ON AN UNUSUAL MASSIVE RECRUITMENT OF THE REEF FISH *CTENOCHAETES STRIGOSUS* (BENNET) (PERCIFORMES: ACANTHURIDAE) TO THE MINICOY ATOLL AND ITS SIGNIFICANCE

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ABSTRACT

A sudden influx, and subsequent settlement, of *C. strigosus* in enormous numbers in the lagoon and on reef flats of Minicoy island, where, but for a couple of specimens dealt with by Jones and Kumaran (1980, this species was almost unknown, is reported. The fish, ranging in length from 50 to 82 mm, which had been obviously leading thus far a pelagic life, were in stages past postlarval, and were already in the process of metamorphosing into adult, with gonads in stages up to Stage III maturity.

This none-too-common phenomenon is discussed in detail as an evidence supporting the concept that at least some reef fishes can assume adult shape and advance in stages of gonadial development while prolonging their pelagic life due to some oceanographic conditions preventing their entry into the reef at the end of their normal postlarval stage.

INTRODUCTION

The slender-toothed Surgeon fish, *Ctenochaetes strigosus* (Bennett 1828), (Fig. 1), has a wide distribution in the coral growing areas of the Indo-Pacific, ranging between the east coast of Africa, Red sea, Mozambique, Lakshadweep, Sri Lanka, Andamans, Philippines, East Indies, Japan, Hawaii and Tuamotu Archipelago as reported by de Beaufort (1951), Munro (1955) and Smith (1953). According to these authors *Ctenochaetes* is represented in the Indo-Pacific by at least two species, viz, *C. strigosus* and *C. striatus*, and both are wide-spread in distribution. The former species is readily separable from the latter by the presence of brown spots on the suborbital region as well as by an yellow ring around the eye. De Beaufort (1951, pp. 128-131) discussed at length on the relationship of these two species, but he seems to be uncertain on their specific genetic relationship. Jones and Kumaran (1980) reported on *C. strigosus*, but they do not make any mention of the other species. However, Carcasson (1977), while providing a field guide to the coral-reef fishes of the Indo-Pacific, holds the view that *C. strigosus* is a species probably confined to

the Hawaiian waters, and the wide-spread Indo-Pacific *Ctenochaetes* should be called *C. striatus*. The present material, forming the basis of this note, includes a large number of specimens; all examined in fresh condition. All the specimens, though juveniles have reddish brown spots and yellow ring around the eye, as

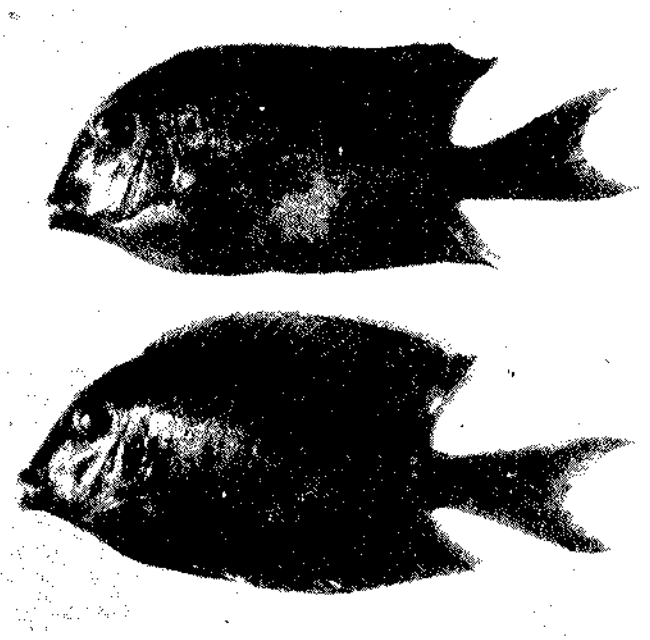

FIG. 1. Juveniles of *Ctenochaetes strigosus* at the time of recruitment to Minicoy.

mentioned earlier, are in perfect agreement with the colour photograph of *C. strigosus* given by Carcasson (1977). This indicates that *C. strigosus*, as mentioned by earlier fish taxonomists, enjoys a wide distribution and is not confined to Hawaii alone. Though we have examined more than a hundred specimens, we could not observe any displaying intermediate characters between *C. strigosus* and *C. striatus*, to settle the nomenclatural problem of these two. We follow Jones and Kumaran (1980) in naming our specimens from Minicoy.

The Unusual Instance of Mass Recruitment

Jones and Kumaran (1980) have reported *C. strigosus* from many islands among the Lakshadweep. They had two specimens of this species from Minicoy. However, regularly sampling the reef fishes from the lagoon and reef flats of Minicoy for nearly two years, we have never come across a single specimen of this species, though many related Acanthuriids were found. However, in the third week of September 1982, large shoals of this species appeared

all on a sudden throughout the lagoon and on the reef flats of the leeward side. They were all juveniles, a chocolate-brown in colour, with bluish longitudinal lines on either side. Their sudden outbreak was a surprise even to the experienced fishermen, since they have never seen this fish in such great profusion in the past. Their appearance along the shore was preceded by turbulent sea and gusty winds for three to four days. Several hundreds of them were killed when they were caught in the cast nets, and thrown away since they are not eaten by the local people. Analysis of the gut of larger serranids and scarrids showed that a good number of these juvenile *Ctenochaetes* was preyed upon by other reef fishes. Within a fortnight of their first sighting, their number was significantly dwindled; by early November, they were observed only among the corals (mostly dead corals) in the lagoon and among the *negro-heads* of reef flats. Subsequent collections and field studies show that the species has established in Minicoy and might form a conspicuous element of the resident fishes of the reef and lagoon in future.

Analysis of the Population

There appears to be no published data available on the biology of this species, as is the case with majority of reef fishes. Samples, collected soon after the appearance of the fish in the lagoon, were analysed to determine their length frequency, food, sex ratio and gonadial stages of maturity. A short account of the data obtained is presented below.

Length frequency

Although the species is reported to attain a total length of 275 mm or more (de Beaufort 1951), in the present study specimens ranged only between 50 and 82 mm in total length, majority being in the range of 60 to 70 mm (Fig. 2). This indicates that the shoal comprised individuals of different ages, probably produced by an extended period of spawning at intervals, during a breeding season, as in the case of some known reef fishes, where one adult female sheds eggs at intervals during a breeding period that could produce larvae of different sizes and age.

Food

Analysis of the gut contents showed mostly algal matter with calcareous particles, indicating that the species is a pure herbivore, grazing on algae attached to corals and reef rocks. It is to be presumed, from the analysis of the gut contents, that the juveniles resorted to the adult mode of grazing on algal food as soon as they reached the reef environs, dispensing with the planktonic mode of feeding that they were hitherto leading. The intestine was elongated and coiled, indicating the transformation from postlarval stage to adult condition even before the fish got settled among the reef environs (*vide infra*).

Sex ratio and maturity stages

Among the 89 specimens examined on the day of their sighting 35 (constituting 39.33%) were males, 19 (21.35%) were females and the rest indeterminable. Among the males, 60% had testis in the First stage of maturity; 34% in the Second stage and 6% in the Third stage. 58% of the females had ovaries at First stage of maurity and the remaining 42% in the Second stage. Those males with a total length of 75 to 80 mm had normally Third stage testis, while females ranging 60 to 65 mm in total length were in Second stage. Specimens with a total length of less than 55 mm were indeterminates.

Age

Owing to lack of earlier estimates, we are not in a position to state precisely the age of the fish when we sighted them in the reef and the lagoon. However, judging from the age at recruitment of other Acanthurids, from published literature as well as from our own prolonged observations at Minicoy, it appears

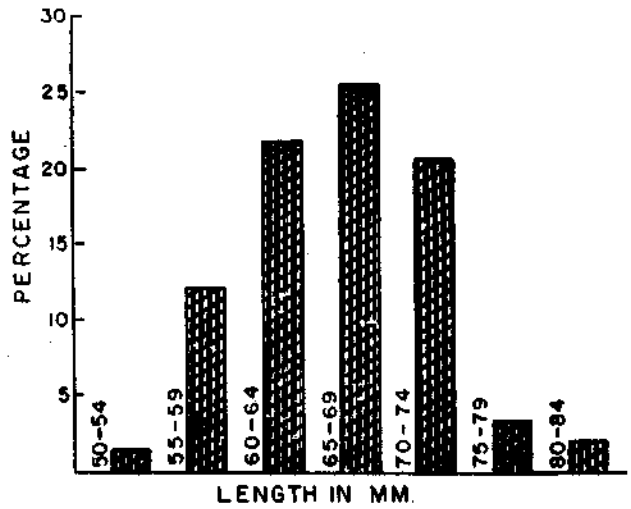

FIG. 2. Length-frequency distribution of juveniles of *C. strigosus* at the time of recruitment to Minicoy atoll in September 1982.

to be possible to draw a reasonably safe deduction on the age of the present stock. In the related *Acanthurus triostegus sandvicensis* of Hawaii the recruitment of postlarvae takes place when they are about two-and-a-half months old (Randall 1961). Our observations on the recruitment of *A. triostegus* from Minicoy (unpub.) corroborate this, the postlarvae at first recruitment being more or less 25 mm in total length (average). We have also observed that many of the reef fishes register an increase of more or less 10 mm per month before attaining the stage at first maturity when they get dispersed from the tide pools of reef flats. Comparing *Ctenochaetes* with *Acanthurus,* which attain almost similar size when full grown, we are tempted to think that the former attained

an age of about 4 to 5 monhs, when they reached the reefs. The conditions of the gonads and the elongated intestine along with the adult form (postlarvae are mostly semicircular in Acanthurids) of the fish prove beyond doubt that they got metamorphosed to adult form, even when leading an extended pelagic post-larval life, probably due to some oceanographic factors which prevented their getting back to the near-reef habitat at the end of the normal postlarval life.

Discussion

Origin of the stock

The general paucity of the species as proved by our repeated samplings, as well as the lack of any previous serious mention of this species from Minicoy, suggests that the present stock of juveniles were spawned in waters away from Minicoy. An argument that could be immediately put against such an assumption is that breeding adults might have been occurring in the deeper parts of the outer reefs of Minicoy, for, the absence of this species in that habitat is not hitherto proved. Further, in many Acanthurids several thousands of eggs can be produced by a single female during a breeding season to create a bloom of larvae with chances of high survival rate. If so, a few breeding pair could have produced the present shoal. But, we were unable to record a single postlarva of *C. strigosus* here for two years before the present shoal appeared. In case the species occur on the outer reefs of Minicoy, the postlarvae naturally should get recruited to the reef flat during the breeding season, at least once, and should be seen along with postlarvae of other reef fishes commonly found on the reef flats from August to February, year to year. Therefore, it is rather difficult to believe that the stock of *C. strigosus* under report were produced by breeding adults living around Minicoy.

Significance of the present observation

Many recent studies (Sale 1978, 1978, 1980; Sale et al 1980; Williams and Sale 1981; Johannes 1980) have yielded illuminating results on the reproductive behaviour and larval recruitment of many reef fishes in the Pacific, though such information from the Indian Ocean is very scanty. Many groups of reef fishes, that are resident forms during adult life, are known to have pelagic larval or postlarval existance, some of them even drifting far away from the spawning grounds and assuming a long pelagic life, while many others have a short pelagic life in the early part of the life history (Mac Connell 1979). On the other hand, in some groups like pomacentriids, for example *Chromis* spp., the eggs are laid among the coral colonies and have no pelagic life. Available data on the period of larval life of these fishes, however, indicate that it varies from two weeks to two-and-a-half months (Johannes 1980). That some of these species may prolong their early pelagic existence, lengthening their postlarval life, should they fail to get into suitable settlement sites at the proper time, is also known (Johannes 1978), though there has not been any direct evidence to

prove it. The present observation on *C. strigosus*, besides being significant in postively supporting this view, provides sufficient evidence also to the fact that at least in a few of such fishes, while they are forced to continue with their pelagic existence, the postlarval life is not necessarily extended, but they proceed with the metamorphosis, assuming an adult form and advancing in gonadial development.

The mechanism by which the larval fishes make their return to the reef is known (Sale 1980). It is mostly assumed that the trip is a passive one, mainly aided with the prevailing water currents. It has also been argued that the recruitment of reef fishes to the sites is stochastic in composition and may sometimes bear little relation to the structure of the resident assemblage there (Sale 1978, 1980). These arguments, though chiefly applicable to micro-habitats within a wider area, seem to be effective also to widely-placed coral environs in a geographic area as far as judging from the present case study. In the present case the juveniles finding a "lottery for living space" at Minicoy seems to be mainly due to a "chance element" (Sale 1978). Because, year-to-year variations in prevailing winds and currents are probably, at least in part, responsible for the observed year-to-year variations in the number of settling reef-fish larvae in a place (Johannes 1980). But, hitherto no serious research on this aspect seems to have been done from the tropics. In oceanic islands, this relationship is likely to be very dominant, and this may be the case in Minicoy, and, perhaps, in other Lakshadweep chain of islands. During July to November, wind and upwelling cause both clockwise and anticlockwise surface sea currents in this part of the Indian Ocean (for a review of this aspect please refer to Silas and Pillai 1982). It is almost a regular annual phenomenon during August-October period to have large quantities of pelagic siphonophores, like *Porpita* and *Physalia physalis*, along with the gastropod *Ianthina* sp., washed ashore in Minicoy. This clearly indicates a strong surface current towards Minicoy, bringing along with it large number of pelagic and planktonic organisms, enriching thereby the waters around. The invasion of juveniles of *C. strigosus* in September 82 was preceeded by strong wind from southwest, which could have accelerated the surface currents. The juvenile fishes might have been caught in this current and by a mere chance able to reach the reefs and lagoon.

Conclusion

The current instance of a sudden large-scale recruitment indicates that *C. strigosus* is one among the reef fishes that are capable of extending its post-larval pelagic existence, if they fail to get back to the reef at the end of the normal pelagic life during their early life history. Further, when *C. strigosus* is forced to resort to an extended pelagic life by prevailing environmental conditions, it nevertheless gets adapted to a perfect mode of pelagic life, transforms to adult form and goes on advancing in the development of gonads. It is likely that

many other reef fishes too may respond in a similar way to unfavourable oceanographic conditions. The recruitment and settlement of resident icthyofaunal elements in an oceanic coral atoll, therefore, seems to be predominantly depending on the prevailing surface-current patterns during the breeding season of the fishes; an element of chance always playing in the larvae getting a living space within a major reef environment, or even in their introduction to far off suitable sites from the place of spawning. In fact, very little information is available at present on the correlation between resident assemblage of fishes in specific habitats, year-to-year variations in the recruitment of species and the overall impact of the prevailing oceanographic conditions in different atolls of Lakshadweep to throw further light on this aspect.

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REFERENCES

CARCASSON, R. H. 1977. *A field guids to the coral reef fishes of the Indian and West-Pacific Oceans*. pp. 320. Collines, London.

DE BEAUFORT, L. F. 1951. *The Fishes of the Indo-Australian Archipelago*. Vol. IX: 1-483, Leiden.

JOHANNES, R. E. 1978. Reproductive strategies of coastal marine fishes in the tropics. *Envir. Biol. Fishes*. 3: 45-84.

JOHANNES, R. E. 1980. Using knowledge of the reproductive behaviour of reef and lagoon fishes to improve fishing yields. In: *Fish Behaviour and its use in the capture and culture of fish es*. ICLARM Conference Proceedings 5: 247-286.

JONES, S. AND M. KUMARAN. 1980. *Fishes of the Laccadive Archipelago*. The Nature Conservation and Aquatic Scienice Service, Trivandrum, 1-760.

MC CONNELL, R. H. LOWE. 1977. *Ecology of Fishes in Tropical Waters*. Studies in Biology: 76. The Camelot Press, Southampton.

MUNRO, I. S. R. 1955. *The Marine and Fresh Water Fishes of Ceylon*, 1-349, Canberra.

RANDALL, J. E. 1961. A contribution to the Biology of the Convict Surgeon fish of the Hawaiian Islands, *Acanthurus triostegus sandvieensis*. *Pacific Sci.*, 15: 215-272.

SALE, F. PETER. 1978. Co-existence of coral reef fishes—a lottery for living space. *Envir. Biol. Fish.*, 3(1): 85-102.

SALE, F. PETER. 1979. Recruitment, loss and coexistence in a guild of territorial coral reef fishes. *Oecologica* (Berl), 42: 159-177.

SALE, F. PETER. 1980. The ecology of fishes in coral reefs. *Oceanogr. Mar. Biol. Ann. Rev.*, 18: 367-421.

SADE. F, PETER, P. J. DOHERTY AND W. A. DOULAN. 1980. Juvenile recruitment strategies and the co-existence of territorial Pomacentrid fishes. *Bull. Mar. Science*, 30: 147-158.

SILAS, E. G. AND P. P. PILLAI. 1982. Resources of tunas and related species and their fisheries in the Indian Ocean. *CMFRI, Bull.*, 32: 1-173.

SMITH, J. L. B. 1953. *The Fishes of Southern Africa*. 1-563. Central News Agency.

WILLIAMS, D. AND P. F. SALE. 1981. Spatial and temporal patterns of recruitment of juvenile coral reef fishes to coral habits within "One Three Island" Great Barrier Reef. *Marine Biology*, 65: 245-253.