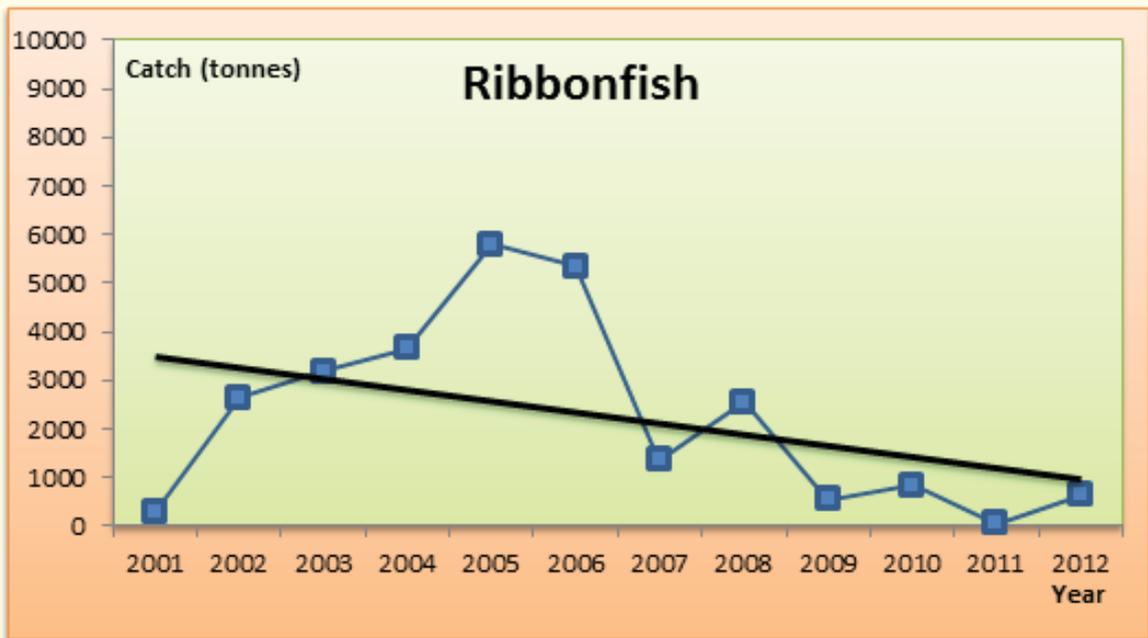
**5) Ribbon fish**  
**Local name: Balle**  
**Resource type: Pelagic**

Ribbon fishes are one of the major fisheries resources which is utilised for fresh, dried and frozen consumption. The frozen ribbon fishes are exported to South East Asian countries where there exists a good demand. The major species of ribbon fishes landed along Goa are the large head hairtail, *Trichiurus lepturus* and the savala hairtail, *Lepturacanthus savala*. The total landings of the ribbon fish along the Indian coast amounts to 2.3-2.4 lakh tonnes/ annum (CMFRI, 2013). The group contributes to about 3.08% of the total marine fishery resource landings in Goa. The average annual catch of ribbon fishes along Goa during 2001-2012 was 2243 tonnes.



**Savala hairtail, *Lepturacanthus savala***





*Source: Directorate of Fisheries, Govt. of Goa (2012-13)*

**Figure 8. Catch trend for ribbon fish during 2001-2012 along Goa coast**

The catch trend in ribbon fish shows a dome shaped curve during the last decade. The catch shows an increase from 291 tonnes in 2001 to 5791 tonnes in 2005. The maximum and minimum catch during the period was 5791 tonnes in 2005 and 49 tonnes in 2011. The decline in landings for the fishery started from 5791 tonnes in 2005 to 49 tonnes in 2011. This fish is landed mainly as a by catch of multiday shrimp trawlers. The catch mainly constitutes juvenile and sub-adult stocks. This may be also a reason for the decline in the landings of the group in the second phase of the decade. So proper stock assessment and management advisories are required for this resource.

## 6) Silver bellies

**Local name: Kampi**

**Resource type: Demersal**

Silver bellies are another important demersal resource which forms the cheap protein source for the common people and the poor. This is utilised for fresh and dried consumption. The dried and dry salted fish is being transported to local interior markets. The major species of silver bellies landed along Goa are *Leiognathus splendens*, *L. dussumieri*, *L. equulus*, *L. bindus*, *Gazza minuta* and *Secutor insidiator*. The total landings of the silver bellies along Indian coast amounts to 0.8-1.2 lakh tonnes/ annum (CMFRI, 2013). The group contributes to about 2.88% of the total marine fishery resource landings in Goa. The average annual catch of silver bellies along Goa during 2001-2012 was 2223 tonnes.



*Leiognathus brevirostris*



*Leiognathus blochii*



*Leiognathus splendens*



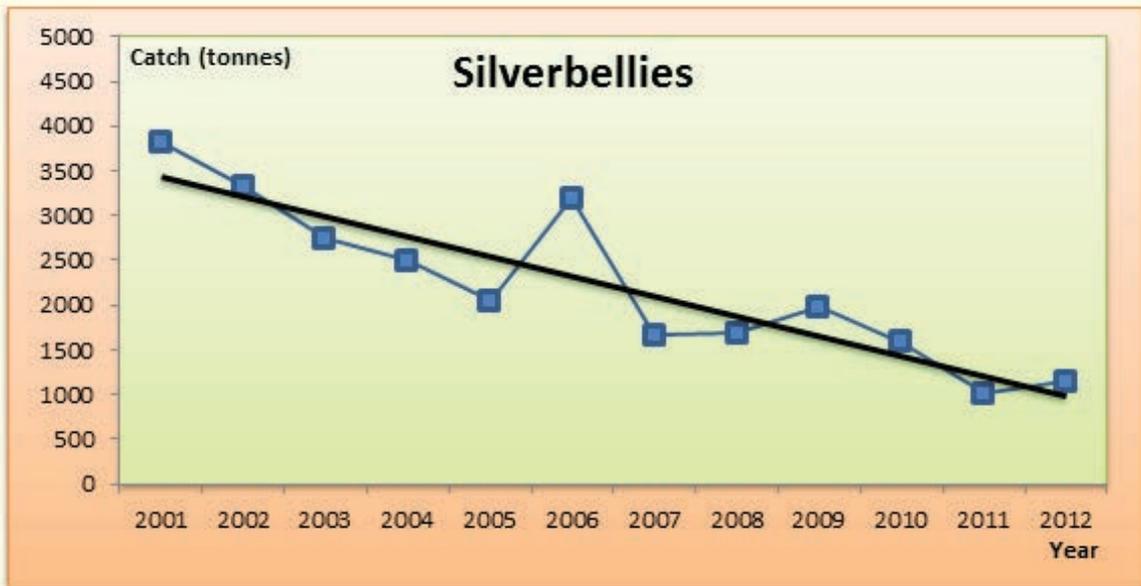
*Leiognathus daura*



*Leiognathus bindus*



*Secutor insidiator*



Source: Directorate of Fisheries, Govt. of Goa (2012-13)

**Figure 9. Catch trend for silver bellies during 2001-2012 along Goa coast**

The catch trend in silver bellies has shown a declining trend during the last decade. The catch was decreasing from 3818 tonnes in 2001 to 1584 tonnes in 2010. The maximum and minimum catch during the period was 3818 tonnes in 2001 and 1012 tonnes in 2011. This resource is generally landed as a by catch of multiday shrimp trawlers. The catch mainly constitutes brooders, juveniles and sub-adult stocks. This may be also a reason for the decline in the landings of the group in the second phase of the decade. So proper stock assessment and management advisories are required for this resource.

## 7) Croakers

**Local name: Dodiario**

**Resource type: Demersal**

Croakers under the family Sciaenidae are important demersal fish resource which forms the cheap protein source for the common people and the poor. This is utilised for fresh and dried consumption. The swim bladder of the fish is dried and used as fish mows for making is in glass in refining the liquor. The dried and dry salted fish is being transported to local interior markets. The major species of croakers landed along Goa are the *Johnius dussumieri*, *J. macrorhynus*, *Johnieops borneensis*, *Johnieops belangerii*, *Otolithoides biaurites*, *Otolithes cuvieri*, *O. ruber*. *O. argenteus* and *Protonibea diacanthus* etc. The total landings of the croakers along Indian coast amounts to 1.6-2 lakh tonnes/annum (CMFRI, 2013). The group contributes to about 2.75% of the total marine fishery resource landings in Goa. The average annual catch of croakers along Goa during 2001-2012 was 2209 tonnes.



*Johnieops belangerii*



*Johnieops borneensis*



*Johnius dussumieri*



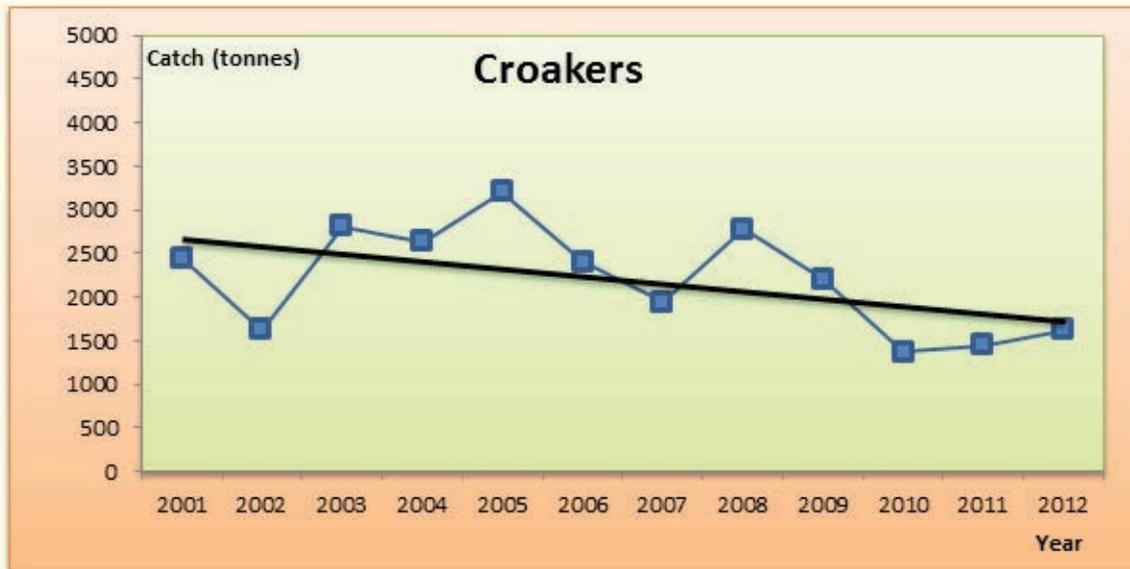
*Johnius macrorhynus*



*Otolithes argenteus*



*Otolithes ruber*



*Source: Directorate of Fisheries, Govt. of Goa (2012-13)*

**Figure 10. Catch trend for croakers during 2001-2012 along Goa coast**

The catch trend in croakers has shown a fluctuating trend during the last decade with a decreasing trend from 2005-2010. The catch was increasing from 1629 tonnes in 2002 to 3211 tonnes in 2005. The maximum and minimum catch during the period was 3211 tonnes in 2005 and 1376 tonnes in 2010. This resource is also generally landed as a by catch of multiday shrimp trawlers and also caught by gillnets, seine nets in small quantities. The large sized croakers like Ghol or Koth will be caught using hook and lines. The catch of Sciaenids also mainly constitutes brooders, juveniles and sub-adult stocks. This may be also a reason for the decline in the landings of the group in the second phase of the decade. So proper stock assessment and management advisories are required for sustainable exploitation of this resource.

## 8) Flat fish

**Local name: Lepo**

**Resource type: Demersal**

Flat fishes are the important demersal fish resource which forms the cheap protein source for the common people and the poor. This is utilised mainly in dried form for consumption. The fresh and iced marketing is also there for this resource. The dried and dry salted fish is being transported to local interior markets. The major species of flat fishes landed along Goa are the *Cynoglossus macrostomus*, *Cynoglossus macrolepidotus*, *Cynoglossus puncticeps*, *Psettodes erumei* and *Brachirus orientalis* etc. The total landings of the flatfishes along Indian coast amounts to 0.5-0.6 lakh tonnes/annum with major contribution from the soles (CMFRI, 2013). This group contributes to about 2.31% of the total marine fishery resource landings in Goa. The average annual catch of flat fish along Goa during 2001-2012 was 2278 tonnes.



*Cynoglossus macrolepidotus*



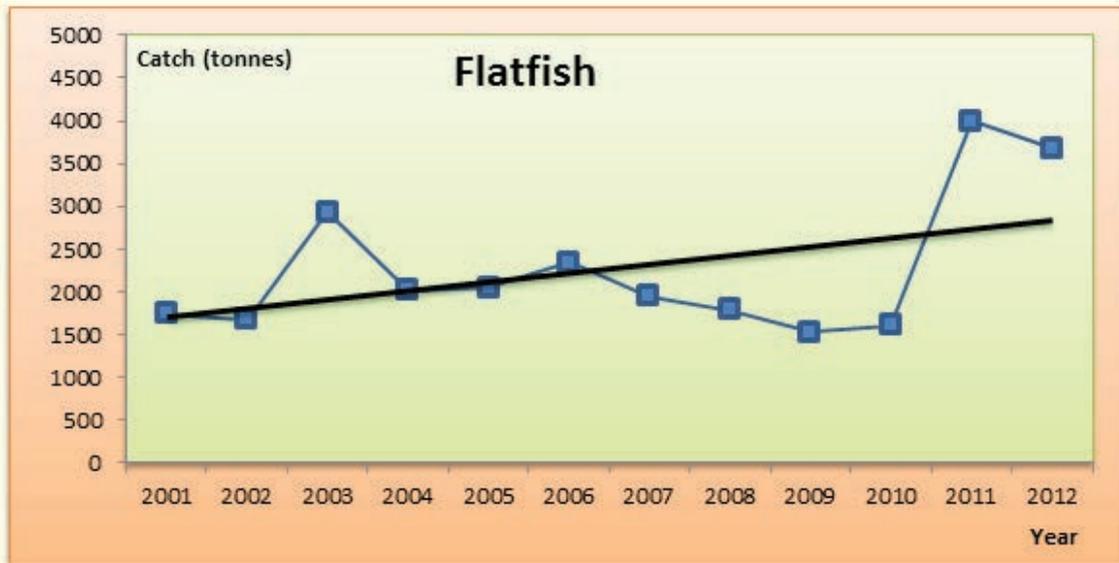
*Cynoglossus puncticeps*



*Pseudorhombus arsius*



*Psettodes erumei*



*Source: Directorate of Fisheries, Govt. of Goa (2012-13)*

**Figure 11. Catch trend for flat fish during 2001-2012 along Goa coast**

The catch trend in flat fish has shown a flat decreasing trend during the last decade. The catch was decreasing from 2935 tonnes in 2003 to 1606 tonnes in 2010 and further it increased rapidly during 2011-12. The maximum and minimum catch during the period was 3995 tonnes in 2011 and 1532 tonnes in 2009. This resource is also generally landed as a by catch of multiday shrimp trawlers and also caught using gillnets, seine nets etc. The catch of flat fish also mainly constitutes brooders, juveniles and sub-adult stocks. This may be also a reason for the decline in the landings of the group in the later part of the decade. So, proper stock assessment and management advisories are required for this resource.

## 9) Cat fish

**Local name: Sangot**

**Resource type: Demersal**

Cat fishes are the important demersal fish resource which is heavily exploited by the trawlers and purse seiners. This is utilised mainly for fresh consumption and some quantity is iced and transported to distant markets. The major species of Cat fishes landed along Goa are the *Arius thalassinus*, *Arius caelatus*, *A. subrostratus*, *A. arius*, *A. tenuispinis*, *A. platystomus* and *A. dussumieri* etc. The total landings of the cat fish along Indian coast amounts to 0.8-0.9 lakh tonnes/annum (CMFRI, 2013). This group contributes to about 1.99% of the total marine fishery resource landings in Goa. The average annual catch of cat fish along Goa during 2001-2012 was 1571 tonnes.



*Arius arius*



*Arius caelatus*



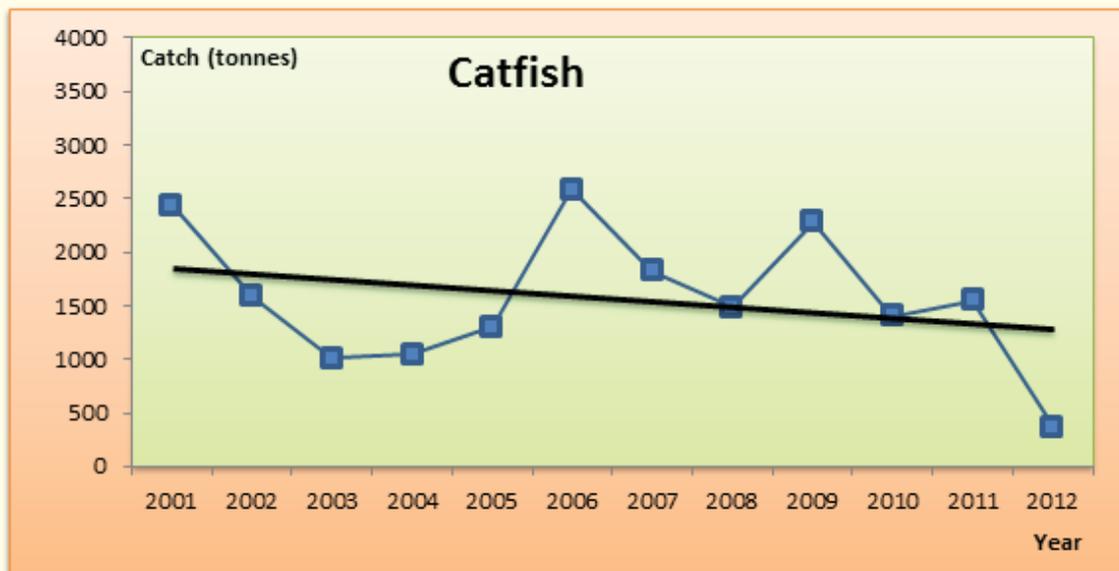
*Arius platystomus*



*Arius tenuispinis*



*Arius thalassinus*



*Source: Directorate of Fisheries, Govt. of Goa (2012-13)*

**Figure 12. Catch trend for catfish during 2001-2012 along Goa coast**

The catch trend in cat fish has shown a fluctuating trend during the last decade. The catch was decreasing from 2436 tonnes in 2001 to 1007 tonnes in 2003 which was followed by an increasing trend from 1043 tonnes in 2004 to 2586 tonnes in 2006. The catch was again decreasing from 2586 tonnes in 2006 to 1480 tonnes in 2008. The maximum and minimum catch during the period was 2586 tonnes in 2006 and 364 tonnes in 2012. This resource is generally being exploited by purse seiners (mouth brooding males and shoaling females), trawlers (Juveniles and sub adults) and gill nets. Thus, the different biological groups of this resource are heavily exploited by different type of gears. So, proper stock assessment and advisories are necessary for the management of this resource.

## 10) Cuttle fish

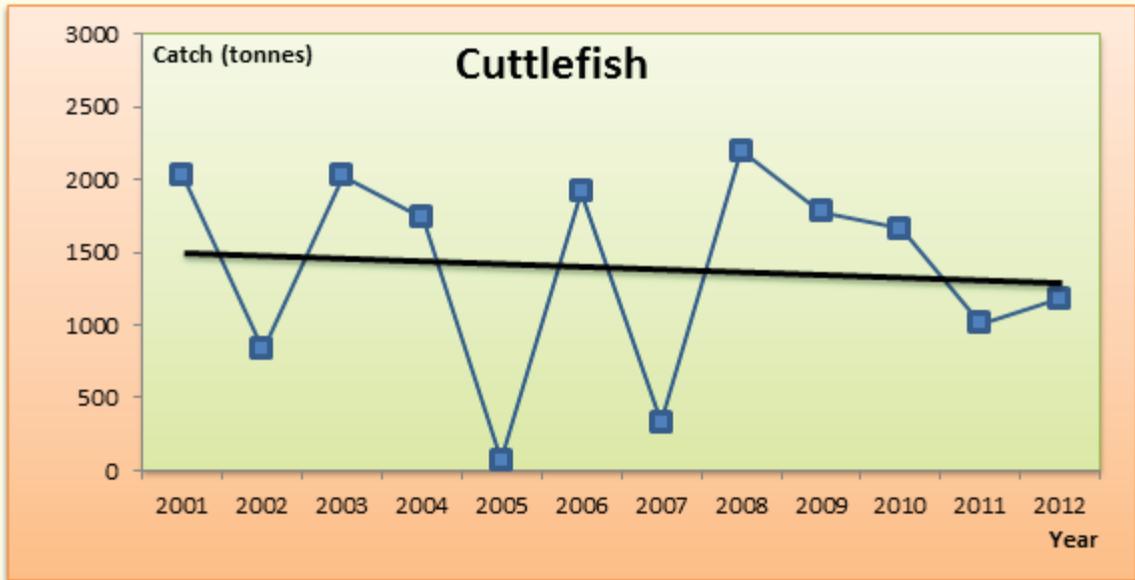
**Local name: Manki**

**Resource type: Mollusc**

Cuttle fish is a major cephalopod resource along with squid, which comes under the Molluscan resources. This important commercial shell fish resource is heavily exploited by the trawlers, hook and lines, squid jiggers and gill nets. This is utilised mainly for frozen export (Whole, fillets, strips, nidamental gland) and for fresh consumption. There is a huge demand for this resource in South East Asia, China, Japan and Europe. The major species of Cuttle fish landed along Goa are the *Sepia pharaonis*, *Sepia aculeate* and *Sepiella inermis*. The total landings of the cuttle fish along Indian coast amounts to 0.7-0.9 lakh tonnes/annum (CMFRI, 2013). This group contributes to about 1.84% of the total marine fishery resource landings in Goa. The average annual catch of cuttle fish along Goa during 2001-2012 was 1398 tonnes.



Cuttlefish, *Sepia pharaonis*



Source: Directorate of Fisheries, Govt. of Goa (2012-13)

**Figure 13. Catch trend for cuttle fish during 2001-2012 along Goa coast**

The catch trend in cuttle fish has shown a fluctuating trend during the last decade. The catch was decreasing from 2027 tonnes in 2001 to 73 tonnes in 2005 which was followed by an increasing trend from 73 tonnes in 2005 to 1659 tonnes in 2010. However, there is a declining trend for the past few years during 2008-2012. The maximum and minimum catch during the period was 2201 tonnes in 2008 and 73 tonnes in 2005. This resource is landed mainly as a by catch of trawls. The overexploitation of the juvenile and brooder stocks of the resource has done mainly by the bottom trawlers and the mid water trawlers. So, proper stock assessment and advisories are necessary for the management of this resource.

## 11) Sharks

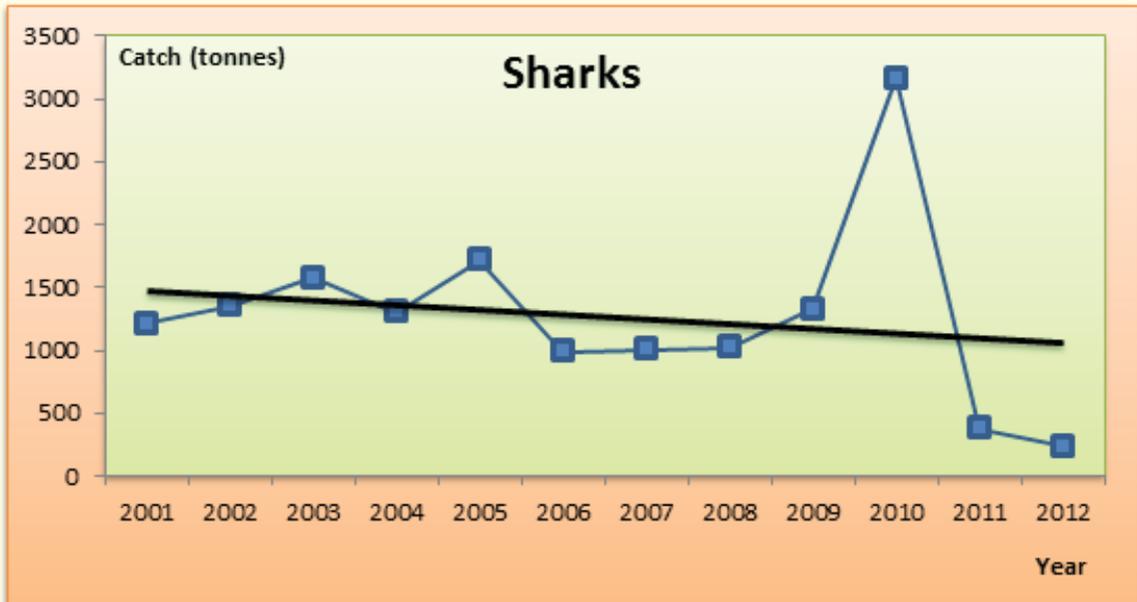
**Local name: Mori**

**Resource type: Demersal**

Sharks are the important demersal fish resource under the main group elasmobranchs which is overexploited by the trawlers, purse seines, gillnets, longlines and hook & lines. This group has very high economic demand which is mainly utilised for fresh and dried consumption. Moreover, the export of frozen shark meat, shark fins, shark liver oil, shark teeth and bones for ornamental purpose gives high contribution to the value of marine products exports from the country. The major species of Sharks landed along Goa are the *Charcharhinus limbatus*, *C. dussumieri*, *Rhizoprionodon acutus*, *Scoliodon sorrokowah*, *Sphyrna zygaena*, *S. lewini* and *Alopias vulpenes* etc. The total landings of the sharks along Indian coast amounts to 0.2-0.25 lakh tonnes/annum (CMFRI, 2013). This group contributes to about 1.72% of the total marine fishery resource landings in Goa. The average annual catch of sharks along Goa during 2001-2012 was 1272 tonnes.



**Sharks**



Source: Directorate of Fisheries, Govt. of Goa (2012-13)

**Figure 14. Catch trend for sharks during 2001-2012 along Goa coast**

The catch trend in shark has shown static trend during the first half of the last decade. The catch declined to 988 tonnes in 2006 from 1716 tonnes in 2005. The static trend has continued again till the year 2009 and in 2010, the catch was mounted to 3159 tonnes. The maximum and minimum catch during the period from 2001-2009 was 1716 tonnes in 2005 and 988 tonnes in 2006. After the sharp increase in 2010, the catch dropped steeply to a historical low of 234 tonnes in 2012. The different biological groups of the resource are generally being exploited by almost all the gears. The sharks are slow growing, low biomass and low fecund fishes. Moreover, they show oviparity, ovo-viviparity and viviparity in their reproductive behaviour. Some of the species are scheduled in the wild life protection act of India. So, proper stock assessment and advisories are necessary for the management of this resource.

## 12) Tuna

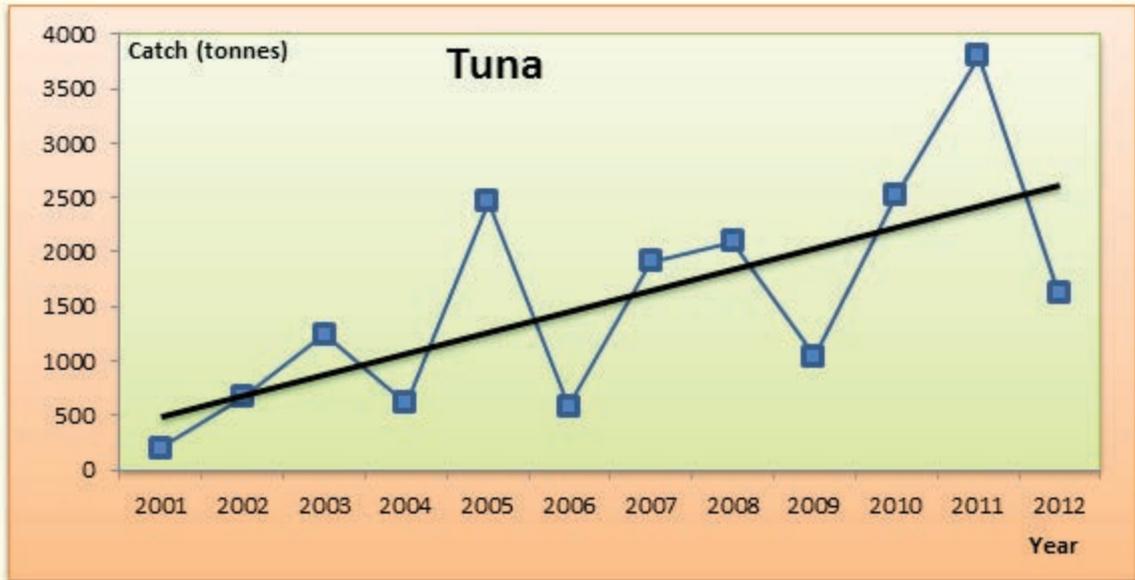
**Local name: Bokdo**

**Resource type: Pelagic**

Tuna is an important pelagic and oceanic fish resource under the family Scombridae which are exploited by the purse seines, longlines, hook and lines, trawls, pole and line and gill nets. This group has very high economic demand which is mainly exported as fresh, frozen, chilled and processed fish to Europe, South East Asia, Japan and USA. They include coastal tunas; *Euthynnus affinis*, *Auxis thazard*, *Auxis rochei* and *Thunnus tongoll* and oceanic tunas; *Thunnus albacares*, *Katsuwonus pelamis* and *Thunnus obesus*. The total landings of the tuna along Indian coast amounts to 0.7-0.8 lakh tonnes/annum (CMFRI, 2013). This group contributes to about 1.57 % of the total marine fishery resource landings in Goa. The average annual catch of tuna along Goa during 2001-2012 was 1564 tonnes.



Tuna



*Source: Directorate of Fisheries, Govt. of Goa (2012-13)*

**Figure 15. Catch trend for tuna during 2001-2012 along Goa coast**

The catch trend in tuna has shown a gradual increasing trend with fluctuations during the last decade. The catch was increasing from 198 tonnes in 2001 to 1241 tonnes in 2003 followed by a decrease in 2004. The catch again showed a fluctuating trend from 2004 (609 tonnes) to 2007 (1916 tonnes) with an increase of catch. In short, the catch was increasing from 198 tonnes in 2001 to 3801 tonnes in 2011. The maximum and minimum catch during the period from was 3801 tonnes in 2011 and 198 tonnes in 2001. However, there was a sharp drop to 1621 tonnes in 2012. The coastal tuna resources are over exploited and oceanic resources are underexploited. The management advisories can be focussed on regulation on coastal tuna fishery and promotion of the oceanic tuna fishery. The oceanic resources can be exploited using different deep sea fishing methods to increase the marine fish production along the coast. The tuna based potential fishing zone advisories are also coming up which will help fishermen to locate and sustainably exploit the resources.

### 13) Crabs

**Local name: Kurlio**

**Resource type: Crustacean**

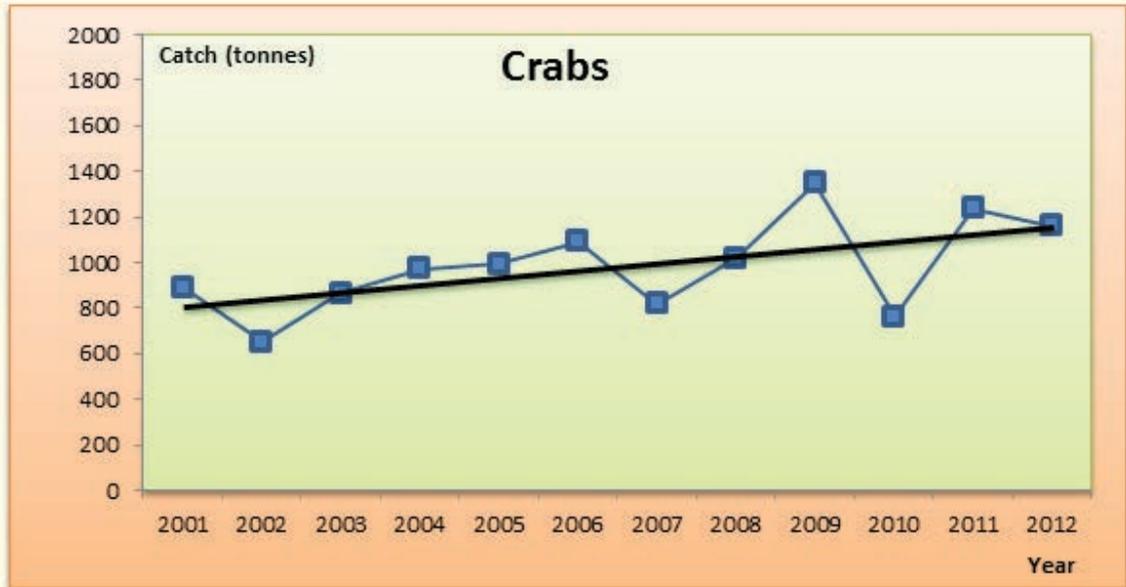
Crabs are one of the major resources which have high demand in the domestic as well as foreign markets. This fetches very high unit price in the foreign markets. This resource is mainly caught using gillnets, traps and trawls (by catch). The dominant species of crabs landed in Goa includes pelagic swimming crab, *Portunus pelagicus*, three spot crab, *Portunus sanguinolentus* and Crucian crab, *Charybdis feriatus*. The major chunk of the catch is utilised as fresh and transported to interior and distant markets with ice. The frozen whole crab, crab meat and crab claw are important export items from the resource. The total landings of the crabs along Indian coast amounts to 0.5 lakh tonnes/ annum (CMFRI, 2013). The group contributes to about 1.11% of the total marine fishery resource landings in Goa. The average annual catch of crabs along Goa during 2001-2012 was 985 tonnes.



*Portunus pelagicus*



*Portunus sanguinolentus*



Source: Directorate of Fisheries, Govt. of Goa (2012-13)

**Figure 16. Catch trend for crabs during 2001-2012 along Goa coast**

The crabs have shown a gradual positive increasing trend from 654 tonnes in 2002 to 1349 tonnes in 2009. The catch was drastically declined to 763 tonnes in 2010 which was followed by an increase to 1160 tonnes in 2012. The maximum and minimum catch during the period was 1349 tonnes in 2009 and 654 tonnes in 2002. A huge quantity of berried females of *Portunus pelagicus* and *P. sanguinolentus* are landed as a by catch of trawls in Goa. This might have caused the sharp decline in the landings of this resource. Proper stock assessment and output control measures are necessary for management of this resource. Minimum Legal Size for the export of different species of crabs has been recommended by MPEDA based on the evaluation of biological reference points. Unfortunately, the same has not implemented in a regulatory mode.



## 5 Chapter

# Options for Marine fisheries management in Goa

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### Co-management

The unregulated growth of fishing capacity and inappropriate management systems cannot be continued any further. The development of a system of “co-management” can be a solution which will be based on the co-operation between fishing community, interested stake-holders, research institutions, NGOs and Government departments. Thus village level traditional societies and boat owners groups will be the backbone of this management system. This can be developed using pilot scale experimental systems of management under the Department of fisheries and research institutions. However, the successful development of co-management system requires huge awareness and capacity building programmes for the fishing community and other stake-holders. Care should be also taken to include spatio-temporal resource and environmental patterns (biology, spawning, juvenile grounds and critical habitats) under the umbrella of co-management.

### Regulated access, gear controls and conversions

It is high time to shift the open water fisheries from ‘open access’ to ‘regulated access’ which is very difficult to implement. Restriction of fishing rights to the vessels can be an option for this management plan. Moreover, some of the mechanised vessels can be modified to deep sea vessels. Important gear controls like the ban on pair trawls and ring seines need to be implemented by building community support under strict enforcement framework. The monsoon trawl ban can be made for two months or three months along the coast. Uniform observation of the trawl ban can be recommended for the entire west coast.

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## **Deep sea fishing**

Deep sea fishing on the entire west coast of India is a monopoly of south east coast fishermen. Deep sea fishing in the Bay of Bengal offers a good opportunity for the north coastal districts. The west coast also offers good scope for deep sea fishing beyond the shelf. This scope can be utilised for exploitation shark, tuna, bill fishes, shrimps, cephalopods and other fisheries resources along Goa.

## **Utilization of fishery advisories**

Potential Fishing Zone advisory is the dissemination of areas of fish availability provided by the International Centre for Oceanic Information Services (INCOIS) through various collaborating institutes like the ICAR Research Complex for Goa is the nodal organization in Goa. This data is derived on Remote Sensing (RS) and Geographical Information System (GIS) techniques. This is based on the satellite derived Chlorophyll and Sea Surface Temperature (SST) information. The advisories benefit the fishermen with a healthy catch and economic fishing operations. The benefits for fishermen derived upon using PFZ information are reduction of searching time, saving fuel, saving human effort and increase in CPUE and average income of the fishermen. In Goa, it is reported that there is a reduction of searching time by 50% for the ring seine fleets. The income generated by fishing in the PFZ was 2 times higher than the income generated in non- PFZ zones. The commercially important species are more abundant in the PFZ area. The utilization of more refined PFZ information will help the fishermen to divert their efforts towards the fishery rich grounds and improvement in their income.

## **Enhancement techniques**

Goa Fisheries Department may develop some linkages with the Research Institutions to make use of the salient findings from the data collected on the fishery biology of different component species of various exploited fishery resources for fishermen to enable them to adopt responsible fisheries. Nearly 80% of the fish production comes from inshore waters, where due to oversupply and overexploitation it is becoming more and more uneconomical for the fishing craft to operate. It is high time to carry out biological resource enhancement activities such as the deployment of artificial reefs and sea ranching of commercially important species. Captive breeding and culture of economically important species such as the cobia, pompano, Seabass, mullets can be attempted to improve the production status. An

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excellent artificial reef habitat can be established near shore areas for attachment of corals and ornamental fishes to popularize the eco-tourism. This can be used by fishermen for fishing, students for education, tourists for snorkeling, SCUBA diving, sport fishing with angles (hooks & line), trap fishing for live ornamental fishes, underwater sightseeing with the help of glass-bottom boats etc.

## **Conclusion**

Presently, the marine fisheries resources of Goa are showing a fluctuating trend. Most of the resources are getting depleted and some of the highly commercial resources are already showing negative growth patterns. Moreover, the natural fishery habitats are getting destroyed due to anthropogenic and natural causes along the Goa coast. The destruction caused by trawlers on the demersal fishery resources is very high. Thus, there is a need for the enhancement of the fishery resources through sustainable exploitation and ecological restoration. The management and regulatory framework should be established by the stakeholders under the leadership of Department of Fisheries to sustain the marine fisheries resources. The monsoon trawl ban is practiced along the Goa coast is an example for the temporal input control mechanism. The implementation of the existing regulatory framework can be done to sustain the fishing activity by traditional and motorised vessels in the inshore waters and by the mechanised units in the offshore waters. Awareness programme on sustainable and responsible fishing operations can be given to the fishermen thorough the research organisations. The awareness and training on creation of artificial fish habitats and protected areas for the replenishment and conservation of inshore fishery resources can be another strategy. The coastal aquaculture including the marine cage culture can be initiated with the research organisations so as to divert a portion of the fisher folk from the capture fisheries. This is also strategic approach for the sustainable development.

## Appendix

### Fish landings at Panjim Fisheries Harbour



Fish landings at Vasco fish market



**Fish landings at Siridao fish landing centre**



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