Marine Fisheries Research and Management

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2000

29 Tuna livebaits

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ABSTRACT

The fishery, biology and dynamics of livebaits used in the tuna pole and line fishery are discussed based on earlier and current work. Their catch in Minicoy showed interannual vartation with an average of 7569 kg and CPUE of 2.5 kg. Clupeids dominated forming 39.5% followed by caesionids(32.1%),apogonids(22.5%) and pomacentrids(5.6%). At Agatti, the mean catch was 52 tonnes with a CPUE of 14 kg comprised exclusively of Spratelloides delicatulus. Biological characteristics such as size,food and feeding, sex-ratio,size at first maturity, spawning and fecundity, length-weight relationship etc of dominant species are given. Stock assessment studies on S.delicatulus and Archamia fucata indicated their over exploitation. Various measures for management and conservation of the resources alongwith future research priorities are indicated.

Introduction

Baitfishes are a variety of small fishes collected live from the lagoon and reef areas.They are thrown live into the sea to attract the tuna shoals in pole and line fishery. In India, Lakshadweep is the only place where an organised tuna pole and line fishey using livebait is practiced. The success of this fishery depends on the availability of livebaits in sufficient quantity during the fishing season. In Minicoy, different fishes are used whereas in northern islands,only sprats are used. Since livebait is an integral part of pole and line fishery, monitoring and managing this resource is very important.

Jones(1958) described the tuna livebait fishery of Minicoy. Jones (1960,

a, b) predicted the importance of *Spratelloides delicatulus* as a livebait and later discovered the occurrence of *S.gracilis*.A complete list of livebait fishes with a key for their identification and also an evaluation with respect to their survival in captivity and chumming response were given by Jones(1964). Thomas(1964) carried out a detailed study on the monthly fluctuations in the availability of major livebaits during 1960-61. Silas and Pillai (1982) described the tuna livebait fishery in Minicoy in particular and world fishery in general. Madan Mohan and Kunhikoya(1986) studied the biology of *S.delicatulus* and *S.gracilis*. Madan Mohan *et al* (1986) studied the biology of *Chromis caeruleus*. Pillai *et al* (1986) gave an account of the livebait fishes covering the fishery, biology, culture and their status. Pillai and Madan Mohan (1986) highlighted the ecological stress and its impact on the baitfishes in Minicoy lagoon. Gopakumar and Pillai(1988) studied certain behavioural aspects of some tuna livebaits in captivity. Kumaran *et al* (1989) described the fishery and some options for developing it. Gopakumar and Mathew (1989) observed the effect of reduced salinity on the mortality of *S.delicatulus*. Gopakumar *et al* (1991) studied the population characteristics of important livebait fishes. Nasser(1993) studied the livebait fishes of Lakshadweep with particular reference to Minicoy. Luther *et al* (1985) did some experiments on holding *Stolephorus* sp in captivity at Vizhinjam. The present paper is a review of these studies and highlighting the work being carried out now.

Material and methods

The food and feeding were studied by gross analysis. The maturity stages were determined based on macroscopic appearence of ovary and microscopic study of ova. Fecundity was estimated from the mature group of ova belonging to stages IV to VI. Size at first maturity was determined based on the percentage of mature fishes in each size group. Spawning periodicity and spawning season were determined based on the occurrence of mature fishes in different months. Length weight relationship was found out using the formula Log W = a + b Log L. Stock assessment was carried out using data for the period 1993-95. For age and growth, integrated method of Pauly (Sparre,1985) was used to get the monthly progression of modes. Loo was calculated using Ford- Walford Plot and Wetherall *et al*. method while K and t_o by von Bertanlaffy plot. Z was estimated from the length converted catch curve. Natural mortality(M) was obtained based on Alagaraja(Sparre,1985). Age at first capture was found out from the selection ogive obtained from the length

converted catch curve as the gear are working like a trawl net in principle. The smallest length in the catch was taken as the length at recruitment and the value of Woo was calculated from Loo and Length weight relationship.The length based Thomson and Bell model (Sparre,1985) was used to find out the yield per recruit and biomass per recruit.

Biology

Spratelloides delicatulus: The size in the fishery ranges from 18 to 66 mm.It is a zooplankton feeder and the food consist of copepods, decapod larvae, lucifer, mysids, amphipods etc with peak feeding during early morning and evening.It attains a size of 60 mm in the first year. It spawns more than once during March-April to December. The fecundity ranges from 235 to 1087 numbers. The size at first maturity is 33 mm. The sex ratio of 1:1 is found. The length weight (mm-g) relationship was found to be Log W = -5.7284 + 3.310171 Log L(r = 0.98).

S. gracilis: The size ranges from 27 to 72 mm. It also feeds on zooplankton with peak feeding during early morning and evening.It spawns more than once during September to April. The fecundity ranges from 541 to 2390. The size at first maturity is 41 mm. The sex ratio is found to be 1:1. The length weight (mm-g) relationship is Log W = -1.4380 + 2.040 Log L (r = 0.9).

Archamia fucata: The size ranges from 25 to 77 mm.It is a nocturnal zooplankton feeder. It attains a size of 66 mm in one year with an average growth of 5.5 mm per month.The presence of mature ovaries from November to April indicates that it is a continuous spawner. It is a mouth breeder. The fecundity is found to be 1140 to 2550 eggs. The size at first maturity is 59 mm. A sex ratio of 1.2: 1 is found for females and males.The length- weight (mm-g) relationship is Log W = -2.331219 + 3.53348 Log L (r=0.974).

A. sangiens: The size in the fishery varies from 22 to 62 mm. It is also a nocturnal zooplankton feeder. It incubates its eggs in the mouth. The size at first maturity is 58 mm. The sex ratio is 1:1. The length-weight (mm-g) relationship in Male:$W = 0.1265\ L^{2.4659}$ (r=0.7995), in Female:$W = 0.02181\ L^{2.9249}$ (r= 0.7357) and in Juvenile:$W = 0.00253\ L^{3.4702}$ (r= 0.9742).

Rhabdamia gracilis: The size varies from 25 to 55 mm and the fish is zooplankton feeder. Size at first maturity is 45 mm. Fecundity ranges from

1500 to 3225. Female,male ratio is 1:2. The length-weight (mm-g) relationship in Male W = 0. 03963 $L^{2.6863}$(r = 0.77), Female W = 0.00161 $L^{3.4976}$ (r=0.879). Juvenile W = 0.04005 $L^{2.5461}$ (r= 0.8779).

Chromis caeruleus: The size ranges from 22 to 82 mm. It is carnivorous, feeding on zooplankton with peak feeding during early morning and late evening hours. It showed a monthly average growth of 5.3 mm in the first year and 2.6 mm in the second year reaching a size of 64 mm and 95 mm respectively. The spawning is continuous with an active period for about nine months from August to April. The fecundity ranges from 1715 to 22765 eggs and the size at first maturity is 41 mm. The sex ratio is 1:1. The length-weight (mm-g) relationship in Mature fishes Log W = -4.2234 + 2.6777 Log L; Juveniles Log W = -5.1718 + 3.3169 Log L.

Pomacentrus pavo: The size varied from 30 to 72 mm. It is a herbivore and browses on algae. Its peak feeding is in early morning and late evening hours. The size at first maturity is 48 mm. Fecundity ranges from 150 to 6000. The female, male ratio is 1 : 2.4. The length-weight relationship(mm-g) in Male W= 0.03413 $L^{2.8166}$(r=0.99). Female W = 0.05076 $L^{2.7306}$ (r = 0.93) Juvenile W = 0.0675 $L^{2.6954}$ (r=0.98).

Pranesus pinguis: The size ranges from 12 to 102 mm . It is a zooplankton feeder, diurnal in habit with peak feeding during early morning and late evening hours. It spawns throughout the year. The fecundity ranges from 90 to 330 eggs. The size at first maturity is 34 mm. The length-weight relationship (mm-g) in Male W= 0.002162 $L^{2.3042}$. Female W = 0.001018 $L^{3.4741}$(r= 0.979).

Fishery

There is no rigid selection in species either in the catch or utilization of baitfishes in Minicoy. The species caught and utilized belong mainly to five families.viz.Clupeidae, Apogonidae, Caesionidae, Pomacentridae and Atherinidae. In other islands, only *S.delicatulus* coming under the family clupeidae is used.

Distribution in space and time

Clupeidae: Two species are employed; *S.delicatulus* and *S.gracilis*. The former species is distributed in the shallow coral sand areas of the lagoon

and are available throughout the season while the latter is a comparatively deep water species associated mostly with massive coral colonies and often co exist with the apogonid *R.gracilis* and abundant during December-March.

Apogonidae: They are generally associated with corymbose, pedicellate corals with reticulately coalescent branches. *Archamia fucata*, *A.sangiens* and *R.gracilis* are the common species. Traditionally, they are exploited only by November and last till March-April. The peak period is December-February.

Pomacentridae: *Chromis caeruleus* and *Pomacentrus pavo* are the important resident species. They are associated with ramose, arborescent corals and are abundant in the regions next to the sand flat areas. Earlier, *Lepidozygus tapeinosoma* which is a migrating species formed an important livebait. But now it is totally absent.

Caesionidae: They are basically migrant and are temporarily associated with branched or massive coral colonies. Only juveniles are available and used in the fishery. During certain seasons in between October and March, they appear in large numbers in the lagoon and adjacent inshore waters. The most dominant species are *Gymnocaesio gymnopterus*, *Caesio caeurulaureus* and *Pterocaesio chrysosona*.

Atherinidae: They occur in nearshore areas of the lagoon often associated with algae. *P.pinguis* is the most dominant one. Despite their hardiness, they are generally preferred only when other baits are not available in sufficient quantity.

Fishing methods

The tuna pole-and-line boats generally collect the bait fishes from the lagoon before going to the tuna fishing ground.They are collected either in the morning of the fishing day or the previous day evening. Two types of net are employed.

(a) Encircling net: This is used to catch *S.delicatulus*. The net made of nylon mosquito netting measures about 80 m long and 3 m broad with lead weights at a distance of 18 cm interval along the foot rope and small floats at a distance of 50 cm along the head rope.

(b) Lift net: The net is made of nylon of below 6 mm mesh size. Each net

measures about 8.1 m long and 6.25 m broad. It is operated by means of poles. This gear is used for collecting *S.gracilis*, apogonids, caesionids and pomacentrids from the deeper part of the lagoon.

Mode of transportation:

The bait fishes after collection are transferred to a watertight wooden bait tank of about 1.0 x 0.8 x 0.8 m which is fitted in front of the engine room of the pole-and-line boat. Circulation of the water in the tank is maintained with the help of inlets and outlets while the boat is in motion. When stationery, water is poured continuously into the the tank.

Storage:

When fishes are collected the previous evening or when there is excess bait after a day's fishing, they are kept alive overnight in bait tanks locally known as 'labari' in Mahl and 'chalapetti' in Malayalam. These floating tanks are made of cane or wood and tin.

Status of the fishery at Minicoy:

On an average, 3002 units caught 7.5 tonnes of livebait during the period 1985-95.. Their exploitation and effort expended depended on the level of tuna fishing activity. The fishing season is from October to April-May.In the bait composition, 39.5 % was constituted by clupeids, 32.1 % by caesionids, 22.5 % by apogonids and 5.6 % by pomacentrids. Till 1992, the percentage composition of caesionids was the highest. In 1995, its contribution was very low. The species composition of baitfishes indicates the utilization of the main groups except apogonids in all the months of the season. Apogonids are exploited only by November. According to the fishermen, by November only apogonids are to be fished as the preceding months coincides with their spawning period. One of the interesting facts is that during the peak period of tuna landing in all the years from 1985-1995, there was a preponderence of caesionids indicating a definite correlation between the abundance of tuna and this species.It could also be seen that during these peak months, the effort expended form about 15 to 30 % and that of tuna catch form 20 to 60 % of the respective years corroborating the fact that live bait exploitation is determined by the abundance of tuna.

Stock assessment

Since *S.delicatulus* and *A.fucata* constitute the two dominant species, attempts were made to assess their stock.

S. delicatulus: The growth parameter Loo was found to be 56.9 mm by modified Welheral *etal.* method and 65.9 mm by Ford-Walford method. Since the latter was nearer to the maximum size available in the fishery, 65.9 mm was taken as Loo. The other parameters estimated by von Bertanlaffy plot were t_o= -0.07 yr., K= 2.95/yr. The total mortality (Z) obtained by linearized catch curve was 17.3. The higher mortality obtained is reasonable considering the limited habitat, the type of net and the short life span of the species. Natural mortality (M) by Alagaraja method was 5.2. So the fishing mortality (F) was 12.1. The other parameters were: age at recruitment = 0.038 year, age at first capture = 0.14 year and T_{max} = 0.99 year. Results of Thomson and Bell analysis (Table 1) indicated that the present fishing is well above the maximum sustainable yield. So in order to maintain the MSY the present F level should be reduced to 80 %. Beverton & Holt Y/R also indicates that the present fishing is above MSY.

A. fucata: Here the Loo obtained by Welheral *etal.* method was taken as it was nearer to the maximum size of fish available in the fishery.Loo= 67.2 mm. Woo= 3.91 g. The other parameters of von Bertalanffy growth equation were, K= 3.9/year, t_o= 0.0052 yr. Total mortality (Z) was 12.7. Natural mortality (M) was 4.5 and hence fishing mortality 8.2, age at recruitment = 0.125 year, age at first capture = 0.15 year. T_{max} = 1.5 years. As in the case of *S.delicatulus*, the exploitation of *A.fucata* is also found to be well above the MSY by both the methods (Table 2). Here the effort is to be reduced by 40 % to maintain the MSY.

Table-1. Yield table of *S.delicatulus* derived by the length based Thompson and Bell analysis.

X	Yield	Mean Biomass
0.2	57669	32634
0.4	77211	22106
0.6	83120	16651
0.8	* 83959	13525 *

1.0	82911	11560
1.2	81209	10220
1.4	79338	9243
1.6	77487	8492
1.8	75724	7892
2.0	74070	7376

X= F factor; MSY=Maximum sustainable yield= 83959 for factor 0.8.

The results on stock assessment indicate some important facts about the fishery. The yield obtained by the Thomson and Bell method is very much above the present yield. In this connection, it is to be noted that at present the estimates are made based on the figures given by the fishermen on enquiry. So it is very likely that the actual magnitude of exploitation is greater than what is reported. However,what is clearly discernable from the analysis by both the methods is that the fishery is overexploited.

Table-2. Yield table of *A.fucata* derived by the length based Thompson and Bell analysis.

X	Yield	Mean Biomass
0.2	3650	1335
*0.4	4264	570 *
0.6	4025	251
0.8	3616	115
1.0	3236	56
1.2	2929	30
1.4	2691	17
1.6	2507	12
1.8	2363	9
2.0	2250	8

MSY = 4264 for factor 0.4.

Conservation, management options

At present, the livebait for pole and line fishery is entirely caught from

the lagoon with a consequential fishing mortality. In Minicoy, all efforts are targeted for one particular resource at a time. If all the available resources are exploited either one after the other or different units catching different groups during the same time by judicious distribution of effort, the negative impacts on any single resource could be reduced.Activities like blanching the reef and dredging lagoon and tampering with the corals should as far as possible be avoided.Because of the inherent limitations of livebait fishery, possible ways of augmenting their production should be explored. Since caesionids are hardy, they can be caught and stored in pens erected in the lagoon. Another alternative is the production of livebait through breeding and rearing them under controlled conditions.

For a proper management, reliable estimates of the potential and exploited stocks are necessary. For this, information on the actual quantity of livebait exploited and the number of hauls made by each boat is essential. Now this information obtained through enquiry with the fishermen are biased to a great extent for want of a definite quantifying mechanism. Baitfishes are generally transferred directly from the net to the livebait tank with the help of a piece of cloth. So quantification is difficult. Biology and population characteristics of many livebaits are still not fully known and hence studies on the above aspects have to be continued. As a part of better utilization of available resources, trials are to be conducted to catch and hold migratory species like caesionids in pens for later use. Monitoring the environmental parameters has also to be continued.

The present exploitation is above the MSY level as far as *S.delicatulus* and *A.fucata* are concerned. Hence steps should be taken to reduce the exploitation pressure through some control on effort and by artificial propagation of livebaits. For understanding the status in the other areas, collection of more data from other islands are envisaged.

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