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Status of Epifaunal Component in the Bottom Trawl Discards Along Kerala Coast (South India)

B. Madhusoodana Kurup*, Premlal, Joice V. Thomas and Vijay Anand
School of Industrial Fisheries
Cochin University of Science and Technology
Cochin - 682 016, India

An attempt was made to quantify the epifauna hauled by the bottom trawlers and discarded in to the sea along the coastal waters of Kerala on the basis of data generated onboard. The epifauna thrown back into the sea from bottom trawlers during 2000-01 and 2001-02 were computed at 1.68 and 1.31 lakh tons respectively. The epifaunal discards comprised of 13 species of finfishes, 23 species of gastropods, 14 species of crabs, 4 species of shrimps, 2 species of stomatopods and 3 species of echinoderms. Highest quantity of epifaunal discards during the period was observed during January (27072 tons) and April (21514 tons) respectively. Highest catch per hour of discards was recorded in monsoon season, 42.64 kg/h in 2001-01 and 41.37 kg/h in 2001-02. Catch per unit of discards in bottom trawlers was highest in August during both the years registering 531.09 and 543.23 kg respectively.

Key words: Epifauna, bottom trawl

Anthropogenic activities such as fishing in general and bottom trawling in particular are among the most destructive human induced physical disturbances inflicted to seabed and its living communities. A series of investigations have been carried out on the ecological effects of fishing (Jennings & Kaiser, 1998; Hall,1999 and Moore & Jennings 2000). On a rough estimate 27 million tons of discards and by-catch organisms are returned to the sea in a year (Alverson, *et al.*, 1994). The direct physical effects include damages sustained by organisms coming in contact with the trawl gear during towing and the consequent mortality of a significant percentage of discards (Houghton *et al.*, 1971; Margetts & Bridger, 1971; De Groot, 1973). Among the indirect effects are exposure of the epibenthic organism to predation (Langton & Robinson, 1990; Bergman & Hup, 1992; Kaiser & Spencer, 1996), reduction in benthic abundance and diversity and habitat complexity (Currie & Parry, 1996; Kaiser & Spencer, 1996; Collie *et al.*, 1997). Among the discarded components, a significant quantity of organisms belong to the epifaunal category (Menon, 1996). Coastal waters of Kerala are endowed with rich and varied fishery resources, which are subjected to heavy exploitation by a variety of fishing gears (Kurup & Rajasree, 2003). Quantitative information on discards are vital in working out their relationship in the energy flow of the marine ecosystem. The present study attempts to provide this information.

Materials and Methods

The quantification of discards on board the trawlers were done on the basis of data generated from operations of 375 bottom trawlers from 6 major fisheries harbours of Kerala such as Sakthikulangara, Neendakara, Cochin, Munambam, Beypore and Puthiyappa during April 2000 to March 2002. The trawl catch composition were analysed from 100 boats which were operated beyond 10 m, with the help of samples collected and preserved in tubs and brought to the shore from the last haul. The trawl catch composition was also examined by collecting samples from 120 boats during trawling operations carried out in the regular fishing grounds with the help of a hired boat during the study period. The units of bottom trawlers for monthly onboard participation from various harbours were selected following Alagaraja (1984). The fishing endurance of the units selected for the present study varied from 1-3 days. The number of hauls in each voyage varied from 1-8 depending on the endurance and availability of fish. The catches from individual hauls were examined separately and the components were sorted in to target, non-target and discards following McCaughran (1992) and species/group level identification was done following FAO (1984), Munro (2000), Dance (1977) and Sethuramalingam & Khan (1991). The marketable fraction of the catch was sorted out and packed in trays of 20 kg and the number of boxes was counted to compute the total weight. The discards were also sorted group/species wise, weighed and 10% of the assorted sample was taken for detailed analysis in the laboratory. Details such as cruise time, facilities on board, OAL, cod end mesh size, fishing endurance and actual fishing hours together with the number of hauls, number of units operated in the vicinity and details of crew, duration and number of hauls performed, depth of fishing, physical nature of fishing grounds, etc. were also collected . The daily discarded fraction from the trawl catch was computed by multiplying the average catch from individual units by total units operated from the harbour on a daily basis. The monthly catch was estimated by multiplying the daily landings with actual fishing days of each month. The discards were categorized under finfishes, crabs, gastropods, shrimps, cephalopods, jellyfish, stomatopods, eggs, juvenile shrimps and snakes. The effort in terms of fishing hours was worked out on the basis of actual time spent for fishing following Kurup & Rajasree (2003). The catch per hour and catch per unit of the discards were computed following Scariah *et al.* (1999). Shannon diversity index based on the biomass of epifauna was carried out using Primer statistical package (Clarke & Warwick, 2001).

Results and Discussion

The quantity of epifauna discarded was computed at 1.68 and 1.31 lakh tons during 2000-01 and 2001-02 respectively. The epifaunal discards comprised of 13 species of finfishes, 23 species of gastropods, 14 species of crabs, 4 species of shrimps in the form of advanced post larvae and juveniles, 2 species of stomatopods and 3 species of echinoderms (Table 1).

Crabs appeared as the dominant groups discarded during the years. During 2000-01 the quantity of crabs discarded were 66637.8 tons followed by stomatopods (66002.7 tons) and gastropods (21419.5 tons). In contrast, during 2001-02 a reduction of the above groups was found (Fig.1).

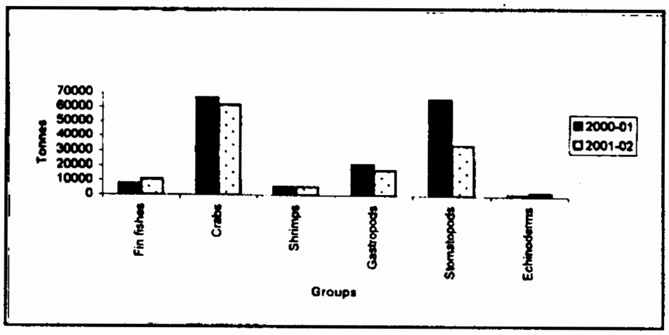

Fig. 1. Groupwise quantification of epibenthos 2000-01 & 2001-02

Highest quantity of epifaunal discards during the first year was observed in January (27072 tons) with a clear dominance of crabs (13361 tons) with *Charybdis granulis* (9696 tons) as the prime species. During the second year in April stomatopods showed their dominance with *Oratosquilla nepa* as the most predominant species. Discards were found minimum in early post monsoon months during both the years (Fig.2).

The seasonal variations of various epifaunal discards during 2000-01 and 2001-02 are depicted in Figs. 3 & 4 respectively. Though a seasonal variation could not be

Table 1. Species wise list of discards

Fin fishes

Conger cinereus
Muraenasox baggio
Muranesox ruppelli
Parapercips nebulosa
Platycephalus argus
Platycephalus niger
Rogadis asper
Aesospia cornuta
Cynoglossus bilenetus
Cynoglossus macrostomus
Cynoglossus malabaricus
Psuedorhombus arsius
Zebrias guaga

Gastropods

Anadora granosa
Babylonia spirata
Babylonia zeylandica
Bursa
Cancellaria spp
Cancellaria bocagene
Conus boeticus
Dossinia penicillium
Ficus ficus
Harpa spp
Modulus
Murex spp
Murex retrirostris
Natica plectaris
Paphia exarata
Pectin
Teritella spp
Teritella maculata
Tibia fucus
Tibia matala
Turbo spp
Turricula javana
Xancus pyrum

Crabs

Callapa lophos
Charybdis cruciata
Charybdis granulis
Charybidis levicarina
Charybidis lucifera
Charybdis smithii
Charybdis varigata
Doclea gracilipes
Dromia spp
Phyllyra coralicola
Podopththalmus vigil
Porphyra spp
Portunnus sanguinolentus
Portunus pelagicus

Stomatopods

Oratosquilla nepa
Squilla tigrina

Echinoderms

Ophiothrix
Asterias spp
Astropecten

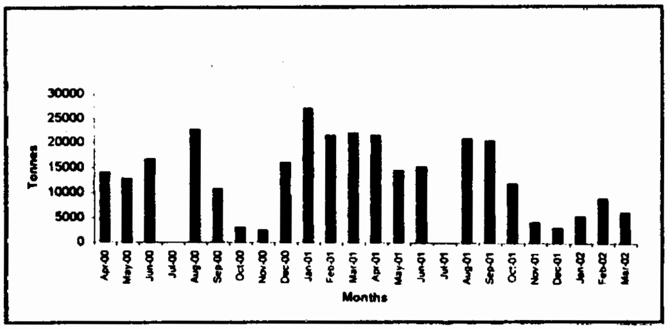

Fig. 2. Temporal variations in quantity of epifaunal discards onboard during April 2000 - March 2002

seen in finfishes, it was very much pronounced in crabs in general and *Charybdis smithii* in particular during the monsoon months. In both the years, the pattern of variation was more or less similar, however, differences could be noticed in the discarded fractions of this group in three different seasons. The discarded fraction of finfishes, shrimps, gastropods, stomatopods and echinoderms were comparatively high during the pre-monsoon season when compared to monsoon and post-monsoon seasons.

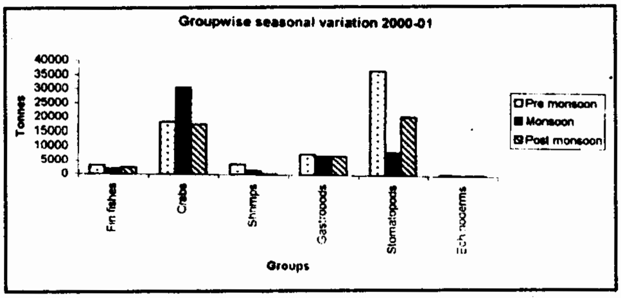

Fig. 3. Groupwise seasonal variation of epifaunal discards 2000-01

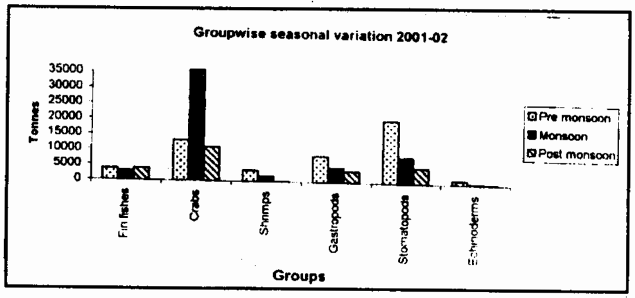

Fig. 4. Groupwise seasonal variation of epifaunal discards 2001-02

The catch per unit varied from 80.32 kg in October to 531.09 kg in August with an average of 207.1 kg/unit during 2000-01.

During 2001-02 it fluctuated from 80.4 kg in December to 543.23 kg in August with an average of 211.58 kg/ unit (Fig.5). Incidentally, *Charybdis smithii* dominated the discards in August during both the years with 395.71 and 326.71 kg/unit respectively and the high catch recorded per unit in this month during both the years can be attributed to the emergence of this crab along the shelf waters of Kerala during the monsoon season.

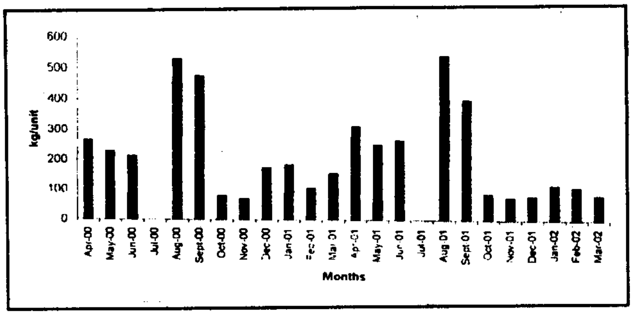

Fig. 5. Temporal variation in catch per unit of epifaunal discards

The CPUE of epifaunal discards during 2000-01 was in the range 11.46 (October 2000) to 69.9 kg/h (August 2000) with a mean value of 35.04 kg/h for the whole year. During 2001-02 it ranged from 71.75 kg/h (August 2001) to 11.64 (October 2001) with a mean value of 29.17 kg/h (Fig.6). During August crabs were the dominant groups discarded in both the years and registered as high as 59.28 and 48.62 kg/h respectively. In general, the CPUE showed a gradually increasing trend form late pre-monsoon months attaining highest values in monsoon months and then decreasing during the post-monsoon months. The CPUE of epifaunal discards during the both the years was highest during monsoon period registering 42.64 and 41.37 kg/h respectively. Crabs were the dominant groups during this period registering on an average 25.6 kg/h (2000-01) and 21.3 kg/h (2001-02). On the contrary, the CPUE was lowest during the post monsoon season, which was worked out as 25.23 kg/h in 2000-01 and 15.28 kg/h in 2001-02.

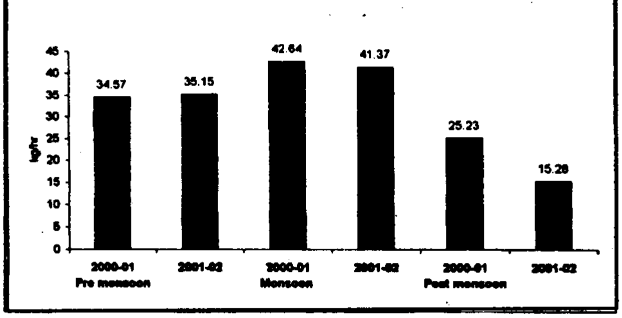

Fig. 6. Seasonal variation in CPUE of epifaunal discards

Shannon diversity index of the major epifaunal discards such as finfishes, crabs and gastropods were calculated based on the biomass recorded during the period of two years. The diversity of finfishes (H') was low in August (0.5) while it registered the peak during January (1.37) during the first year. During the second year, October recorded the lowest (0.64) while highest value was recorded in January with 1.30 (Fig.7). In gastropods, during the first year Shannon's diversity ranged between 1.4 in December to 2.28 in March; in contrast, it ranged from 0.64 in June to 2.04 in December during the second year, thus showing a progressive reduction during the second year (Fig.8).

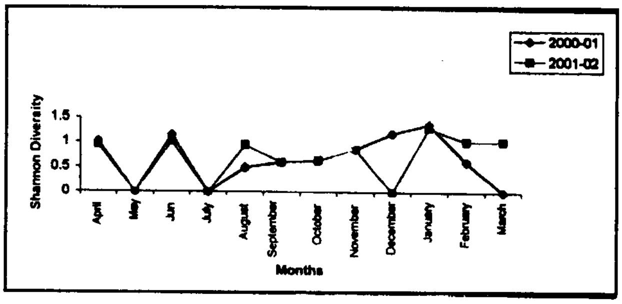

Fig. 7. Yearwise variation in Shannon diversity of Epifaunal Finfishes during April 2000 - March 2002

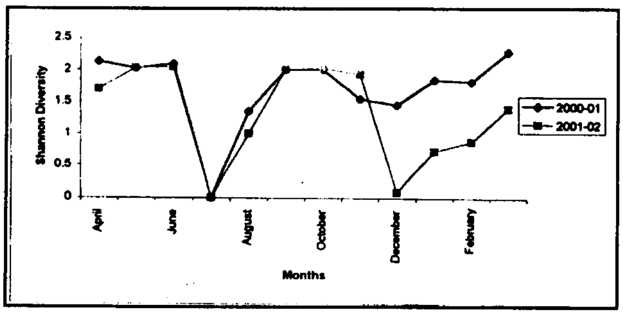

Fig. 8. Yearwise variation in Shannon diversity of Gastropods during April 2000 - March 2002

Similar trend was observed in crabs also (Fig.9) showing variation from 0.37 (August) and 1.49 (December 2000) during the former year while the range was (H') from 0.35 (August 2001) to 1.13 (June 2001) during the latter year. Though the diversity values were relatively low during the second year, the variation between the two years was not statistically significant (P>0.01).

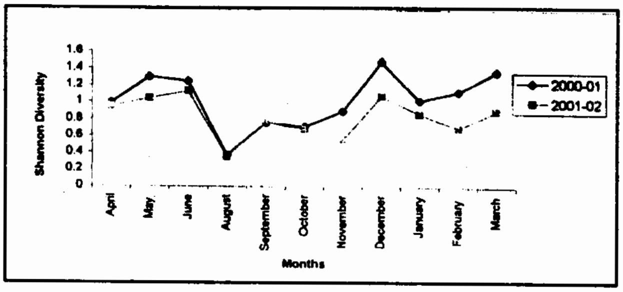

Fig. 9. Yearwise variation in Shannon diversity of Crabs during April 2000 - March 2002

Over much of the world's continental shelves, benthic dwelling fish and shellfish are captured by trawls and dredges, which are hauled along the bottom (De Groot, 1984; Watling & Norse, 1998). The results of the present study revealed that the bottom trawling operations carried out along the southwest coast of India brought about serious impact on the epifauna by their massive removal from the ecosystem.

The quantity of discards depends entirely on the trawling pressure exerted in the fishing grounds. Even though quantity of discards was more in pre-monsoon, catch per hour was higher in monsoon because of lesser trawling effort exerted during this period. High discards encountered during the pre-monsoon can be attributed to spurt in fishing for shrimps *Metapenaeus dobsonii* in the inshore waters between depths 0-40 m, where the trawlers use trawl nets rigged with adequate weight of sinkers, thereby scraping the bottom vigorously and thus harvesting a large assemblage of epifaunal organisms, which clog the net resulting in hauling of discards in higher quantities. It thus appears that the epifauna quantified now formed 61% of the total discarded quantity from the bottom trawlers as reported by Kurup (2001). In the present study it was observed that most of the fish and cephalopod species that were thrown back into water were dead on account of their prolonged exposure on the deck during the process of sorting of target species from the catch.

A few robust forms such as crabs and some of the gastropods and echinoderms can survive trawling (Juhl & Drummond, 1976; Bergmann *et al.*, 2001) and therefore they will be in the live state in the discarded fraction (Poiner *et al.*, 1998; Bergmann *et al.*, 2001). The method by which trawling is conducted affects the survival of all animals caught in trawl, the most important being the duration of the haul, the time spent out of water on deck and the extent of damage from nets (Wassenberg & Hill, 1989). In the present observation crabs, gastropods, stomatopods and bivalves dominated the discards and this finding is similar to that of Eleftheriou (2000) who also reported large number of less mobile groups in the trawl catches. This situation may lead to the proliferation and predominance of these organisms in the fishing grounds as reported by Pauly (1979). Profound abundance of non-edible crabs was recorded in the fishing grounds of Kerala with a CPUE of 120-200 kg by Thomas and Kurup (2001) and this can be attributed to the reasons cited above.

Many workers have reported that repeated trawling and dredging caused a shift from species with relatively larger adult body size towards higher abundance of smaller bodied organisms (Auster, *et al.*, 1996; Kaiser & Spencer, 1996; Watling & Norse, 1998). In the present study, the discarded quantity of echinoderms showed a double fold increase during the second year and this result strongly corroborates the above reports. Moreover, the increase of crabs and gastropods in the trawled areas observed in the present study is also complementary to the above concept. So the incessant trawling operation may cause a shift in the community level at the seabed by allowing the existence of organisms such as crab, echinoderms and gastropods, which have the ability to survive in the discards.

Physical disturbance due to mobile fishing gear is a serious and growing threat to diversity and production in marine benthic habitats (Currie & Parry, 1996; Kaiser & Spencer, 1996). The high proportion of invertebrate discards in the trawl catches and a perceptible reduction in the diversity of crabs and gastropods observed in the present study during the second year is complementary to the above findings. It may therefore, be reasonably inferred that the rich and diversified faunal assemblage of the coastal water of Kerala are prone to severe biodiversity decline on account of the physical damages inflicted on sea bottom and its living communities due to bottom trawling. Consequently there is every possibility of the emergence of unimportant and non edible species and their dominance in the near future.

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