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The Marine Fisheries Information Service : Technical and Extension Series envisages dissemination of information on marine fishery resources based on research results to the planners, industry and fish farmers, and transfer of technology from laboratory to field.

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1124 Exploited seerfish fisheries of India during 1998-02

Seerfishes are esteemed table fishes. In India, they are considered as one of the high value resources due to their superior quality meat, high economic return and export market. Seerfish fishery is important to artisanal fishermen who use driftnet/gillnet/hooks and line employing country crafts with or without out-board engines and medium size boats with inboard engines, in the coastal waters of 25-60 m depth. They are the target species for these indigenous gears. During the last two and half decades, the bottom trawlers from depths between 50 and 300m also exploit this resource. This fishery requires continuous monitoring for judicious exploitation and proper management to attain the maximum sustainable yield. The above objectives were fulfilled by implementing series of technical programmes at eight centres, four from the east coast (Visakhapatnam, Kakinada, Chennai, and Tuticorin) and four from the west coast (Kochi, Calicut, Mangalore and Veraval) of India during 1997/98-2001/02 and the important findings are reported.

All-India production trend

The yearly catch of seerfish in India had fluctuated from 4,505 t in 1953 to an all-time high of 54,871 t in 1998 (Fig.1). Decade-wise average annual production showed an increasing trend over the past five decades however, the rate of increase through successive decades shows decreasing trend. It has come down from 92.5% in 1970s, to 62.5% in 1980s, 27.6% in 1990s and further to 16.9% during 1998-02 indicating attainment of optimum production. The annual production during 1998-02 varied from 42,578 t in 2001 to 54,871 t in 1998 with an average of 48,847t forming 1.9% of the marine fish landing of the country. The east coast which ranked first in seerfish production during 1950s and 1960s with around 60% contribution had progressively been reduced to 40% in 1990s and during 1998-02.

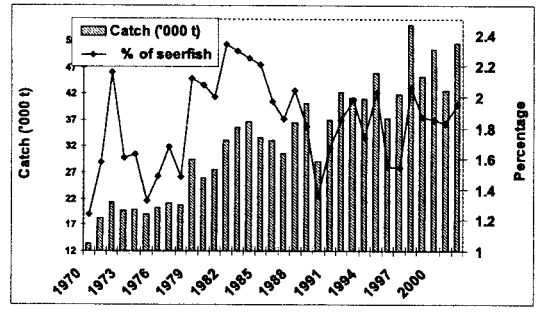

Fig. 1 All India seerfish catch

Regional trends

The regionwise average annual landing of seerfish during different decadal periods (Table 1) had indicated that the rate of increase in production improved manifold in almost all states during 1970s as compared to 1960s and thereafter it showed decreasing trend during 1980s and 1990s. During 1998-02, northwest region (Gujarat and Maharashtra) topped in seerfish production in the country with an average annual catch of 19,429 t (39.8%) followed by southeast region (Andhra Pradesh, Tamil Nadu and Pondicherry) with 15,225 t (31.2%), southwest region (Goa, Karnataka and Kerala) with 9,590 t (19.6%), northeast

region (Orissa and West Bengal) with 3,834 t (7.8%) and Union Territories (Andamans and Lakshadweep) with 769 t (1.6%) respectively. Karnataka-Goa which recorded a negative growth during 1990s had improved with 4,840 t (9.9%). Overall, as compared to the annual average catch during 1990s, the average catch during 1998-02 improved in all regions except Kerala and Gujarat. Kerala which recorded a 7% reduction during 1990s continued to record negative growth during 1998-02 (12.9%) also. Gujarat with a 124% increase during 1990s recorded a marginal decrease (9.5%) during the study period.

quarter (26.4%), first quarter (24.9%) and second quarter (11.3%). East coast recorded maximum catch during third quarter (33%) and west coast during fourth quarter (45%).

Gearwise catch

Gear-wise production (in %) in relation to all-India annual seerfish catch during 1998-02 given in Fig.2 indicates that gillnet operated all along the Indian coasts was the major contributor of seerfish in the country, accounting for 66.3% (31,800 t). The west coast contribution was more (54.6%) than the east coast (45.4%). Gillnet was the dominant

Table 1. Region-wise annual average catch (t) and rate of increase (%) through successive decades in India.

Region	Catch/Rate of increase	1960s	1970s	1980s	1990s	1998-02
Northeast coast	Catch	292	980	2076	3252	383
	Rate of increase		235.4	111.7	56.6	17.9
Southeast coast	Catch	5996	9105	9907	11138	15225
	Rate of increase		51.9	8.8	12.4	36.7
East coast	Catch	6288	10086	11983	14390	32.4
	Rate of increase		60.4	18.8	20.1	
Southwest coast	Catch	2392	5513	9994	9200	9590
	Rate of increase		130.5	81.3	-7.9	4.2
Northwest coast	Catch	1791	4559	10782	17523	19430
	Rate of increase		154.6	136.5	62.5	10.9
West coast	Catch	4182	10072	20776	26723	29019
	Rate of increase		140.8	106.3	28.6	8.6
Union Territories	Catch	—	—	—	677	769
	Rate of increase		—	—	—	13.6
All-India	Catch	10471	20158	32760	41790	48848
	Rate of increase		92.5	62.5	27.6	16.9

Seasonal variations

On an all-India basis, fourth quarter contributed higher landings (37.4%) followed by third

gear in all the maritime states except in Maharashtra and Goa. Next to gillnet, trawl contributed 14.3% (6,879 t). Production by this gear along the west coast was 77.7% (5,348

t) and along the east coast it was 22.3% only (1,531 t). About 59% of the trawl catch came from northwest coast where it formed the second dominant gear for seerfish exploitation. Hooks and line, the second dominant gear along Tamil Nadu and Andhra Pradesh coasts landed 6.9% (3,301 t) of seerfish, in which, the east coast contribution was 61.3% (2,022 t) as this gear happen to be the most common along the east coast. Along the west coast, this gear landed appreciable catch only in Kerala (458 t, 9.6%), Maharashtra (495 t, 5.2%) and Gujarat (303 t, 3.1%). Purseseine occasionally landed seerfish as one of the incidental catches especially during the post monsoon season along Kerala, Karnataka, Goa and Maharashtra coasts. It is the most dominant gear along Goa coast with 1,053 t (64.1% of the total seerfish catch of the state) and the second dominant gear along Karnataka coast (895 t, 28%). Along Maharashtra coasts also this gear landed appreciable catch of 1,836 t annually and this formed 19.1% of the total seerfish catch of the state.

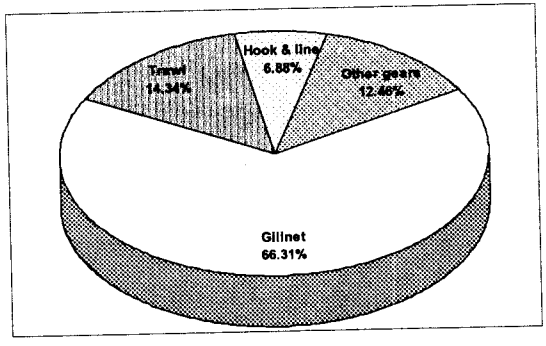

Fig.2. Gearwise contribution of seerfish in India during 1998-2002.

Species composition

On an all-India basis, the king seer *Scomberomorus commerson* dominated the landing by all gears (66.3%), followed by the spotted seer *S.guttatus* (33.5%) (Fig. 3). The other two species, the streaked seer *S.lineolatus* and the wahoo *Acanthocybium solandri* occurred rarely forming 0.1% each. While the king seer was the dominant species along the mid-east, southeast, southwest and mid-west coasts of India, the spotted seer was most common along the northeast and northwest coasts of India. The streaked seer is recorded only from southeast and southwest coasts (Andhra Pradesh, Tamil Nadu and Kerala). The wahoo was recorded only from southeast to northwest coasts.

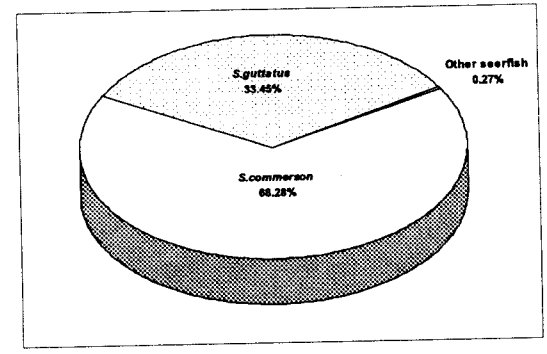

Fig.3. Species composition of seerfish in India during 1998-2002.

Size distribution

The regionwise size-range, maximum size (L_{max}), maximum expected length ($L\infty$), minimum size at maturity (L_m), and size with optimum yield (L_{opt}) indicated that both the king seer and the spotted seer attain a large size in the east coast and correspondingly the values of L_{max}, $L\infty$, L_m and L_{opt} are higher in the east coast (Table 2).

The size range of king seer in the major gear of gillnet (Figs.4 and 5) was wide along the east coast (14-154 cm) as compared to the west coast (30-140 cm) with a mean size of

71 and 67 cm respectively (Table 3). On an average, this gear caught 8.68 million fishes annually from the Indian coasts, of which 32.8% of the fishes had chance to spawn before they were caught and only 10% of them were caught with optimum yield. Hooks and line harvested this species at higher length and out of 5.4 lakh fishes caught along the east coast, 53.9% had chance to reproduce before being caught and the fish with optimum yield was 18.1%. Comparatively, gillnet and hooks & line exploit the higher length groups of this species and the trawl exploits much smaller size groups. Out of 11.61 million fishes landed by trawl from the Indian seas, only 0.63% of them were potential breeders. This shows that the king seer is optimally harvested by bigger meshed gillnets (65-170 mm) and hooks and line. Trawl and small meshed gill nets (40-70 mm) like *podivalai* from Tuticorin coast target small sized fishes, which might lead to depletion of spawning stock thereby, affecting recruitment.

The length range of *S.guttatus* in large meshed gillnet was 14-58 cm from the west coast and 10-70 cm from the east coast (Figs.6 and 7) with a mean size at 40 cm along both the coasts (Table 3). Out of 17.2 million fishes caught from the Indian seas annually during 1998-02 by the bigger meshed gillnet, about 44% of the fishes were with optimum yield and more than 63% fishes had chance to reproduce before being caught. Whereas, in trawl, 41.1% of 6.6 million fishes caught were capable of breeding once before being caught

Table 2. Region-wise length-range, maximum expected length ($L\infty$), minimum size at maturity (L_m) and size with optimum yield (L_{opt}) of *S.commerson* and *S.guttatus*.

Species	Size-range (cm)	L_{max} (cm)	L_∞ (cm)	L_{opt} (cm)	L_m (cm)
S.commerson					
West coast	10-140	140	143.2	93.9	72.1
East coast	10-154	154	157.3	103.5	78.4
S.guttatus					
West coast	14-62	62	64.3	40.7	35.1
East coast	8-70	70	72.4	46.1	39.1

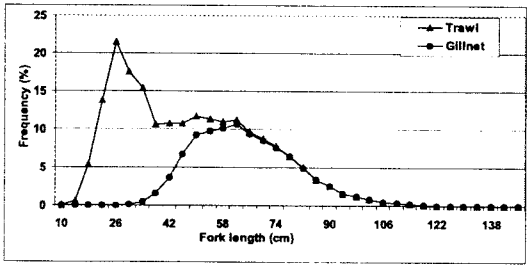

Fig.4. Annual average length frequency distribution of *S.commerson* in different gears along west coast of India during 1998-2002.

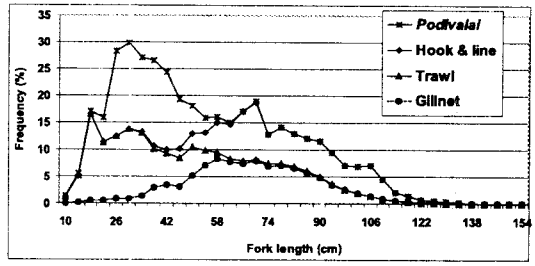

Fig. 5. Annual average length frequency distribution of *S.commerson* in different gears along east coast of India during 1998-2002.

and fish with optimum yield was 27.9%. More fishes were caught at younger sizes along the east coast. While 73.2% fish caught along the west coast were capable of reproduction as against 8.2% in the east coast. This might lead to growth and recruitment over fishing along the northeast coast where this species is abundant.

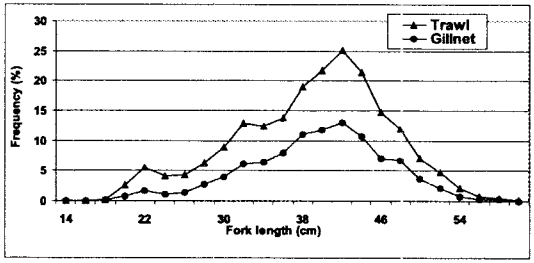

Fig. 6. Annual average length frequency distribution of *S.guttatus* in different gears along west coast of India during 1998-2002.

Young fish exploitation

Young fish (< 34 cm) exploitation of *S.commerson* by large meshed gillnet and hooks and line was almost negligible along both the coasts. But trawl exploited young fishes in bulk and the percentage of exploitation was 58.8% in the west coast and 57.8% in the east coast. Similarly small meshed gillnet (40-70 mm) *podivalai* landed young fishes in large quantities along Tuticorin coast of Tamil Nadu. In the case of *S.guttatus*, young fish (<18 cm) exploitation was negligible (0.2% in the west coast and 9.6% in the east coast) by the large meshed gillnet. In trawl, while young fish exploitation was almost nil along the west coast, they were caught abundantly along the east coast (42.5%).

Fishery at selected centres

Veraval: Seerfish production at this centre has fluctuated from 726 t in 2001-02 to 1,408 t in 2000-01 with an annual average of 1,065 t. Out of the two gears contributing to seerfish catch, *viz.* gillnet and trawl, the former was the dominant gear (76%). The average annual catch rate (C/E) was 28.3 kg in gillnet and 4.3 kg in trawl. *Scomberomorus commerson* and *S.guttatus* supported the fishery of which the

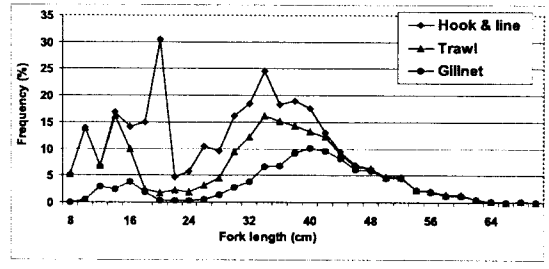

Fig 7. Annual average length frequency distribution of *S.guttatus* in different gears along east coast of India during 1998-2002.

spotted seer was the most dominant species in both the gears contributing 81%.

Mangalore: Seerfish catch varied from 782t in 2001-02 to 1,409 t in 2000-01 with an average annual production of 1,019 t. Though they were taken by different gears such as gillnet, trawl, purseseine and other indigenous gears, gillnet and trawl were the major gears contributing 42 and 47% respectively, with an average annual C/E of 37 kg in gillnet and 18.2 kg in trawl. Purseseine also exploited this resource during post-monsoon months (11%) at a C/E of 7.3 kg. The fishery was represented by three species, *viz.* king seer, spotted seer and the wahoo *Acanthocybium solandri* forming 96.0, 3.9 and 0.1% respectively. The king seer dominated the catch in all gears.

Calicut: The annual seerfish landing varied from 29 t in 1998-99 to 144 t in 2000-01 with an average of 90 t. During 1997-98 and 1998-

Table 3. Gear-wise size-range, mean-size, no. of fish caught and percentage of youngfish contribution, fish above minimum size at maturity (L_m) and optimum yield (L_{opt}) along the west and east coasts of India.

Species/Gear	Size- range (cm)	Mean-size (cm)	Youngfish (%)	No. of fish caught- annual average (in million)	Fish >L_m (%)	Optimum yield (%)
S.commerson						
Gillnet (70-140 mm mesh size)						
West coast	30-140	67	0.09	4.27	29.7	10.0
East coast	14-154	71	2.8	4.41	35.8	10.6
Trawl						
West coast	10-100	34	58.8	8.44	0.5	0.01
East coast	10-110	34	57.8	3.17	1.04	0.04
Hook and line						
East coast	30-146	82	0.01	0.054	54	18.1
***Podivalai* (Gillnet 40-70 mm mesh size)**						
East coast	10-70	38	100			
S.guttatus						
Gillnet						
West coast	14-58	40	0.2	10.92	67.6	56.5
East coast	10-70	40	9.6	6.3	56.4	22.3
Trawl						
West coast	18-62	39	0.0	3.34	73.2	53.6
East coast	8-60	25	42.5	3.25	8.2	1.4

99 they were caught exclusively by gillnet and from 1999-00 onwards trawl also emerged as an important gear for seerfish exploitation. The average annual C/E was 16.3 kg in gillnet and 2.2 kg in trawl. The production by these two gears was almost in equal proportions. The fishery was supported exclusively by the king seer.

Kochi: The annual seerfish catch ranged from 184 t in 2001-02 to 511 t in 1998-99 with an average landing of 286 t. They were taken by gillnet, trawl and purseseine. Gillnet was the dominant gear contributing as high as 95% at a catch rate of 36 kg. The fishery was represented by the king seer, the wahoo and the spotted seer forming 97.6, 1.4 and 1.0 % respectively.

Tuticorin: Seerfish catch at the centre fluctuated from 508 t in 2001-02 to 767 t in 1999-00 with an average of 586 t annually. They were harvested by three gears *viz.* gillnet, trawl and hook and lines accounting for 56, 31 and 13% respectively at a catch rate of 20.4, 5.3 and 6.3 Kg respectively. Out of

four species, the king seer was the most dominant species (93.5%). The other species were spotted seer (2.4%), the wahoo (2.3%) and the streaked seer (1.8%).

Chennai: Seerfish production at this centre varied from 165 t in 2000-01 to 677 t in 1998-99 with an annual average of 360 t. Gillnet, trawl and hook and line contributed 43, 24 and 33% respectively. The catch rate was highest in gillnet (79 kg) followed by hook and lines (19 kg) and trawl (2 kg). There were only two species in the fishery *viz.*, the king seer (63%) and the spotted seer (37%).

Kakinada: Seerfish catch varied from 216 t in 1997-98 to 316 t in 1998-99 with an average of 260 t. Gillnet contributed 80% and the rest by trawl. The C/E was 15 kg in gillnet and 1kg in trawl. The catch was represented by king seer (58.4%), spotted seer (40.9%), wahoo (0.4%) and the streaked seer (0.3%).

Visakhapatnam: The landing varied from 120t in 2001-02 to 207 t in 1999-00 with an annual average of 173 t. Hook and line was the major contributor (61.8%), followed by gillnet (31.2%) and trawl (6.9%). The average annual catch rate was 4.5 kg in gillnet and 4.1 kg in hook and line. The fishery was constituted by two species, the spotted seer and king seer, of which, the spotted seer (61.5%) was the dominant species similar to the northern most centre, Veraval on the west coast of India.

Stock assessment

Length-weight relationship

S.commerson: $W = 0.016077\ L^{2.80}$

S.guttatus : $W = 0.022966281\ L^{2.78}$

Growth parameters $L\infty$ K and t_0 were estimated for the king seer from both west and east coast separately (Table 4). The growth rate of both species was faster in the east coast as revealed from the higher values of $L\infty$ and K.

Recruitment

Both the species spawn and young recruits enter the stock almost round the year. Recruitment for king seer took place in a single pulse extending from October to February with a peak in December in the west coast and during March-April and December in the east coast. For spotted seer, recruitment occurred in a single pulse during August-November with a peak in October in the west coast whereas, there were two peaks in the east coast, a major one during March-April and another minor one during December.

Mortality and standing stock

Along the west coast young kingseer of 26-30 cm size groups suffered high fishing mortalities and among the higher length groups mortality was higher between 74-78 and 90-94 cm size groups. This is because of bulk

Table 4. Growth parameters of king seer and spotted seer

Region	*S.commerson*			*S.guttatus*		
	$L\infty$(cm)	K	t_0	$L\infty$ (cm)	K	t_0
West coast	142	0.5	-0.0314	69	1.0	-0.0116
East coast	168.5	0.73	-0.0173	75	1.1	-0.0089

exploitation of young ones by the bottom trawl and the larger groups by the gillnets. Along the east coast, main loss in the stock up to 20 cm was due to natural causes. Thereafter, loss due to fishing increased and exceeded natural losses. For spotted seer, fish above 38-40 cm were exposed to higher fishing mortalities along the west coast. In the east coast fishing mortality was high for fishes of 12-18 cm size and fishes larger than 34 cm. The mortality parameters obtained using the weighted length-frequency of the west and east coast landings separately for both the species indicates that these two species (Table 5) were exposed to high fishing pressure with an exploitation rate (E) of above 0.7 suggesting that there is a need for a moderate reduction in the effort input.

Thompson and Bell multifleet yield prediction analysis on the likely effects of different combinations of fishing effort on the yield of king seer and spotted seer by drift gillnet and bottom trawl along the west coast give the following scenario:

S.commerson

Scenario 1:

Keeping the present trawl effort constant and the drift gillnet effort varied, the likely impact on the yield of *S.commerson* by trawl, gillnet and the total yield of *S.commerson* (by both gears combined) is summarised here under. When the gillnet effort is increased further, the present seerfish catch by trawl would increase whereas, the catch by gillnet would decline from the present level. However, if the gillnet effort is reduced by 20% from the present level, a maximum yield of 10,221 t would be obtained or in other words 80% of the present gillnet effort along the west coast would be ideal to realise optimum yield by this gear. In this scenario, the effect on total catch of *S.commerson* would be same as on the gillnet yield of the species and an optimum catch of 13,306 t would be obtained at 80% of the present gillnet effort.

Scenario 2:

If the present gillnet effort is kept constant and the trawl effort increased the seerfish catch would increase from the present level (3,350 t) but then, the increase would be very nominal if the trawl effort is increased further. The seerfish catch by gillnet will come down from the present catch of 9,996 t if the trawl effort is increased. Similar trend is expected on the total catch of *S.commerson* along the west coast of India and the present catch of 12,142 t would slide down with an increase in the trawl effort from the present level.

S.guttatus

Scenario 1:

If the trawl effort is maintained at the present level and the gillnet effort is increased further, the seerfish production by trawl will decrease from the present yield of 2,174 t. The gillnet catch of *S.guttatus* will be optimum (7,405 t) at the present effort level and with further increase in gillnet effort may lead to a reduction in production. In this scenario, the

impact on the total catch of *S.guttatus* would be same as on the gillnet production of the species *i.e.*, the total catch of the species would decline. In fact the maximum yield of 9,589 t MSY is obtained at 80% of the present gillnet effort.

Scenario 2:

If there is no change in the present gillnet effort and the trawl effort is varied, maximum yield (2,188 t) in trawl would be obtained at 40% of the present trawl effort or in other words 60% of the trawl effort should be reduced. In gillnet, a maximum yield of 7,412t would be obtained at 60% of the present trawl effort. Any further increase in trawl effort would result in reduction in the present spotted seer catch (7,404 t) by gillnet. In this situation the effect on the total production of *S.guttatus* will be same as on the gillnet production of the species and the total catch will be optimum (9,598 t) at 60% of the present trawl effort with 9,579 t.

Average annual yield, total stock and biomass of *S.commerson* were estimated to be 18,000, 28,213 and 10,651 t respectively for the west coast and 14,500, 19,308 and 4,849 t for the east coast. In the case of *S.guttatus,* the average yield, stock and biomass were 11,000, 14,323 and 2,311 t respectively for the west coast and 5,000, 6,502 and 996 t for the east coast.

Table 5. Estimates of mortality rates, exploitation rates, yield, biomass and stock of king seer and spotted seer.

Region	Natural mortality rate (M)	Total mortality rate (Z)	Fishing mortality (F)	Exploitation rate (E)	Exploitation ratio (U)	Yield (Y) (t)	Biomass (Y/F) (t)	Stock (Y/U) (t)
S.commerson								
West coast (1998-2002)	0.73	2.43	1.69	0.70	0.634	18000	10,651	28213
East coast (2001-2003)	0.91	3.9	2.99	0.77	0.751	14500	4849	19308
S.guttatus								
West coast (1998-2002)	1.41	6.17	4.76	0.77	0.768	11,000	2,311	14,323
East coast (2001-2003)	1.5	6.52	5.02	0.77	0.769	5,000	996	6,502

Management

As both king seer and spotted seer are exposed to higher fishing pressure along both the coasts of India, the effort level should be brought down. Young fishes of king seer are exploited heavily by trawl along the Mangalore-Malpe, Tuticorin and Chennai coasts. Hence, the minimum size at first capture must be enhanced by increasing the mesh size of nets deployed. The present gillnet mesh size of 65-170 mm should be increased to 130 mm. The operation of small meshed gillnet like *podivalai* along the Tuticorin coast should be discouraged. As the hooks and line and large meshed gillnets target large sized seerfishes, these gears may be encouraged for sustainable harvest in the inshore fishing grounds. Further, the operation of these gears may be extended to deeper waters (by resorting to multi-day gillnetting) in order to increase the production from the untapped portion of the stock available in the offshore waters.

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