

PRESENT STATUS OF EXPLOITATION OF FISH AND SHELLFISH RESOURCES : LIZARDFISHES

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ABSTRACT

The lizardfish fishery of the different maritime States along the west coast during monsoon is compared with the premonsoon and postmonsoon seasons. In Kerala the catch rate of lizardfishes was the highest during monsoon, while in Karnataka and Goa the peak catch rates were during premonsoon, followed by postmonsoon. In Maharashtra the most productive period was postmonsoon with the catch rates being the lowest during premonsoon and moderate during monsoon. In Gujarat the catch rates were almost equal during pre and postmonsoon seasons, there being no landings during monsoon. The lizardfish fishery at Cochin was supported mainly by *Saurida tumbil* (50.9%) and *S. undosquamis* (48.5%) with negligible quantities of *Trachinocephalus myops*. During premonsoon, the fishery was constituted almost exclusively by *S. undosquamis*. The dominant species in monsoon was *S. tumbil*, while in postmonsoon *S. undosquamis* predominated. The catch rate of *S. tumbil* in the inshore area indicated some correlation with the intensity of monsoon, while no such correlation could be observed for *S. undosquamis*. The peak spawning season of *S. undosquamis* appeared to be pre and postmonsoon months, while *S. tumbil* exhibited a prolonged breeding season and the fact that only a part of the lizardfish stock was available for exploitation during monsoon ruled out the possibility of monsoon trawling seriously affecting the spawning potential of the resource. At Bombay *S. tumbil* was the only dominant species occurring in all the seasons. The biological investigations of *S. tumbil* suggested that spawning took place in postmonsoon period and only 6.7% of the females had developing ovaries in monsoon. During monsoon only 5.7% of the fishes were below the minimum size of maturity and the sex ratio showed predominance of males. The recruitment of young ones was seen during premonsoon period. The fishing of *S. tumbil* in monsoon therefore did not seem to pose recruitment and growth overfishing problems causing depletion of the stock.

INTRODUCTION

The lizardfishes constituted mainly by *Saurida tumbil* and *S. undosquamis* form an important constituent of the demersal fishery resources exploited by small mechanised trawlers along the west coast of India. The average all India annual production of lizardfishes for the period 1975-84 was 11,476 tonnes. The average annual landings from the west coast was 8,849 t, forming 77% of the all India catch (Anon., 1986).

The lizardfishes are caught mainly by mechanised shrimp trawlers. As these trawlers operate within 50 m depth in the coastal waters where the traditional fishermen also fish, clashes have been frequent. To prevent the unhealthy competition between traditional and mechanised sector leading to clashes, most of the maritime States have enacted legislations demarcating the deeper areas for mechanised fishing and shallow inshore areas for the traditional sector. However, due to the lucrative catch and price offered to the penaeid prawns by exporters, increasing number of

trawlers undertake fishing operations during June - August period in States like Kerala in spite of inclement weather conditions prevailing during this period. On account of this, the fishermen operating traditional gears have been expressing a strong feeling that these trawlers fishing in monsoon months, adversely affect the stocks of demersal fishes resulting in poor catch returns in the recent years as compared to the fish production in the past when trawling operations remained suspended during monsoon months. It is in this context, the present investigations are undertaken to examine whether the monsoon fishing has any effect on the fishery for lizardfishes in order to indicate a broad strategy that may be adopted by the government and the fishing industry for the rational exploitation of the resource.

The earlier reported works on the biology of lizardfishes in Indian waters included the studies by Annigeri (1963), Kuthalingam (1959), Rao (1983) and Dighe (1977). The information available on the spatial and seasonal distribution of the lizardfish resources is limited to the works of Joseph (1980),

Sulochanan and John (1988), Sudarsan *et al.* (1988, 1989) and Nair and Reghu (1990).

DATA BASE

The data collected on catch and effort of lizardfishes by the Fisheries Resources Assessment Division of the Central Marine Fisheries Research Institute (CMFRI) during 1984 - 1988 were utilised for the present study to understand the annual and seasonal fluctuations of the fishery in the different maritime States of the west coast. In order to compare the monsoon fishery with the other seasons the fishing period was divided into pre-monsoon (February-May), monsoon (June-August) and postmonsoon (September-January). At Cochin the species composition, size, sex and maturity condition of *Saurida tumbil* and *S. undosquamis* were collected regularly during 1984-88. The data on monthly lizardfish landings were examined with reference to the rainfall data to see whether any relationship existed between these parameters.

OBSERVATIONS

Fishery characteristics

Annual production : Kerala ranked first in the production of lizardfishes, the average estimated annual landing for the period 1971-88 being 5,863 t forming more than 64% of the total lizardfish catch of the west coast (Table 1). Though there were wide fluctuations in annual landings, the fishery showed an increasing trend from 1,395 t in 1971 to 11,294 t in 1975. There was, however, a drastic decline in the production to 99 t in 1976, only to increase again to 5,169 t in 1977. The production stabilised between 5,000 - 7,000 t during 1978-82. The highest catch of 13,336 t was recorded in 1988.

Karnataka contributed to only 7.1% (630 t) of the total lizardfish production on the west coast. Exhibiting wide fluctuations in annual catches, no definite trend in the production pattern of lizardfishes in the State was observed. During nineteen seventies, the catch varied from nil to negligible quantities in most of the years, the maximum catch recorded being only 385 t in 1977. The landings, which fluctuated between 148 and 1,364 t in the early eighties, increased to 2,672 t in 1987 and 2,911 t in 1988.

The lizardfish fishery in Goa was relatively poor till 1974. It, however, showed an increasing

TABLE 1. Annual Lizardfish landings in different maritime States along the west coast of India during 1971-1987

| Year | Kerala | Karnataka | Goa | Maharashtra | Gujarat | Total |
|-----------------------|--------|-----------|-----|-------------|---------|--------|
| 1971 | 1395 | 351 | - | 148 | - | 1,894 |
| 1972 | 1426 | 18 | - | 577 | 1169 | 3190 |
| 1973 | 1136 | - | - | 987 | 563 | 2686 |
| 1974 | 8839 | 3 | 1 | 637 | 1546 | 110266 |
| 1975 | 11294 | 75 | 151 | 218 | 1267 | 13005 |
| 1976 | 99 | 187 | 25 | 1089 | 2797 | 4197 |
| 1977 | 5169 | 385 | 239 | 1135 | 42 | 6970 |
| 1978 | 6246 | 92 | 279 | 1815 | 82 | 8514 |
| 1979 | 5326 | 155 | 104 | 2374 | 6 | 7965 |
| 1980 | 7080 | 508 | 199 | 1057 | 85 | 8929 |
| 1981 | 5691 | 148 | 707 | 1308 | 110 | 7964 |
| 1982 | 5480 | 250 | 403 | 1160 | 807 | 8100 |
| 1983 | 5456 | 1364 | 540 | 3236 | 627 | 11233 |
| 1984 | 6322 | 591 | 736 | 2170 | 1619 | 11438 |
| 1985 | 6205 | 479 | 447 | 1883 | 1007 | 10021 |
| 1986 | 6594 | 1153 | 724 | 2875 | 227 | 11573 |
| 1987 | 5196 | 2672 | 640 | 1777 | 470 | 10755 |
| 1988 | 13336 | 2911 | 245 | 2388 | 554 | 19434 |
| Average for 1971-1988 | 5683 | 630 | 307 | 1491 | 721 | 8827 |
| Percentage | 64.4 | 7.1 | 3.4 | 16.9 | 8.2 | |

trend in the subsequent years with the production ranging from 25 t (1977) to 736 t (1984). The mean annual production was 308 t.

During 1971-1988, Maharashtra contributed, on an average, 1,491 t forming 16.89% of the total lizardfish production along the west coast. Though the fishery was characterised by fluctuations in annual landings, it indicated an upward trend, the catch increasing from 148 t (1971) to 2,386 t (1988). The highest landing of 3,236 t was recorded in 1983.

The average estimated annual landings in Gujarat was 721 t which formed 8.2% of the lizardfish landings of the west coast. The fishery which had been comparatively good during 1972 - 1976 dwindled drastically to 42 t in 1977 and generally remained low till 1981. The catch increased to 807 t in 1982, reached 1,619 t in 1984 and again to 226 t in 1986. Thereafter a revival of the fishing was seen in 1987 and 1988.

Gearwise landings : The gearwise analysis of lizardfish landings for the period 1984-88 (Table 2) showed that they were caught predominantly by mechanised trawls, contributing to 97.5% of the total catch in Kerala, 99.9% in Karnataka, 98.3% in Maharashtra and 99.2% in Gujarat. In Goa, the landings were exclusively by trawls. The contribution from gears such as hooks and line, gill net and boat seine accounted for 2.5% of the total lizardfish catch in Kerala, while in Karnataka only stray catches were recorded in purse seine and gillnets. In Gujarat and Maharashtra small quantities were caught by gillnets.

Seasonwise landings : The seasonwise distribution of effort (boat trip), catch (t), catch rate (kg/boat trip), seasonwise percentage in annual lizardfish landings and the percentage of lizardfishes in total trawl catch in different States of the west coast are given in Tables 3 - 7. It is seen that in Kerala during premonsoon period the average catch was 2,294 in 1988. The average catch rate was 10.4 kg/bt and the percentage of lizardfishes was 5.1% of the total trawl landings. About 31.2% of the annual lizardfish catch was obtained during this period. During the monsoon period, the average catch was 2,654 t which ranged from 1,648 t in 1987 to 4,959 t in 1988. The average catch rate was 37.7 kg/bt which ranged from 26 kg/bt (1984) to 49.1 kg/bt (1988). The monsoon period contributed more than 36.1% of the total annual lizardfish landings. In postmonsoon period the average catch was 2,392 t fluctuating from 1107 t (1985) to 3,897 t (1988). The average catch rate was 10.8 kg/bt, the percentage contribution for the period being 32.6% of the annual lizardfish landings. Thus, the monsoon period could be considered as the most productive period in Kerala when the mean catch rate of lizardfishes was higher than that in the premonsoon and postmonsoon seasons (Table 3).

In Karnataka (Table 4) the premonsoon period was the most productive season when more than 63% of the annual lizardfish catch was landed, the balance being obtained during the postmonsoon months. There was no landing during monsoon, the average trawling effort expended being only 2.4% of the annual effort. During premonsoon the average catch was 1,134 t which fluctuated from 383 t in 1985 to 2,080 t in 1988. The average catch rate for the period was 11.4 kg/bt. During postmonsoon period the average catch was 667 t at a catch rate of 6.3 kg/bt and the catch

TABLE 2. Gearwise catch (tonnes) of lizardfishes in different maritime States of the west coast during 1984-88

| Year | Trawls net | Hooks & line | Gill net | Boat seine | Purse seine | Others | Total |
|--------------------|------------|--------------|----------|------------|-------------|--------|-------|
| <i>Kerala</i> | | | | | | | |
| 1984 | 6099 | 158 | 58 | - | - | 7 | 6322 |
| 1985 | 6075 | 32 | 68 | 4 | - | 24 | 6203 |
| 1986 | 6447 | 131 | 6 | 10 | - | - | 6594 |
| 1987 | 5076 | 93 | 24 | 3 | - | - | 5196 |
| 1988 | 13001 | 87 | 168 | - | - | 80 | 13336 |
| Average | 7340 | 100 | 65 | 3 | - | 22 | 7530 |
| Percentage | 97.47 | 1.34 | 0.86 | 0.04 | | 0.29 | |
| <i>Karnataka</i> | | | | | | | |
| 1984 | 591 | - | - | - | - | - | 591 |
| 1985 | 479 | - | - | - | - | - | 479 |
| 1986 | 1149 | - | - | - | 4 | - | 1153 |
| 1986 | 2669 | - | 1 | - | 1 | 1 | 2672 |
| 1987 | 2908 | - | - | - | 2 | 1 | 2911 |
| Average | 1559 | - | 0.2 | - | 1.4 | 0.4 | 1,561 |
| Percentage | 99.88 | | 0.03 | | 0.06 | 0.03 | |
| <i>Goa</i> | | | | | | | |
| 1984 | 736 | - | - | - | - | - | 736 |
| 1985 | 447 | - | - | - | - | - | 447 |
| 1986 | 724 | - | - | - | - | - | 724 |
| 1987 | 640 | - | - | - | - | - | 640 |
| 1988 | 245 | - | - | - | - | - | 245 |
| Average | 558 | - | - | - | - | - | 558 |
| Percentage | 100.0 | | | | | | |
| <i>Maharashtra</i> | | | | | | | |
| 1984 | 1,955 | - | 42 | - | - | - | 1997 |
| 1985 | 1883 | - | - | - | - | - | 1883 |
| 1986 | 2875 | - | - | - | - | - | 2875 |
| 1987 | 1634 | - | 143 | - | - | - | 1777 |
| 1988 | 2388 | - | - | - | - | - | 2388 |
| Average | 2147 | - | 37 | - | - | - | 2184 |
| Percentage | 98.31 | | 1.69 | | | | |
| <i>Gujarat</i> | | | | | | | |
| 1984 | 1,613 | - | 6 | - | - | - | 1619 |
| 1985 | 992 | - | 15 | - | - | - | 1007 |
| 1986 | 227 | - | - | - | - | - | 227 |
| 1987 | 463 | - | 7 | - | - | - | 470 |
| 1988 | 554 | - | - | - | - | - | 554 |
| Average | 770 | - | 6 | - | - | - | 776 |
| Percentage | 99.22 | | 0.78 | | | | |

TABLE 3. Seasonwise effort and catch particulars of lizardfishes caught by mechanised trawls in Kerala during 1984-88

| Year/ Season | Effort (boat trips) | Catch (tonnes) | Catch rate (kg/unit) | Percentage of lizardfish in annual catch | Percentage of lizardfishes in total trawl catch |
|--------------------|---------------------------|-------------------|-------------------------|--|--|
| <i>Premonsoon</i> | | | | | |
| 1984 | 132,565 | 1,522 | 11.4 | 24.9 | 5.8 |
| 1985 | 159,515 | 2,568 | 16.1 | 42.3 | 7.8 |
| 1986 | 192,098 | 1,969 | 10.2 | 30.5 | 5.8 |
| 1987 | 276,120 | 1,264 | 4.6 | 24.9 | 2.1 |
| 1988 | 336,995 | 4,145 | 12.3 | 31.9 | 5.9 |
| Average | 219,458 | 2,294 | 10.5 | 31.3 | 5.1 |
| <i>Monsoon</i> | | | | | |
| 1984 | 65,616 | 1,711 | 26.1 | 28.1 | 4.6 |
| 1985 | 59,417 | 2,400 | 40.4 | 39.5 | 6.5 |
| 1986 | 64,740 | 2,554 | 39.5 | 39.6 | 5.4 |
| 1987 | 60,931 | 1,648 | 27.1 | 32.5 | 4.5 |
| 1988 | 100,891 | 4,959 | 49.2 | 38.1 | 10.4 |
| Average | 70,319 | 2,654 | 37.7 | 36.2 | 6.5 |
| <i>Postmonsoon</i> | | | | | |
| 1984 | 100,371 | 2,866 | 28.5 | 47.0 | 10.2 |
| 1985 | 162,584 | 1,107 | 6.8 | 18.2 | 3.8 |
| 1986 | 150,999 | 1,924 | 12.7 | 29.9 | 5.2 |
| 1987 | 251,988 | 2,164 | 8.6 | 42.6 | 4.5 |
| 1988 | 437,376 | 3,897 | 8.9 | 29.9 | 4.6 |
| Average | 220,663 | 2,392 | 10.8 | 32.6 | 5.3 |

during the period, fluctuating from 96 t in 1985 to 1,430 t in 1987.

In Goa, the seasonal fishing trend reflected the pattern in Karnataka, with the premonsoon season contributing to 66.1% of the annual lizardfish catch, while the postmonsoon period contributed to the rest. There was no landing during monsoon when the trawling effort was very low forming only 6.9% of the annual trawling effort. During the premonsoon period the average catch was 340 t at a mean catch rate of 6.9 kg/bt. During postmonsoon, the catch fluctuated from 31 t (1988) to 477 t (1986), at an average catch of 139 t, there being no landings in 1984 and 1985. The average catch rate for the period was 5.8 kg/bt which fluctuated from 5.1 kg/bt in 1988 to 6.8 kg/bt in 1986 (Table 5).

In Maharashtra (Table 6) the average landing

was highest in postmonsoon (37.1%) followed by premonsoon (25.4%) and lowest during monsoon (14.5%). The average lizardfish production for the period 1984-88 during January - March in Maharashtra was estimated to be 491 t, the production being the lowest in 1984 and the highest in 1986. The catch rate fluctuated from 1.8 kg/bt in 1988 to 11.68 kg/bt in 1986, with an average of 4.7 kg/bt. During premonsoon, the average landing was 546 t at an average catch rate of 5.6 kg/bt. The maximum catch occurred in 1988 (1,110 t) and the minimum in 1985 (260 t). The average production was lowest during monsoon (312 t), which seemed to be mainly due to the lower trawling effort expended during the period. However, the catch rate realised during the period was comparatively high (8.2 kg/bt). The production ranged from 145 t in 1984 to 427 t in 1987, while the minimum and maximum catch rates were recorded in 1988 and 1986 respectively. The postmonsoon period was the most productive period recording the highest mean catch (1021 t) and catch rates (8.7 kg/bt). The maximum catch was recorded in

TABLE 4. Seasonwise effort and catch particulars of lizardfishes caught by mechanised trawls in Karnataka during 1984-88

| Year/ Season | Effort (boat trips) | Catch (tonnes) | Catch rate (kg/unit) | Percentage of lizardfish in annual catch | Percentage of lizardfishes in total trawl catch |
|--------------------|---------------------------|-------------------|-------------------------|--|--|
| <i>Premonsoon</i> | | | | | |
| 1985 | 75,764 | 383 | 5.1 | 79.9 | 2.8 |
| 1986 | 105,192 | 834 | 7.9 | 72.6 | 2.7 |
| 1987 | 127,988 | 1239 | 9.7 | 46.4 | 2.3 |
| 1988 | 86,696 | 2080 | 23.9 | 71.5 | 4.8 |
| Average | 98,910 | 1134 | 11.4 | 62.9 | 3.2 |
| <i>Monsoon</i> | | | | | |
| 1985 | 752 | - | - | - | - |
| 1986 | 3,346 | - | - | - | - |
| 1987 | 8,720 | - | - | - | - |
| 1988 | 7,279 | - | - | - | - |
| Average | 5,024 | - | - | - | - |
| <i>Postmonsoon</i> | | | | | |
| 1985 | 67,233 | 96 | 1.4 | 20.1 | 0.6 |
| 1986 | 70,243 | 315 | 4.5 | 27.4 | 1.1 |
| 1987 | 177,474 | 1430 | 8.1 | 53.6 | 2.8 |
| 1988 | 108,248 | 828 | 7.7 | 37.1 | 2.1 |
| Average | 105,799 | 667 | 6.3 | 37.1 | 2.1 |

1988 (1478 t), while the minimum occurred in 1987 (437 t). The catch rates, however, showed a decreasing trend from 17.5 kg/bt (1984) to 5.3 kg/bt (1988).

TABLE 5. Seasonwise effort and catch particulars of lizardfishes caught by mechanised trawlers in Goa during 1984-88

| Year/season | Effort (boat trips) | Catch (tonnes) | Catch rate (kg/unit) | Percentage of lizardfish in annual catch | Percentage of lizardfishes in total trawl catch |
|--------------------|---------------------|----------------|----------------------|--|---|
| <i>Premonsoon</i> | | | | | |
| 1984 | - | - | - | - | - |
| 1985 | 56,018 | 447 | 7.9 | 100.0 | 2.5 |
| 1986 | 34,678 | 247 | 7.1 | 34.1 | 1.4 |
| 1987 | 59,424 | 471 | 7.9 | 73.6 | 2.6 |
| 1988 | 45,089 | 194 | 4.3 | 79.2 | 0.9 |
| Average | 48,802 | 340 | 6.9 | 66.1 | 1.8 |
| <i>Monsoon</i> | | | | | |
| 1984 | 17,028 | - | - | - | - |
| 1985 | 2,635 | - | - | - | - |
| 1986 | 6,286 | - | - | - | - |
| 1987 | 2,844 | - | - | - | - |
| 1988 | 2,530 | - | - | - | - |
| Average | 6,265 | - | - | - | - |
| <i>Postmonsoon</i> | | | | | |
| 1984 | 36,329 | - | - | - | - |
| 1985 | 30,178 | - | - | - | - |
| 1986 | 70,006 | 477 | 6.8 | 65.8 | 1.8 |
| 1987 | 32,820 | 169 | 5.2 | 26.4 | 1.4 |
| 1988 | 9,947 | 51 | 5.1 | 20.8 | 1.4 |
| Average | 35,856 | 139 | 3.9 | 33.9 | 0.7 |

In Gujarat, the lizardfish production was almost of the same magnitude during premonsoon and postmonsoon period, there being no landing during monsoon. During premonsoon the catch ranged from 39 t in 1987 to 985 t in 1988 at an average of 382 t. The average catch rate was 9.2 kg/bt fluctuating from 0.8 kg/bt (1987) to 21.8 kg/bt in (1988). During postmonsoon the average production was 388 t at an average catch rate of 9 kg/bt (Table 7).

Fishing at selected centres

Cochin : The estimated annual effort, catch and catch per unit of lizardfishes for the period 1984-

TABLE 6. Seasonwise effort and catch particulars of lizardfishes caught by mechanised trawlers in Maharashtra during 1984-88

| Year/Season | Effort (boat trips) | Catch (tonnes) | Catch rate (kg/unit) | Percentage of lizardfish in annual catch | Percentage of lizardfishes in total trawl catch |
|---------------------------|---------------------|----------------|----------------------|--|---|
| <i>January - March</i> | | | | | |
| 1984 | 30,537 | 315 | 10.3 | 16.1 | 1.2 |
| 1985 | 40,170 | 418 | 10.4 | 22.2 | 1.6 |
| 1986 | 76,776 | 897 | 11.7 | 31.2 | 2.2 |
| 1987 | 9,319 | 332 | 3.5 | 20.3 | 0.7 |
| 1988 | 281,536 | 495 | 1.8 | 20.7 | 0.7 |
| Average | 104,667 | 491 | 4.7 | 22.9 | 1.2 |
| <i>April - June</i> | | | | | |
| 1984 | 31,848 | 446 | 14.0 | 11.8 | 3.1 |
| 1985 | 30,733 | 260 | 8.5 | 13.8 | 0.9 |
| 1986 | 62,981 | 476 | 7.6 | 16.6 | 1.4 |
| 1987 | 51,353 | 438 | 8.6 | 26.8 | 1.6 |
| 1988 | 303,766 | 1110 | 3.7 | 46.4 | 1.3 |
| Average | 96,136 | 546 | 5.7 | 25.4 | 1.5 |
| <i>July - September</i> | | | | | |
| 1984 | 16,922 | 145 | 8.6 | 7.4 | 0.7 |
| 1985 | 16,656 | 213 | 12.8 | 11.3 | 1.3 |
| 1986 | 16,599 | 353 | 21.3 | 12.2 | 1.5 |
| 1987 | 26,706 | 427 | 16.0 | 26.1 | 1.9 |
| 1988 | 114,453 | 425 | 3.7 | 17.8 | 1.4 |
| Average | 38,267 | 312 | 8.2 | 14.5 | 1.5 |
| <i>October - December</i> | | | | | |
| 1984 | 59,780 | 1049 | 17.5 | 53.7 | 2.2 |
| 1985 | 89,076 | 992 | 11.1 | 52.7 | 1.1 |
| 1986 | 90,492 | 1149 | 12.7 | 39.9 | 2.2 |
| 1987 | 72,186 | 437 | 6.1 | 26.8 | 0.9 |
| 1988 | 278,477 | 1478 | 5.3 | 15.1 | 0.9 |
| Average | 118,002 | 1021 | 8.7 | 37.2 | 1.8 |

85 to 1987-88 are presented in Table 8. The trawling effort expended was found to be lowest in 1985-86 (30,044 bt) and highest in 1987-88 (46,762 bt), the average annual trawling effort expended for the period being 39,404 units. The total estimated average annual production of lizardfishes for the period 1984-88 was 507 t. Though there was a slight decline in the catch during 1985-86, it increased from 318 t in 1984-85 to 776 t in 1987-88. The annual catch rate also had been showing an increasing trend from 7.28 kg/bt in 1985-86 to 16.59 kg/bt in 1987-88.

TABLE 7. Seasonwise effort and catch particulars of lizardfishes caught by mechanised trawlers in Gujarat during 1984-88

| Year/ Season | Effort (boat trips) | Catch (tonnes) | Catch rate (kg/unit) | Percentage of lizardfish in annual catch | Percentage of lizardfishes in total trawl catch |
|--------------------|---------------------------|-------------------|-------------------------|--|--|
| <i>Premonsoon</i> | | | | | |
| 1984 | 45,143 | 985 | 21.8 | 61.1 | 2.1 |
| 1985 | 31,757 | 466 | 14.7 | 46.9 | 1.1 |
| 1986 | 48,806 | 143 | 2.9 | 62.9 | 0.2 |
| 1987 | 47,610 | 39 | 0.8 | 8.4 | 0.1 |
| 1988 | 34,093 | 277 | 8.1 | 50.0 | 0.8 |
| Average | 41,481 | 382 | 9.2 | 49.6 | 0.8 |
| <i>Monsoon</i> | | | | | |
| 1984 | 547 | - | - | - | - |
| 1985 | 1,582 | - | - | - | - |
| 1986 | 276 | - | - | - | - |
| 1987 | 1,874 | - | - | - | - |
| 1988 | 1,241 | - | - | - | - |
| Average | 1,104 | - | - | - | - |
| <i>Postmonsoon</i> | | | | | |
| 1984 | 44,913 | 628 | 14.0 | 38.9 | 1.1 |
| 1985 | 54,217 | 526 | 9.7 | 53.0 | 0.7 |
| 1986 | 37,383 | 84 | 2.2 | 37.0 | |
| 1987 | 44,088 | 424 | 9.6 | 91.5 | 0.8 |
| 1988 | 34,100 | 277 | 8.1 | 50.0 | 0.5 |
| Average | 42,940 | 388 | 9.0 | 50.4 | 0.7 |

The seasonal distribution of trawling effort, catch and catch rates of lizardfishes for the period 1984-85 to 1987-88 are presented in Table 10. During premonsoon period the average catch of lizardfishes at Cochin was 175 t forming 24.3% of the total annual lizardfish catch for an average fishing effort of 18,600 bt. The average catch rate

TABLE 8. Annual effort and catch particulars of lizardfishes at Cochin during 1984-88

| Year | Effort (Boat trip) | Catch (kg) | Catch rate (kg/boat trip) |
|---------|-----------------------|---------------|------------------------------|
| 1984 | 38,190 | 318,400 | 8.33 |
| 1985 | 30,038 | 219,000 | 7.28 |
| 1986 | 46,171 | 713,000 | 15.44 |
| 1987 | 46,762 | 776,000 | 16.59 |
| 1988 | 49,764 | 1,699,000 | 34.15 |
| Average | 42,183 | 744.8 | 17.65 |

during the period was 9.41 kg/bt. The catch fluctuated from 21 t at a catch rate of 1.38 kg/bt in 1985 to 682 t at a catch rate of 31.85 kg/bt in 1988. During monsoon season, an average 450 t forming 62.5% of the total annual lizardfish catch were landed. The total catch of lizardfishes was the highest during the monsoon of 1988 (796 t), while the lowest catch was recorded in the monsoon of 1985 (191 t). However the contribution of monsoon fishery to the total annual lizardfish landings was found to be higher during 1984 and 1986, forming 89.2% and 87.2% of the annual landings respectively, when the premonsoon and postmonsoon fishery were poor. The average fishing effort during the period was 11,699 units. The average catch rate was 38.48 kg/bt, the highest among all seasons, which had been showing an increasing trend from 19.83 kg/bt in 1984 to 89.9 kg/bt in 1988. In postmonsoon period the average production was 119.8 t for a mean fishing effort of 11,844 bt and the catch rate of 10.6 kg/bt. Thus when compared with premonsoon and postmonsoon seasons the catch as well as catch rates of lizardfishes in monsoon season were found to be considerably higher.

The lizardfish fishery at this Centre was supported mainly by *Saurida tumbil* (50.9%) and *S. undosquamis* (48.5%) with negligible quantities of *Trachinocephalus myops* (Table 12). During the premonsoon months the fishery was constituted almost exclusively by *S. undosquamis* forming 96 and 83.7% of the catch in 1987 and 1988 respectively. *S. tumbil* was the main component species exploited during monsoon. *S. undosquamis* was not landed during the monsoon months in 1986, while in 1987 it formed 0.1% of the total lizardfish catch during this period. However its share increased to 45.9% in 1988. On an average, during postmonsoon period, the contribution of *S. tumbil* and *S. undosquamis* was 49.3% and 50.6% respectively.

Bombay : The average annual catch of lizardfishes at Sassoon Dock and New Ferry wharf landing centres together by the trawlers was 1,876 t at a catch rate of 39.6 kg/bt (Table 9). The lizardfishes formed 2.3% of the total fish landings.

During premonsoon period, the average catch of lizardfishes was 641.1 t which fluctuated from 420.8 t in 1985 to 1,206 t in 1988. The average catch rate during this period was 39.4 kg/bt (Table 11). During monsoon season, the average

TABLE 9. Annual effort and catch particulars of lizardfishes in trawl catches at Bombay during 1984-88

| Year | Effort (Boat trip) | Catch (kg) | Catch rate (kg/boat trip) |
|---------|--------------------|------------|---------------------------|
| 1984 | 44,512 | 1209,594 | 27.17 |
| 1985 | 42,590 | 1086,215 | 29.50 |
| 1986 | 47,231 | 2038,033 | 43.15 |
| 1987 | 49,480 | 1493,610 | 30.18 |
| 1988 | 52,918 | 3551,035 | 67.15 |
| Average | 47,346 | 1875,697 | 39.61 |

catch was 150.6 t, varying from 34.4 t in 1984 to 256.4 t in 1988 at an average catch rate of 23.3 kg/bt. In the postmonsoon period the average catch was 1083.9 t and it fluctuated from 544.6 t in 1985 to 2,008.6 t in 1988. The average catch rate was 44.04 kg/bt being the highest among all the seasons. Thus, this period was found to be the best period for lizardfish fishery registering 47.2% and 10.5%

TABLE 10. Seasonwise effort and catch particulars of lizardfishes in trawl catches at Cochin during 1984-88

| Year/Season | Effort (Boat trip) | Catch (kg) | Catch rate (kg/boat trip) |
|--------------------|--------------------|------------|---------------------------|
| <i>Premonsoon</i> | | | |
| 1984 | 19,786 | 33,000 | 1.65 |
| 1985 | 15,458 | 21,000 | 1.38 |
| 1986 | 20,337 | 32,000 | 1.55 |
| 1987 | 19,510 | 108,000 | 5.54 |
| 1988 | 17,912 | 682,000 | 31.35 |
| Average | 18,600 | 175,200 | 9.41 |
| <i>Monsoon</i> | | | |
| 1984 | 14,378 | 285,000 | 19.83 |
| 1985 | 5,910 | 191,000 | 32.25 |
| 1986 | 14,918 | 534,000 | 35.78 |
| 1987 | 14,447 | 445,000 | 30.78 |
| 1988 | 8,846 | 796,000 | 89.91 |
| Average | 11,699 | 450,200 | 38.48 |
| <i>Postmonsoon</i> | | | |
| 1984 | 4,026 | 400 | 0.09 |
| 1985 | 8,670 | 7,000 | 0.79 |
| 1986 | 10,916 | 147,000 | 13.51 |
| 1987 | 12,805 | 223,000 | 17.42 |
| 1988 | 23,006 | 221,800 | 9.64 |
| Average | 11,844 | 119,840 | 10.08 |

higher catch rate than in the monsoon and premonsoon seasons respectively. When compared with postmonsoon and premonsoon seasons the catch as well as the catch rates of lizardfishes in monsoon season were 7.2 and 4.3 times lesser and 89.3% and 69.5% lower respectively.

Four species of lizardfishes viz. *Saurida tumbil*, *saurida undosquamis*, *Synodus indicus* and *Trachinocephalus myops* were found in the trawl catches of the Bombay waters. The catch composition of the four species in different seasons during 1987 and 1988 is given in Table 13. Among these species, only *S. undosquamis* occurred in all the seasons in both the years, *S. indicus* and *T. myops* occurred in monsoon period with negligible percentage of 0.08 and 0.72 in 1987 and 0.06 and 0.19 in 1988 respectively.

TABLE 11. Seasonwise effort and catch particulars of lizardfishes in trawl catches at Bombay during 1984-88

| Year | Effort (Boat trip) | Catch (kg) | Catch rate (kg/boat trip) |
|--------------------|--------------------|------------|---------------------------|
| <i>Premonsoon</i> | | | |
| 1984 | 14,439 | 439,712 | 30.45 |
| 1985 | 14,988 | 420,888 | 28.08 |
| 1986 | 17,177 | 515,540 | 30.01 |
| 1987 | 17,486 | 543,370 | 31.07 |
| 1988 | 17,190 | 1286,031 | 74.81 |
| Average | 16,256 | 641,108 | 39.43 |
| <i>Monsoon</i> | | | |
| 1984 | 6,344 | 54,387 | 8.57 |
| 1985 | 5,585 | 120,653 | 21.60 |
| 1986 | 6,510 | 109,190 | 16.77 |
| 1987 | 5,991 | 212,492 | 35.47 |
| 1988 | 7,955 | 256,422 | 32.33 |
| Average | 6,477 | 150,629 | 23.26 |
| <i>Postmonsoon</i> | | | |
| 1984 | 23,729 | 715,495 | 30.15 |
| 1985 | 22,017 | 544,674 | 24.74 |
| 1986 | 23,544 | 1413,303 | 60.03 |
| 1987 | 26,003 | 737,748 | 20.37 |
| 1988 | 27,773 | 2008,582 | 72.32 |
| Average | 24,613 | 1083,960 | 44.04 |

BIOLOGY

Length composition

Saurida undosquamis : With the dominant modal size at 145 mm (Fig. 1) exclusively supported the fishery at Cochin in the premonsoon months in 1986. There was no landing of this species during monsoon, while the postmonsoon fishery was composed mainly of fishes with modes at 145 and 195 mm. In 1987, the premonsoon fishery was good consisting mainly of fishes with modes at 155 and 183 mm. The monsoon and postmonsoon fishing season was very poor. In 1988, the fishery was very good during premonsoon and monsoon when the dominant size modes were at 125, 175 and 245 mm in the former period and at 145, 165, 195 and 225 mm in the latter season.

TABLE 12. Seasonwise species composition of lizardfishes in trawl catches at Cochin during 1986-88

| Year/Season | <i>S. tumbil</i> | <i>S. undosquamis</i> | <i>T. myops</i> |
|--------------------|--------------------|-----------------------|-----------------|
| <i>Premonsoon</i> | | | |
| 1986 | - | - | - |
| 1987 | 4,000 (3.9) | 98,000 (96.1) | |
| 1988 | 101,000 (16.5) | 519,000 (83.7) | |
| Average | 52,500 (14.5) | 308,500 (85.5) | |
| <i>Monsoon</i> | | | |
| 1986 | 534,000 (100.0) | - | - |
| 1987 | 432,000 (97.0) | 1,000 (0.1) | 12,000 (2.9) |
| 1988 | 427,000 (53.6) | 366,000 (46.0) | 3,000 (0.4) |
| Average | 464,300 (78.4) | 122,300 (20.8) | 5,000 (0.8) |
| <i>Postmonsoon</i> | | | |
| 1986 | 75,000 (50.6) | 73,000 (49.4) | - |
| 1987 | 52,000 (22.8) | 176,000 (77.2) | - |
| 1988 | 160,600 (77.3) | 46,500 (22.4) | 600 (0.3) |
| Average | 95,800 (49.3) | 98,500 (50.6) | 200 (0.1) |

Figures in paranathesis indicate percentage.

During 1986-87, the successful monsoon fishery was supported by *S. tumbil* with modes at

265, 285 and 325 mm (Fig. 2). In the postmonsoon months the fishery, however, was composed of fishes with relatively smaller sizes at 145, 185 and 255 mm. During the premonsoon of 1987 the fishery was very poor. The monsoon fishery was composed of fishes with modes at 205, 275, 315 and 385 mm, while that of postmonsoon period by the juveniles at 205 mm modal size. In 1988, the fishery in the premonsoon season was contributed by fishes with modes at 185 and 195 mm while the monsoon fishery was supported by larger fishes with modes at 295 and 305 mm.

The seasonwise size distribution of *S. tumbil* at Bombay for the period 1987 and 1988 is given in Fig. 3. During premonsoon periods of 1987 and 1988, the size of the fish ranged from 90 to 470 mm and 90 to 440 mm respectively with mean size at 287.3 mm in 1987 and 250.8 mm in 1988. During monsoon the size range of *S. tumbil* was from 160 to 440 mm in 1987 and 180 to 450 mm in 1988 with mean sizes at 268.1 mm and 266.6mm respectively. In the postmonsoon period the size range was 190-490 mm in 1987 and 190-420 mm in 1988 with mean sizes at 289.3 mm and 259.3 mm in the two years respectively. The occurrence of small specimens in the size range of 90-210 mm (modal sizes 120 mm, 110 mm) in the premonsoon periods of 1987 and 1988, suggest recruitment in this period.

Spawning : The seasonal distribution of mature, ripe and spent *S. undosquamis* and *S. tumbil* at Cochin during premonsoon, monsoon and postmonsoon periods is given in Table 14. During the monsoon season *S. undosquamis* was composed almost exclusively of immature fish. The spawning season of the species was found to be prolonged as indicated by the continued occurrence of spawning and spent fish during the premonsoon and postmonsoon months.

S. tumbil spawns almost throughout the year. However, the percentage of gravid and spent fish in the fishery was found to be higher during monsoon as compared to premonsoon and postmonsoon seasons. In Bombay waters, 98.85% of females of *S. tumbil* had their ovaries in immature/resting phase in the premonsoon period, whereas 93.3% in the monsoon and 44.6% in postmonsoon period (Table 15). There was an increasing trend in the percentage of developing ovaries from 1.17% in premonsoon to 6.67% in monsoon and 31.1% in postmonsoon seasons. The mature and gravid

TABLE 13. Seasonwise species composition of lizardfishes in trawl catches (kg) at Bombay during 1987-88

| Year | <i>S. tumbil</i> | <i>S. undosquamis</i> | <i>Sy. indicus</i> | <i>T. myops</i> |
|--------------------|--------------------|-----------------------|--------------------|-----------------|
| <i>Premonsoon</i> | | | | |
| 1984 | 526,634 (96.2) | 6,955 (1.3) | 5,434 (1.0) | 4,347 (0.8) |
| 1988 | 1270,598 (98.8) | 11,831 (0.9) | - | 3,602 (0.3) |
| Average | 898,616 (98.3) | 8,393 (0.9) | 2,717 (0.3) | 3,975 (0.5) |
| <i>Monsoon</i> | | | | |
| 1987 | 210,261 (98.9) | 1,169 (0.6) | 170 (0.1) | 892 (0.4) |
| 1988 | 254,935 (99.4) | 846 (0.3) | 154 (0.1) | 487 (0.2) |
| Average | 232,598 (99.2) | 1,008 (0.4) | 162 (0.1) | 690 (0.3) |
| <i>Postmonsoon</i> | | | | |
| 1987 | 737,453 (99.9) | 295 (0.1) | - | - |
| 1988 | 1990,304 (99.1) | 18,078 (0.9) | - | - |
| Average | 1363,878 (99.3) | 9,186 (0.7) | - | - |

TABLE 14. Sex ratio and the gonadial condition of the females of *Saurida undosquamis* and *S. tumbil* at cochin during 1986-88

| Sex ratio/maturity | Premonsoon | | Monsoon | | Postmonsoon | |
|-----------------------|------------|------|---------|-------|-------------|------|
| | No. | % | No. | % | No. | % |
| <i>S. undosquamis</i> | | | | | | |
| Male | 61 | 37.4 | 1 | 20.0 | 85 | 49.1 |
| Female | 102 | 62.6 | 4 | 80.0 | 88 | 50.9 |
| Immature/resting | 51 | 50.0 | 4 | 100.0 | 13 | 14.9 |
| Developing | 24 | 23.5 | - | - | 7 | 8.0 |
| Gravid | - | - | - | - | 6 | 6.9 |
| Spent | 27 | 26.5 | - | - | 62 | 70.2 |
| <i>S. tumbil</i> | | | | | | |
| Male | 15 | 46.8 | 19 | 44.1 | 82 | 62.2 |
| Female | 17 | 53.2 | 136 | 55.9 | 50 | 37.8 |
| Immature/resting | 5 | 29.4 | 12 | 8.7 | 15 | 30.0 |
| Developing | - | - | 10 | 7.2 | 1 | 2.0 |
| Gravid | 2 | 11.8 | 7 | 5.1 | 8 | 16.0 |
| Spent | 10 | 58.8 | 107 | 79.0 | 26 | 52.0 |

Figures in paranthesis indicate percentage.

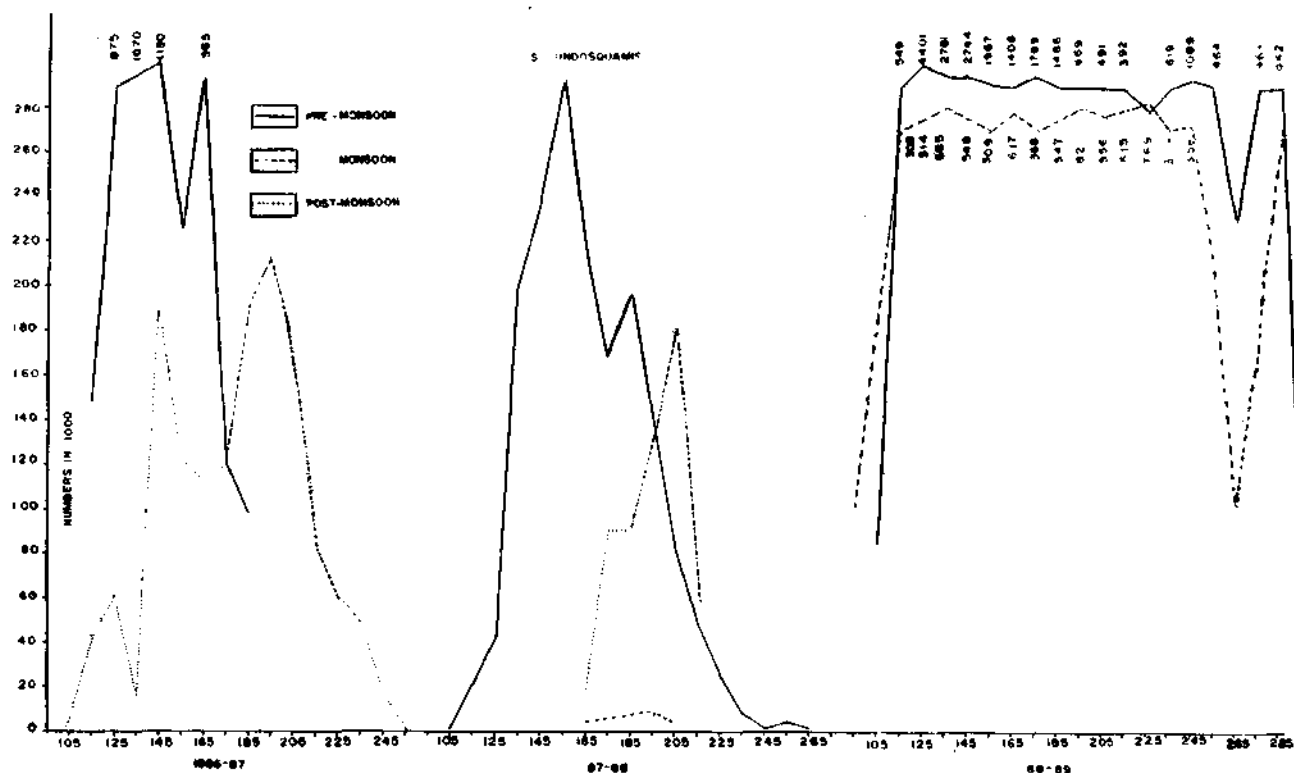


Fig. 1. Seasonwise size distribution of *Saurida undosquamis* in trawl catches at Cochin during 1986-88.

females were found only in postmonsoon period indicating that the spawning of *S. tumbil* occurs in postmonsoon period at Bombay.

The minimum size at maturity for *S. tumbil* in Bombay waters is 208 mm (Dighe, 1977). The

Relationship between rainfall and lizardfish fishery

The rainfall data for the period 1984-88 are plotted against the catch and catch rates of lizardfishes at Cochin to see whether any relationship

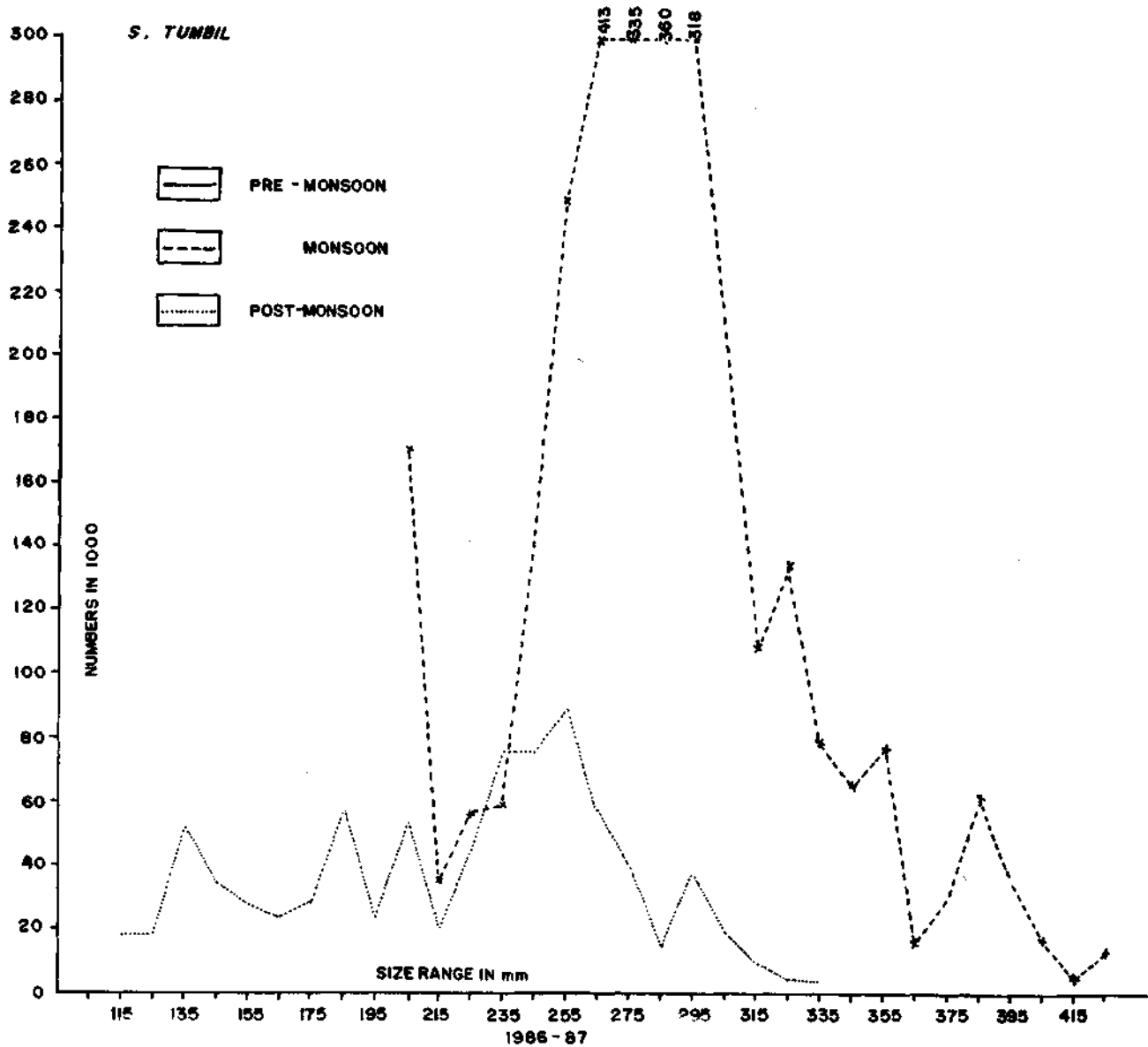


Fig. 2 a. Seasonwise size distribution of *Saurida tumbil* in trawl catches at Cochin during 1986-88.

percentage of fishes below the minimum size of maturity was 24.3 in the premonsoon, 5.7 in monsoon and 2.5 in the postmonsoon periods. The sex ratio showed dominance of males in all the three seasons.

exists between the fishery and the intensity of monsoon (Fig. 4). The monthly lizardfish catch showed an increase with the onset of monsoon with very high landings in June, the trend continuing upto August during most of the years. The catches

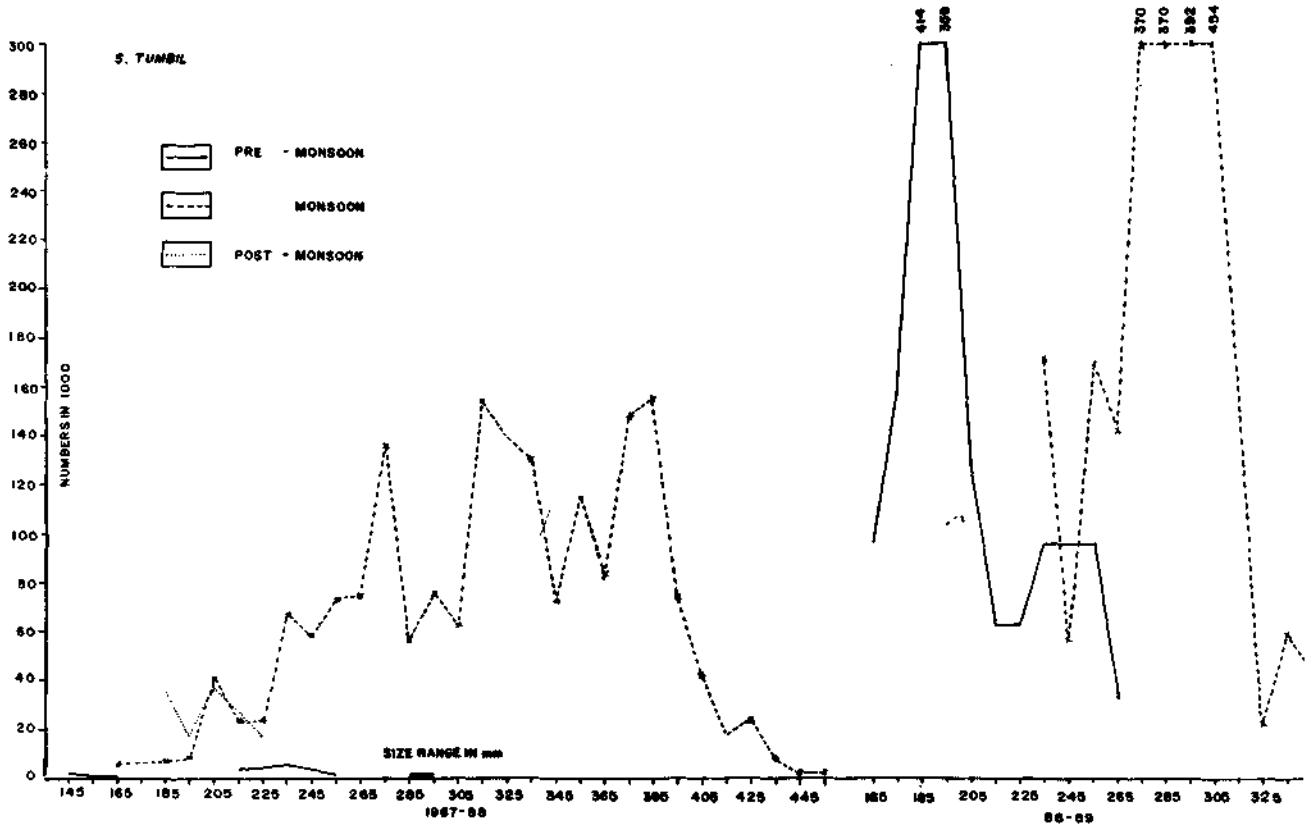


Fig. 2 b. Seasonwise size distribution of *Saurida tumbil* in trawl catches at Cochin during 1986-88.

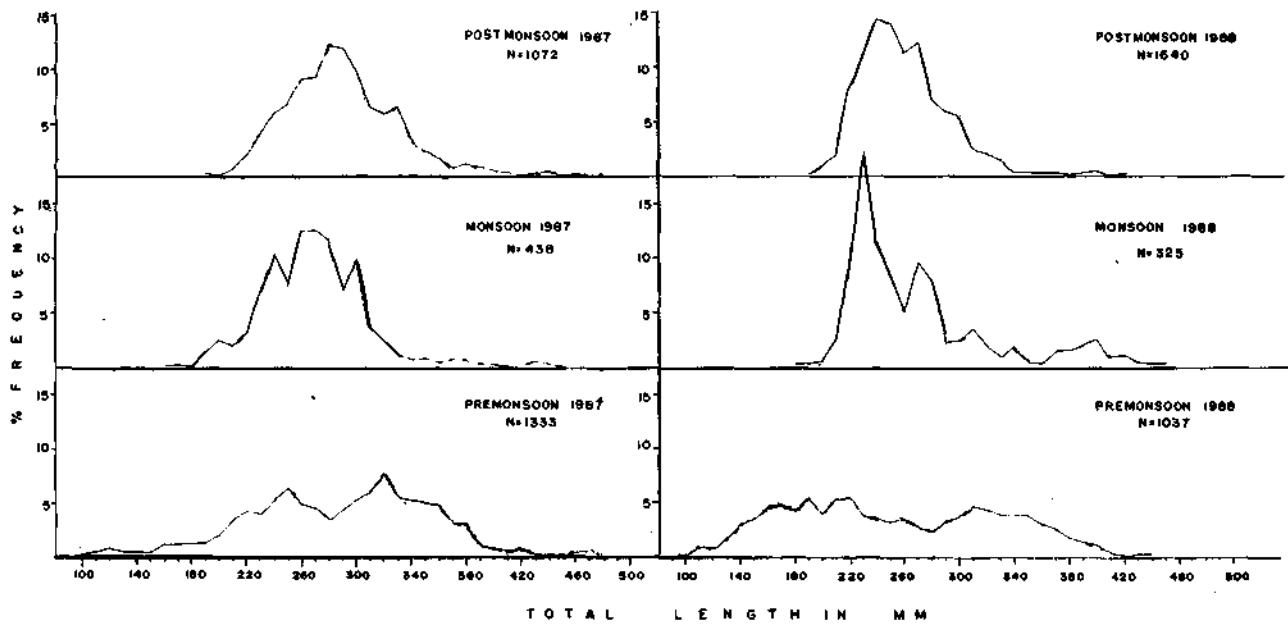


Fig. 3. Seasonwise size distribution of *Saurida tumbil* in trawl catches at Bombay during 1987-88.

were negligible in the premonsoon and postmonsoon periods of 1984, 1985 and 1986. In 1987 the fishery was comparatively better during the premonsoon and postmonsoon months with peak catches during monsoon.

In June 1985 the lizardfish catch was only 117 t, though the monsoon was rather vigorous with rainfall of 963 and 414 mm in June and July. In 1986, inspite of poor rainfall (610 and 296 mm in June and July respectively) the fishery was good, the landings being 158 and 205 t. Similarly very high catch rates for lizardfishes were observed when the monsoon was poor and *vice versa*. Thus no positive or negative correlation could be discerned between absolute monthly rainfall in a

TABLE 15. Seasonwise sex ratio and maturity stages of females of *Saurida tumbil* in trawl catches at Bombay during 1987-88

| Season | Males Nos. | Females Nos. | Sex ratio Males: Females | Female maturity stages | | |
|-------------|------------|--------------|--------------------------|------------------------|------------|----------------|
| | | | | Immature/ resting | Developing | Mature/ gravid |
| Premonsoon | 109 | 86 | 1:79 | 85 (98.8) | 1 (1.2) | - |
| Monsoon | 73 | 45 | 1:0.62 | 42 (93.3) | 3 (6.7) | - |
| Postmonsoon | 96 | 74 | 1:77 | 33 (44.6) | 23 (31.1) | 18 (24.3) |

Figures in paranthesis indicate percentage.

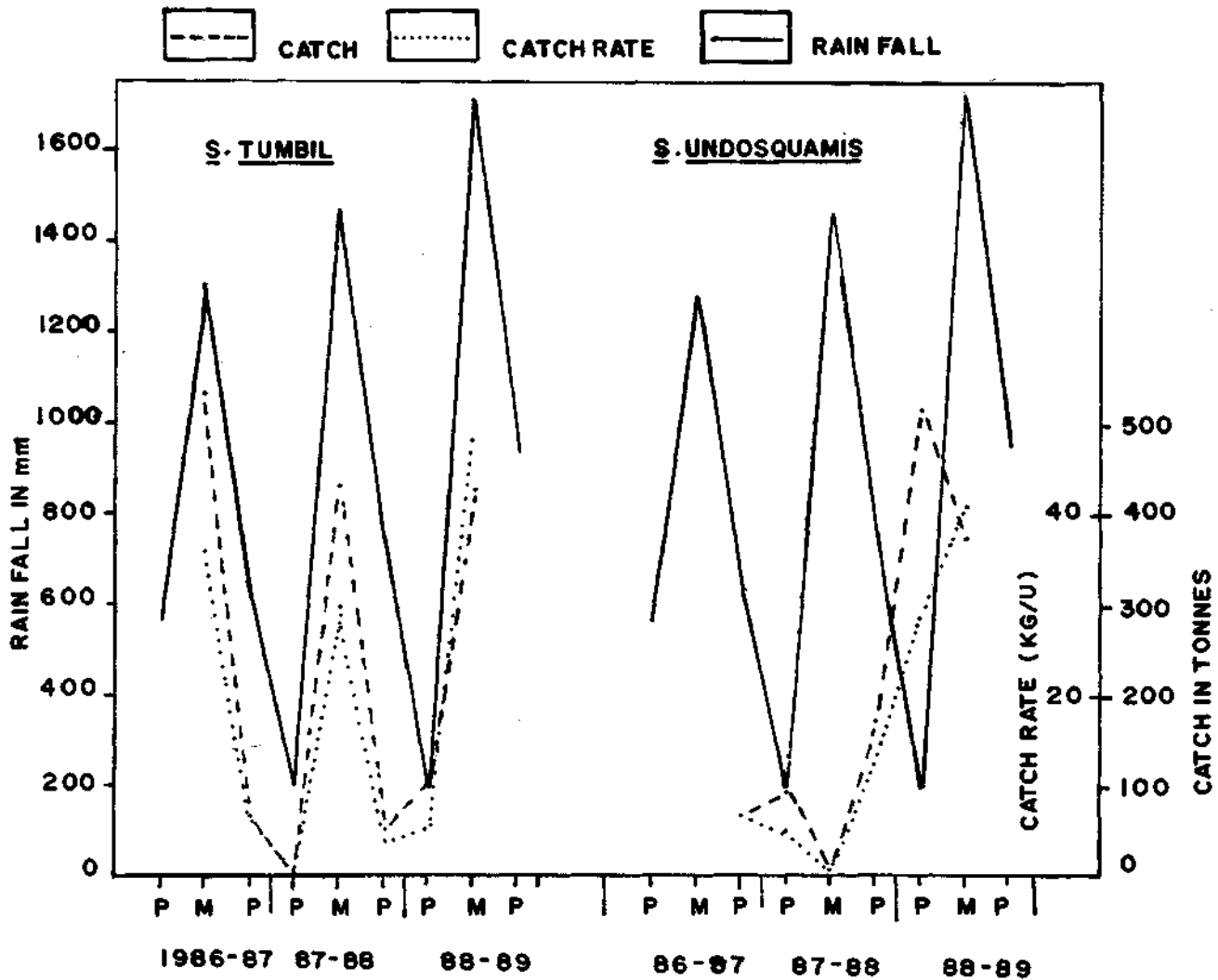


Fig. 4. Total and specieswise catch and catch rates of lizardfishes in relation to rainfall in different months at Cochin during 1984-88.

particular year and the catch and catch rates of lizardfishes.

The relationship between monthly rainfall and catch and catch rates of the important component species of lizardfishes *viz.*, *Saurida tumbil* and *S. undosquamis* is given in Fig. 4. The landings of *S. tumbil* were the maximum in the months of July (1986 and 1987) immediately following the peak monsoon rainfall in June, the total catch of the species exhibiting some degree of positive correlation with monsoon. In 1988 the peak catch rates occurred in August, coinciding with the highest monthly landings for the year, whereas in 1986 and 1987 the catch rates were found to be the highest in September, which was characterised by very poor landings. The catch and catch rates of *S. undosquamis* were the maximum in May during all the years and showed no positive or negative correlation with monsoon.

The relationship between rainfall and the catch trend of *S. tumbil* and *S. undosquamis* during premonsoon, monsoon and postmonsoon periods of 1986 to 1988 is analysed. The rainfall had been the lowest in 1986 the highest in 1988. The abundance of *S. tumbil* as indicated by catch rate, was the lowest in the monsoon of 1987, when the rainfall was moderate, In 1986 the catch was higher at 35.8 kg/bt, though the rainfall was comparatively less than that in the monsoon of 1987. However, the catch rate for the species was found to be the highest in the monsoon of 1988, when the monsoon was also at its maximum intensity indicating that some correlation exists in most of the years between the catch rate and rainfall. The main fishing seasons for *S. undosquamis* were the premonsoon and postmonsoon months and the abundance of the resource was not showing any correlation with the intensity of rainfall in a particular year.

DISCUSSION

The upwelling starts in the southern regions first and extends northwards with the onset of southwest monsoon (Ramamirtham and Rao, 1974; James *et al.*, 1987; Ramamirtham and Jayaraman, 1960). Jayaraman and Gogate (1957) showed the presence of oxygen deficient, highly saline, cold waters off Bombay during southwest monsoon due to upwelling. Along the Maharashtra Coast, the upwelling continues upto December off Bombay, though with less intensity (Rao *et al.*, 1972). Patil *et al.* (1962) reported that the stable summer conditions of the shelf waters along the Gujarat Coast gradually progress towards unstable conditions with the onset of southwest monsoon. The presence of oxygen deficient bottom waters brought about by upwelling during monsoon is reported to result in disappearance of demersal fishes as the fishes try to escape the oxygen poor colder waters by either migrating to the offshore surface waters or towards the shore (Banse, 1959; Carruthers *et al.*, 1959). Probably due to the varying effect of upwelling on the lizardfish resource along west coast the seasonwise abundance of the resource in the inshore coastal waters differs between different maritime States. Monsoon is the most productive season in Kerala, while in Karnataka and Goa there is no catch during monsoon months due to negligible fishing effort, the most productive season being premonsoon. In Maharashtra in spite of comparatively high catch rates the production is poor during monsoon due to reduced fishing effort, the most productive period being the postmonsoon. In Gujarat, the lizardfish production is almost equal during the premonsoon and postmonsoon periods, there being no fishery in monsoon period. In Kerala during monsoon the demersal stock of lizardfishes consisting mainly of *S. tumbil* is seen to concentrate at 20-45 m depth zone and is exploited by 28-32' shrimp trawlers. In the postmonsoon and premonsoon seasons, *S. tumbil* population seems to dissipate and randomly distributed. In Bombay, the fall in the catch rate of lizardfishes during monsoon by 89.3% and 69.5% as compared to that in the postmonsoon and premonsoon periods respectively supports the view reported by Banse (1959).

The exploratory trawling operations of Fishery Survey of India vessels indicated the availability of lizardfishes in the entire shelf area of the west coast with highest average catch of 10.8 kg/hr from Wadge Bank and 3.9 kg/hr from northwest coast with the highest concentration in 100-200 m depth zone (Joseph and John, 1986). The proportion of lizardfishes seems to be the highest off Cochin at 60-79 m depth. The potential yield of the resource along southwest coast was estimated to be 4,100 t, 2,900 t, 1,700 t and 500 t in the 0-50 m, 50-100 m, 100-200 m and 200-500 m depth strata respectively, the potential yield for the entire depth range being 9,200 t (Sudarsan *et al.*, 1989). The standing stock for the entire depth range estimated by them was 12,900 t. Nair and Reghu (1989) based

on the demersal trawling operations of FORV *Sagar Sampada* observed that lizardfishes, composed mainly of *Saurida tumbil* and *S. undosquamis*, were the most abundant at Wadge Bank (68.9 kg/hr) followed by southwest and northwest zones. However, in the bottom trawl catches of M. T. *Muraena* in the EEZ of the northwest coast lizardfishes accounted for only a small percentage of the groundfish catch. Nearly 80% of the catch was recorded from 91-125 and 126-360 m depth ranges with catch rates at 5.91 and 5.69 kg/hr respectively (Bapat *et al.*, 1982).

The average annual production of lizardfishes from the southwest coast comprising Kerala, Karnataka and Goa for the period 1984-88 is 9,772 t against an estimated annual potential of 9,200 t. The annual yield of lizardfishes for the entire west coast is estimated at 12,712 t against a potential yield of 12,300 t. In average annual yield of lizardfishes has thus been found to be higher than the estimated potential yield of the resource from the west coast. In 1988 the annual catch increased to 19,434 t. This high annual catch against potential yield clearly indicates that the MSY estimates of lizardfishes (Sudarsan *et al.*, 1989) are apparently gross underestimates. The seasonal migration of lizardfishes, mainly of *S. tumbil*, from deeper waters leading to their concentration in inshore fishing grounds during monsoon especially along the Kerala Coast also might not have been properly evaluated.

Joseph *et al.* (1987) recorded maximum catch and catch rates for lizardfishes at 46 - 73 m depths in the second and third quarters while in the fourth quarter the maximum occurred at 73-120 m depth. The depthwise seasonal distribution of lizardfishes showed that in the Wadge Bank and southwest coast the resource was the maximum in 41-60 and 61-80 m depth ranges during April - June closely followed by July-September, while in October-December the greatest abundance was at 101-150 m. However, in the northwest, the abundance in the shallower waters was the highest during October-December (Nair and Reghu, 1989). The same trend has been noticed in the catch trend of lizardfishes in the commercial fisheries at Cochin and Bombay. At Cochin the monsoon period contributes more than 80% of *S. tumbil* landings, while more than 78% of *S. undosquamis* catch is obtained during premonsoon and postmonsoon periods. The surveys conducted by FORV *Sagar Sampada* have

shown that the lizardfish resource of the southwest coast is composed mainly of (1) *S. tumbil* - the concentration of which is usually higher in deeper waters beyond 40 m during most part of the year and (2) *S. undosquamis* - the concentration of which is higher in comparatively shallower waters.

In order to understand the effect of fishing on lizardfish resources during monsoon two aspects namely, recruitment overfishing due to excessive removal of spawning stock that is responsible for the future recruitment and the growth overfishing due to large scale capturing of juvenile fishes which would grow in due course and add to the biomass are examined. The spawning season of *S. tumbil* in Kerala is prolonged, while the spawning of *S. undosquamis* is more intense during premonsoon and postmonsoon seasons. Since only a part of the stock becomes vulnerable to monsoon trawling, the fear of monsoon trawling being deleterious to the stock is unfounded. At Bombay the spawning period of *S. tumbil* is during postmonsoon period which is further supported by the appearance of young recruits in the premonsoon season that immediately follows it. Dighe (1977) also reported that *S. tumbil* exhibits breeding period from January. During monsoon only 6.7% of the females have developing ovaries, the rest having their ovaries in immature/resting state. Thus, capturing of lizardfish stock in monsoon does not appear to be detrimental to the stock causing recruitment overfishing problem.

The lizardfish fishery along the Kerala Coast seems to be supported by two distinct stocks of *S. tumbil* - an inshore resident stock and an offshore migrant stock that enters the coastal waters during monsoon. At Cochin the premonsoon and postmonsoon fishery is supported mainly by juveniles with modes at 145 to 205 mm, while the monsoon fishery is composed of fishes with modes at high size groups. At Bombay the juveniles of *S. tumbil* in the fishing grounds are observed during premonsoon period when 24.3% of the catch consists of juveniles, whereas in monsoon their representation is only 5.7% of the total catch. Thus, fishing in monsoon may not cause growth overfishing problem since the proportion of juveniles removed from the stock is relatively less.

In the maritime States of the west coast, bottom trawling is generally carried out by commercial shrimp trawlers primarily for prawns. However, in Kerala, there is directed fishing by

mechanised boats for finfish resources during monsoon. Among the finfish resources exploited, lizardfishes form a significant part of the catch. During this period due to the non-availability/scarcity of pelagics such as sardine, mackerel and carangids, lizardfishes fetch higher prices (Rs. 4/- to Rs. 5/- per kg) as compared to the other seasons (less than Rs. 2/- per kg). Moreover the fishery is mainly supported by *S. tumbil* which has got better consumer acceptance. It is felt that better price for the catch can be obtained if the fish is supplied to the consumer in a more fresh condition. *Since lizardfish is a resource exclusively harvested by*

mechanised trawlers, the question of any conflict with the traditional sector does not crop up. It may therefore be concluded that fishing in monsoon is not deleterious to the stock of lizardfishes in general and S. tumbil in particular.

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