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Marine Fishery Resources off Chennai: Landings by Day and Night Trawlers

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Abstract

Off Chennai, the trawlers engaged in night fishing realised nearly 25% higher catch rate (42.4 kg/h) than those engaged in day fishing (34.3 kg/h) during 1996-1998. Barring June and July, the catch rate of night trawlers was higher for 10 months in a year. The day : night ratio of catch rate was very high for catfishes, rays, eels and flatfishes. On the other hand, the ratio was low for carangids, perches and squids. The diel and seasonal vertical migration of fishes and the possibility of utilizing this information for fishing are discussed.

Key words: Fishery resources, trawlers, fish landings

Introduction

Catching capacity of a fishing gear is dependent on the availability and vulnerability of fish to that gear. The availability of fish is dependent on the environmental parameters, behaviour of fish and is often dependent on vertical distribution of fish stocks (Anon, 1980). Consequently, catch rate, which depicts the changing availability of fish to gear, fluctuates diurnally and seasonally in nearly all fisheries (Laevastu and Favorite, 1988). Hence, estimation of diurnal and seasonal vertical migration of fish stocks is of practical interest for fishing. Investigations on the relationship between vertical migration, availability of fish to gear and catchability are very few in the Indian waters. Silas (1974) and Venkataraman and Badrudeen (1974) reported seasonal vertical migration of the Indian mackerel and diurnal migration of the silverbellies, respectively and indicated that vertical migration influenced the catch rates. For the present study, data on effort, catch and catch rate of trawlers operated during day and night off Chennai during 1996-1998 were analysed in order to assess the possible diurnal and vertical migration of different fish stocks and to understand availability of fish to the trawl.

Material and Methods

The Chennai Fisheries Harbour, which is one of the large fisheries harbours along the southeast coast of India, provides base for about 700 trawlers. Of these, 150 trawlers (overall length: 10-11 m; engine capacity: 65-80 hp) undertake daily voyages and trawl at 15-80 m depth off Chennai (Vivekanandan, 1996). These trawlers either fish during daytime between 0600-1400 hours and land the catches between 1400-1800 hours or fish during night between 2200-0500 hours and land the catches between 0600-0800 hours everyday. All the trawlers employ bottom trawl nets with almost same design. The head rope length is 20 m and the cod end mesh size is 10-15 mm.

Data on the effort, catch and catch composition of the trawlers were collected from the landings at the harbour between 0600-1800 hours for 18 days in a month and converted for monthly values during 1996-1998. As the trawlers spent 2 to 4 hours in reaching the trawling grounds and an equal time for return to the base, the landings between 0600 and 0800 hours were considered to represent catches during night and those between 1400 and 1800 hours as catches during daytime.

Results

The trawlers which undertook daily voyage expended 190,932 fishing hours and landed 7,300 tonnes at the rate of 38.2 kg/h (Table 1). Though the trawlers spent more effort in day fishing, the landings by the night trawlers was about 15% higher (3897 tonnes) than the day trawling (3403 tonnes). Consequently, the trawlers engaged in night fishing realized nearly 25% higher catch rate (42.4 kg/h) than those engaged in day fishing (34.3 kg/h).

Table 1. Performance of day and night operations of commercial trawlers off Chennai (the values are annual averages for the year 1996-1998)

Time of trawling	Effort (h)	Landings (t)	Catch rate (kg/h)
Day	99126	3403	34.3
Night	91806	3897	42.4
Total	190932	7300	38.2

Analysis of data on the diurnal and seasonal variations in the performance of the trawlers revealed the following important patterns (Fig.1): (i) The total effort was higher during July, December and January. The night trawl effort was higher during January-March, but the day trawl effort was higher during May-September. (ii) The landing from night fishing were higher during 8 months in a year i.e., from September to April. (iii) The night operations realised substantially higher catch rates during 10 months in a year, except in June and July.

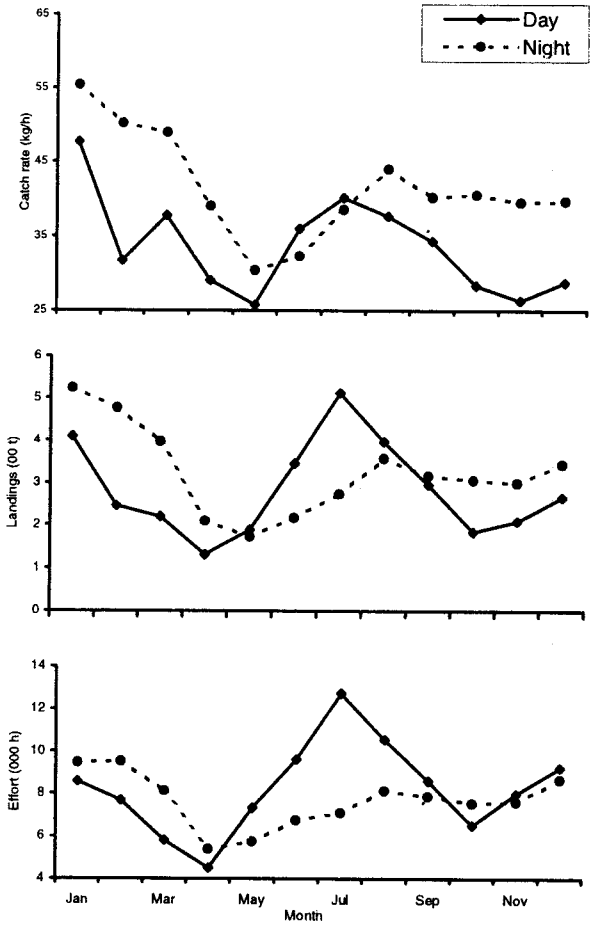

Fig. 1. Monthly effort, landings and catch rate of day and night trawling off Chennai

The trawlers landed 24 major groups of finfishes, crustaceans and cephalopods. During day trawling, the annual average catch rate (kg/h) of different groups of fishes *viz.*, silverbellies (5.2), carangids (4.4), threadfin breams (3.6), clupeids (2.2) and penaeid prawns (2.2) were high (Table 2). During night trawling also the catch rates of the same groups (barring carangids) were high: silverbellies (6.8), penaeid prawns (4.4), threadfin breams (4.2) and clupeids (3.5) (Table 3). The catch rates of several fish groups realised from day *vis-a-vis* night trawling were distinctly different. Based on the ratio of catch rates realised from day and night trawling (D:N ratio), the fish groups could be classified into the following 3 categories (Table 4): Category I: 14 groups with higher D:N ratio; for instance, the D:N ratio was very high for catfishes (1:10), rays (1:7.5), eels (1:7) and flatfishes (1:5). Category II: 7 groups with equal D:N catch rate ratio (for example, sharks, goatfishes, crabs, etc.). Category III: 3 groups with low D:N ratio (squids: 1:0.8; carangids: 1:0.5 and perches: 1:0.3).

A seasonal pattern in the catch rates of day and night trawling was also evident. Whereas the catch rates of 6 groups in category I were higher in the night trawling throughout the year, the catch rate of penaeid prawns was higher in the night trawling during January-October but day trawling realised higher catch rates in November-December (Table 4). The catches of several other groups were also higher in the night trawling during most part of the year barring June and July when day trawling yielded better catch rates. The catch rates of a few dominant groups that were considerably higher in the night trawling.

Discussion

The seasonal and diel differences in the catches and catch rates of several fish groups indicate the possibility of distinct diurnal vertical migration of several fish groups. As the commercial trawlers employed bottom trawl nets with a mouth opening of about 20 m, the catches would have realized whenever fishes descend to or remain near the bottom. Considering this, it is possible to interpret the categorization in Table 4 as the following three corresponding types of migratory behaviour of fishery groups: Category I: Groups with night time occurrence on or close to the bottom; migration and dispersal into the watermass above after sunrise (catfishes, rays, pomfrets, penaeid prawns etc.); Category II: Groups which spend considerable amount of time in midwater and without any distinct diel migration (clupeids, ribbonfishes, crabs, cuttlefishes etc.); Category III: Groups with daytime occurrence on or close to the bottom; migration and dispersal into the watermass below after sunset (*Psenes* sp., carangids and perches). According to Zusser (1985) the patterns and rates of diel vertical migrations are associated with the onset of evening and with morning twilight which stimulate food-searching behaviour.

The diel difference in the catch rates of most of the fish groups was distinctly different in June and July compared to other months. Seasonal differences in diurnal migration are due to either hydrographical changes or for spawning (Laevastu and Favorite, 1988). Silas (1974) collected larvae and post-larvae of the pelagic fish, the Indian mackerel from 30-80 m depth zone in the southwest coast and concluded that the fish migrates to the deeper waters for spawning.

Table 2. Catch rate (kg/h) of different fish groups realized from day trawling off Chennai during 1996-1998

Group	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Sharks	0.9	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1
Rays	0.2	0.2	0.2	0.2	0.2	0.1	0.0	0.1	0.0	0.1	0.3	0.3	0.2
Eels	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Catfishes	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Clupeids	2.5	3.5	3.6	4.4	1.1	2.3	2.1	2.1	2.4	1.1	1.2	1.4	2.2
Lizard fishes	0.8	1.0	1.6	1.4	3.1	3.5	2.4	2.1	1.9	1.6	0.6	0.3	1.8
Perches	1.5	0.8	2.0	1.8	1.8	2.5	4.0	2.5	1.1	0.4	0.0	0.0	1.7
Threadfin breams	4.6	3.3	3.3	2.5	3.3	3.9	5.5	4.0	4.2	3.7	1.7	1.5	3.6
Goatfishes	1.0	0.9	2.6	0.8	0.8	2.0	1.9	2.4	2.2	2.3	1.3	1.5	1.7
Croakers	1.9	1.0	1.3	0.8	0.6	0.5	0.4	0.6	0.8	0.7	1.6	2.0	1.0
Ribbon fishes	3.3	1.7	1.4	1.4	0.6	0.8	0.8	1.1	1.3	1.7	2.9	2.8	1.6
Carangids	12.4	4.3	4.3	0.7	1.6	3.8	8.3	5.3	4.4	2.2	0.2	0.4	4.4
Siverbellies	5.1	5.1	6.6	4.9	4.9	6.0	4.2	5.6	5.7	4.7	4.7	5.1	5.2
Pomfrets	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.1	0.1
Psenes	0.2	0.3	0.1	0.1	0.0	0.0	0.1	0.3	0.1	0.0	0.0	0.0	0.1
Mackerel	0.4	0.3	0.4	0.6	0.6	1.0	0.8	0.4	0.5	0.7	0.0	0.0	0.5
Seer fishes	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.0	0.0	0.1
Barracudas	0.4	0.2	0.4	0.3	0.0	0.3	0.7	0.6	0.6	0.3	0.0	0.0	0.3
Flatfishes	0.2	0.1	0.3	0.2	0.1	0.0	0.0	0.1	0.1	0.1	0.3	0.4	0.1
Penaeid prawns	3.8	2.8	2.3	1.7	1.5	1.6	0.9	1.2	1.6	1.6	3.8	4.6	2.2
Sand lobsters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Crabs	3.4	0.9	1.4	2.0	0.8	1.4	1.5	1.8	1.5	1.3	2.5	2.9	1.8
Stomatopods	0.1	0.0	0.2	0.1	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.0	0.1
Cuttlefishes	0.5	0.6	0.4	0.5	0.4	0.4	0.6	1.4	0.5	0.5	0.4	0.3	0.6
Squids	0.7	1.0	0.6	1.0	1.4	2.1	2.7	2.3	1.8	1.8	1.1	0.7	1.6
Miscellaneous	3.4	3.6	4.5	3.5	3.0	3.6	2.8	3.3	3.3	3.0	3.5	4.3	3.4

Table 3. Catch rate (kg/h) of different fish groups realized from night trawling off Chennai during 1996-1998

Group	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Sharks	0.2	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1
Rays	1.6	1.5	1.7	1.2	1.3	1.3	1.3	1.9	2.0	1.3	1.0	1.2	1.5
Eels	0.2	0.2	0.3	0.0	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Catfishes	0.4	0.3	0.4	0.4	0.2	0.1	0.2	0.1	0.1	0.3	0.2	0.2	0.2
Clupeids	3.6	4.3	6.9	5.2	2.1	1.9	3.1	3.6	2.8	2.6	2.6	2.8	3.5
Lizard fishes	2.9	3.0	2.0	2.4	2.2	2.2	2.6	3.0	2.5	2.5	1.9	1.2	2.4
Perches	0.4	0.3	0.5	1.2	0.6	0.6	0.6	1.0	0.6	0.2	0.3	0.2	0.5
Threadfin breams	6.5	5.9	3.9	3.0	3.3	2.9	3.9	4.4	4.0	4.4	4.2	2.7	4.2
Goatfishes	1.9	1.9	1.6	1.4	1.1	1.1	1.3	2.0	1.9	2.3	1.8	2.1	1.7
Croakers	4.1	3.2	3.2	2.4	1.5	1.4	1.4	2.3	2.4	3.2	2.9	3.0	2.7
Ribbon fishes	4.9	3.4	2.3	1.4	0.7	0.7	1.4	1.2	1.5	2.5	3.3	4.4	2.5
Carangids	2.7	2.3	3.3	1.7	1.0	1.7	1.9	2.9	2.0	1.8	2.0	1.4	2.1
Siverbellies	9.7	8.7	7.2	5.4	5.0	5.3	6.2	6.3	6.5	6.3	6.9	6.0	6.8
Pomfrets	0.6	0.3	0.2	0.1	0.2	0.1	0.1	0.2	0.3	0.2	0.3	0.2	0.2
Psenes	0.1	0.1	0.3	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Mackerel	0.3	0.8	1.2	1.4	0.4	0.5	0.6	0.8	0.3	0.2	0.1	0.2	0.5
Seer fishes	0.2	0.1	0.1	0.0	0.1	0.0	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Barracudas	0.6	0.4	0.5	0.4	0.2	0.4	0.6	0.6	0.6	0.3	0.2	0.2	0.4
Flatfishes	0.6	0.6	0.6	0.5	0.4	0.3	0.4	0.4	0.3	0.6	0.7	0.6	0.5
Penaeid prawns	6.6	5.3	4.2	3.4	3.3	4.1	5.2	4.2	3.9	3.5	3.8	4.2	4.4
Sand lobsters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Crabs	1.7	1.5	1.6	1.4	1.3	1.6	1.5	1.5	1.9	2.3	2.6	3.4	1.9
Stomatopods	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1
Cuttlefishes	0.9	0.8	0.9	0.8	0.6	0.6	1.0	1.2	1.0	1.0	0.6	0.7	0.8
Squids	1.0	1.3	1.3	1.3	1.1	1.4	1.5	1.9	1.5	1.4	0.9	0.9	1.3
Miscellaneous	3.5	3.4	4.4	3.7	3.4	3.9	3.3	4.0	3.6	3.4	3.0	3.9	3.6

Table 4. Ration of catch rate from day (D) and night (N) trawling, and the months (1= January, .., 12= December) which yielded higher catch rate during night trawling compared to day trawling

Group	Ratio (D:N)	Months of higher rates in right trawling
Category I (higher catch rates in nights)		
Catfishes	1:10.0	1 to 12
Rays	1:7.5	1 to 12
Eels	1:7.0	1 to 12
Flatfishes	1:5.0	1 to 12
Croakers	1:2.7	1 to 12
Pomfrets	1:2.0	1 to 12
Penaeid prawns	1:2.0	1 to 10
Clupeids	1:1.6	1 to 5, 7 to 12
Ribbon fishes	1:1.6	1,3,5, 7 to 12
Lizardfishes	1:1.3	1 to 4, 7 to 12
Silverbellies	1:1.3	1 to 5, 7 to 12
Cuttlefishes	1:1.3	1 to 7, 9 to 12
Barracudas	1:1.3	1 to 8, 11,12
Threadfin breams	1:1.2	1 to 4, 9 to 12
Category II (equal catch rates)		
Sharks	1:1.0	2 to 5, 9
Goatfishes	1:1.0	1 to 5, 11,12
Mackerel	1:1.0	2 to 4, 8,11,12
Seer fishes	1:1.0	1,2,5,7,11,12
Psenes sp.	1:1.0	2 to 4, 6
Crabs	1:1.0	2 to 6, 9,10,12
Stomatopods	1:1.0	1,2,5,7,11,12
Category III (lower catch rates in nights)		
Squids	1:0.8	1 to 4, 8,11,12
Carangids	1:0.5	4,11,12
Perches	1:0.3	11,12

Parrish *et al.* (1964) indicated that catches of flatfishes were higher at night than during the day but the night hauls contained more small fish. It appears that the behaviour of fish in relation to fishing gear may change with their size, age and physiological condition. It is possible that the different diel behaviour and catchability of different species may influence the effects of fishing on the stocks, as well as resources assessments with trawl surveys. A detailed investigation on these aspects is required to understand the availability of fish to gear properly and to advantageously employ suitable gears at appropriate time of the day.

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