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Tuna Baitfishery in Minicoy and Agatti Islands of Lakshadweep

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Abstract

The pole-and-line tuna baitfishery at two major fishing islands of Lakshadweep during the fishing seasons of 1988-89 and 1989-90 are described. The total bait caught/season at Minicoy was about 7 tonnes with a CPUE of 2.1 kg while at Agatti it was about 47 tonnes with a CPUE of 8.5 kg. A total of 11 species belonging to the families : Clupeidae, Caesionidae, Apogonidae and Pomacentridae contributed to the fishery at Minicoy and at Agatti only a single species *Spratelloides delicatulus* was used as live bait. The size distribution of baitfishes and the influence of environmental parameters on the fishery was also studied. More information on the fishery in other areas of Lakshadweep, the exact quantity of bait used by a boat, biology of baitfishes to understand their recruitment and culture potential are some of the management options discussed.

Introduction

The Lakshadweep archipelago consists of 10 inhabited islands and 17 uninhabited islets with a total land area of 28.5 sq.km lying between 8° and 12° 30' N latitudes and 71° and 74° E longitudes. Oceanic tuna such as the skipkack (*Katsuwonus pelamis*) and yellowfin (*Thunnus albacares*) are caught from the Lakshadweep waters using the pole-and-line fishing method. Pole-and-line fishing comprises two fisheries, one for batifish and the other for tuna. The fishery depends upon adequate quantities of suitable baitfishes, which are used to attract schools of tuna to the boat and to excite them into a feeding mode so that they can be caught by lure attached to a pole and line.

The tuna pole-and-line fishery of Minicoy in its early form is described by Jones (1958) and Jones and Kumaran (1959). Pillai *et al.*, (1986) presents an exhaustive account of the baitfishery at Minicoy. The importance of adequate and suitable data for stock assessment of baitfishes is emphasized by Gopakumar *et al.*, (1991). This paper describes the baitfishery of two islands of Lakshadweep with reference to its development and management.

Materials and methods

The present study concentrated on two locations of pole-and-line fishery in Lakshadweep. Minicoy, the southernmost island is located 215 nautical miles off Kochi at a latitude of 8° 17' N and longitude 73° 04' E. The island of Agatti is located in the center of the Lakshadweep group at a latitude of 10° 51' N and longitude 72° 11' E. To the north of Agatti, at a latitude of 10° 54' N and longitude 72° 14' E are the islets of Bangaram, Tinnakara and Parali. Situated at about 32 km northwest off Agatti is the submerged reef known as Perumal Par. The fishermen of Agatti regularly catch the baitfish, S. delicatulus from the lagoons of Bangaram and Perumal Par. The fishermen of Minicoy use an encircling net to catch *S. delicatulus* and a lift net for all other species of bait. At Agatti, the live baitfishery is dependent only on *S.delicatulus* caught by an encircling net. The dimensions of the gears used are the same as described by Jones (1958) with slight modifications.

Data on the baitfishery at Minicoy for the season starting from September 1988 to April 1989 and from September 1989 to April 1990 were collected from information supplied by the fishermen and by joining baitfishing trips. Details such as the time spent on baitfishing, species caught, the number of hauls, quantity of bait caught and used, area of fishing and relative abundance of bait were collected. Effort represented in numbers is the total number of baitfishing trips made by the boats in a month while catch (in kg) is the total amount of bait caught for the respective effort. Due to the inherent problems of estimating the catch of baitfishes such as the quantity of bait caught in a day, a confidence interval of + or - 25% is arbitrarily assigned to the estimates made in this study.

The influence of environmental parameters on the variations in baitfish abundance (as estimated from CUPE) was studied by multiple regression analysis. The independent variables were water temperature, primary production by plants (algae and seagrasses) and zooplankton biomass. These data from the baitfishing grounds were collected from a simultaneous study on the hydrology of the Minicoy Lagoon (Nasser, 1993). Monthly total rainfall and average wind speed (km/h) were collected from the Meteorological Station at Minicoy.

Results and Discussion

The baitfish catch at Minicoy nearly doubled during the second season with about 9.3 tonnes exploited from the lagoon (Table 1). The CPUE ranged from 1.5 to 2.7 kg, with higher CPUE noticed when caesionids are used in the fishery. At Agatti also, the catch was higher during the second season and CPUE ranged from 8.1 to 9.3 kg. The fishing season at Minicoy starts with exploitation of clupeids and recruitment of caesionids to the lagoons starts by November. From November to March, various species of caesionids are exploited and towards the end of the season resident apogonids are caught in large numbers by the fishermen.

Table 1: Catch and effort statistics of tuna baitfishery at Minicoy and Agatti Islands.

Month	Minicoy Effort (Trips)	Minicoy Catch (Kg)	Agatti Effort (Trips)	Agatti Catch (Kg)
September 1988	74	128		
October	291	465	308	2492
November	465	1044	800	6800
December	552	1324	902	7326
January 1989	228	483	897	7268
February	203	395	1050	8820
March	367	684	525	4305
April	141	222	340	2822
May	178	135	312	2527
TOTAL	2399	4870	5134	42360
September 1989	170	251		
October	360	527	280	2296
November	581	1308	882	7518
December	640	1507	1012	8901
January 1990	619	1652	773	7190
February	629	1202	1081	9890
March	625	1675	902	7396
April	400	955	778	6302
May	105	212	440	3612
TOTAL	4129	9289	6148	53105

A total of 11 species contributed to the fishery at Minicoy. They were the sprats, *Spratelloides delicatulus* and *S.gracilis* ; fusiliers, *Gymnoceasio gymnoptera, Caesio striatus, Pterocaesio pisang* and *P.chrysozona* ; damsel fishes, *Chromis viridis* and *Lepidozygous tapeinosoma* ; and the cardinal fishes, *Archamia fucata, Apogon thermalis* and *Rhabdamia gracilis*. Among these baitfishes, *S.delicatulus, G.gymnoptera* and *C. striatus* formed the bulk of the catch with the contribution from other species ranging from 1 to 6%. *S.delicatulus* caught at Minicoy was smaller when compared to the ones caught at Agatti. In the case of other species, the average total length varied from 3.2 cm (*R.gracilis*) to 8.3 cm (*C. striatus*).

The multiple regression of environmental and biophysical parameters on total CPUE was significant ($P<0.01$) with an overall correlation coefficient of $r^2 = 0.81$. Significant partial negative correlations of rainfall ($P<0.01$) and wind speed ($P<0.05$) were also observed (Table 2). However, rainfall and wind speed showed significant positive correlation ($P<0.01$) with CPUE of sprats. The overall correlation coefficient was significant ($P<0.01$) with a r^2 value of 0.93.

The baitfishery at Minicoy depends on the availability of migratory species mainly caesionids. Bait catch during the second season more than doubled mainly due to the increase in catches of *C.striatus* and *G.gymnoptera* from November to April. Pillai *et al.*, (1986) observed a similar trend at Minicoy and Maniku *et al.*, (1990) reported caesionids to be the major

Table 2: Multiple regression of five independent variables on CPUE of baitfishes and on combined CPUE of S. delicatulus and *S. gracilis* at Minicoy.

Variables	Minimum	Maximum	Mean
Temperature	27.5	29.5	28.6
Total rainfall	0.0	279.7	58.4
Wind speed	1.4	4.9	2.6
Productivity	1.7	7.8	4.7
Zooplankton	0.1	2.8	0.6
Total CPUE	1.5	2.7	2.1
CPUE of sprats	0.1	1.4	0.6

A. Correlation matrix of independent variables on total CPUE.

	Temperature	Rainfall	Wind speed	Productivity	Zooplankton
Temperature	X				
Rainfall	0.335	X			
Wind speed	-0.137	0.605	X		
Productivity	0.287	0.071	0.052	X	
Zooplankton	-0.171	-0.059	-0.110	-0.501	X
Total CPUE	0.141	-0.721**	-0.552*	0.305	-0.330

B. Correlation matrix of independent variables on combined CPUE of sprats.

	Temperature	Rainfall	Wind speed	Productivity	Zooplankton
Temperature	X				
Rainfall	0.385	X			
Wind speed	-0.222	0.546	X		
Productivity	0.264	0.068	0.054	X	
Zooplankton	-0.255	-0.067	-0.179	-0.468	X
CPUE of sprats	0.036	0.757**	0.900**	-0.029	-0.187

* P<0.05 ** P<0.01

group of baitfishes used in the Maldives. Juvenile fusiliers, locally known as Muguran, are good baitfish because they are easy to catch, make good chummers and are fairly hardy. They appear in the fishery from late October and are available in most months till the end of the fishing season. The fluctuations in the Minicoy baitfishery seems to depend mostly on migrant species. Further, the stocks of resident species, chiefly the apogonids are on the decline due to the deterioration of their habitat and what remains is inadequate to support a sizable fishery.

Due to its fragile nature, one third of *S.delicatulus* caught dies during transportation to the tuna grounds. The more the time taken for tuna fishing, the greater is the mortality. From experience the fishermen of Agatti have learned that if they carry smaller amounts of bait, the mortality is greatly reduced. In spite of this, boats in these areas usually carry three times more than what is required fearing shortage when tuna shoals are sighted. The capture of mature fishes in large quantities and mass destruction of eggs during the fishery may have adverse effect on recruitment. Intensive fishing at any one area for a prolonged period of time will also lead to shortage of bait. If all the units at Perumal Par operate for 2-3 days at a stretch, a bait shortage will be experienced. Previous surveys (Kumaran *et al.*, 1989 and Gopakumar *et al.*, 1991) clearly show that there is potential for other live baits in these areas. Although the use of a lift net was demonstrated by fishermen of Minicoy, it has not found ready acceptance in the northern group of islands. This may be due to the availability of *S. delicatulus*, but for optimum utilization of the bait resource other species will also have to be exploited to reduce the fishing pressure on blue sprat.

The total catch of baitfishes from pole-and-line fishing areas of Lakshadweep is estimated to be 60 tonnes per year when the fishery at Bitra and Suheli is also taken into consideration. This low production may be due to the isolated nature of pole-and-line fishery being restricted to only a few islands. The longer distance between islands also makes it impossible for the fishermen to exploit the bait of other lagoons. The Maldivian baitfishery, which has many similarities with that of Lakshadweep is supported by catches from more than 30 islands. The Fijian fishery on the other hand has more than 100 recognised baiting sites and the effort is spread widely. The estimate of total baitfish catch is based on the bait catches of Minicoy and Agatti. Data from all areas of baitfishing need to be collected for understanding the exploitation rate and to suggest appropriate management measures.

The CPUE at Minicoy which is in the range of 1.5 to 2.7 kg/haul and at Agatti, Bangaram and Perumal Par from 8.1 to 9.3 kg/haul is far less when compared to other baitfisheries. It is 30 kg/haul for caesionids, apogonids and pomacentrids and 40 kg/haul for *Spratelloides* in the Maldives (Maniku *et al.*, 1990), 117 kg for anchovies and sprats in the Solomon Islands (Nichols and Rawlinson, 1990) and 84 kg/haul for a variety of baitfishes in Fiji (Sharma and Adams, 1990). The differences in the fishing methods between Lakshadweep and elsewhere are the night fishing for live baits in the South Pacific and the availability of a wider area for baitfishing in the Maldives.

The relationship between catch and effort is found to be linear with a near uniform CPUE. A similar observation was reported from Solomon Islands (Nichols and Rawlinson, 1990) and Papua New Guinea and Fiji baitfisheries (Dalzell and Lewis, 1988). Dalzell and Lewis (1988) suggests that the lack of a curvature in the catch-effort relationship may be due to the dynamics of the pole-and-line fishery, as bait are essential to the capture of tuna, fishermen will quickly leave a bait ground when catches decline and will try other locations for bait supply. This is the case with the fishermen of Agatti who can choose from more than one site. The selection of baiting locations by the fishermen depends on the close proximity to the tuna fishing grounds and the expected catch rate from a bait ground at that particular time. The baitfishery at Agatti may therefore be self regulatory. When catch rates in a particular bait ground decrease the fishermen move to new baiting locations. This movement gives baitfish stocks at the first site time to recover due to the reduced fishing effort. The favoured bait grounds of Agatti fishermen are Bangaram and Perumal Par. But in recent times some of them migrate to Bitra and Suhlei for tuna fishing when bait is scarce. The baitfishery at Bangaram and Perumal Par has to be therefore monitored closely for if there is a collapse of baitfish stocks at these sites it would have adverse economic effects on the pole-and-line fishery of the area. This once again brings into sharp focus the need for diversifying the fishery for species other than *S.delicatulus.* At Minicoy, the lack of additional bait grounds is compensated by the judicious use of a wide variety of bait fishes. Fishing starts with clupeids then shifts to caesionids and migratory pomacentrids when they enter the lagoon and finally to resident apogonids. There is even a traditional closed season for apogonids which can be fished only by middle of the fishing season when the amount of other baits are low. The destruction of coral heads has depleted the stock of resident bait fishes and the fishery at present relies heavily on the migratory species. Recruitment or arrival of these fishes in the lagoon depend on a number of favorable environmental factors such as currents and rainfall. The fishery at Minicoy, therefore, merits further attention with particular reference to habitat changes and environmental fluctuations. Stock assessment studies and biology of baitfishes will have to be attempted. Culture trials of certain apogonids such as *Archamia fucata* may also be undertaken to augment the natural population of baitfishes.

Small schooling pelagic fishes are likely to be susceptible to climatic effects on the aquatic environment due to their habitat being close to the air-water interface. There is also evidence to suggest that production of tropical clupeoids is indeed strongly influenced by environmental effects, particularly wind and rainfall (Dalzell, 1990). Production of several tropical clupeiod fishes are influenced by rainfall (Dalzell, 1984 ; Ianelli, 1988). The total bait catch at Minicoy was adversely affected by rainfall. Rainfall through runoff and stream discharge will lower salinity and increase turbidity which may have adverse effects on pelagic species (Dalzell, 1990). Tham (1954) suggested that declines may be due to the difficulties plankton feeders have in catching their prey in turbid waters or to the effect that a heavy particulate suspension has on the effective functioning of their respiratory systems. There was no significant correlation between rainfall and total catch in the Kiribati baitfishery (Ianelli, 1988) and Dalzell (1984) also did not obtain correlation between rainfall and catch rates of the con-gener S.gracilis from the northern PNG baitfisheries. The present investigation on the influence of rainfall on baitfish catches suggest that abundance of clupeids at Minicoy are strongly related to environmental parameters.

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