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MARINE LIVING RESOURCES OF THE UNION TERRITORY OF LAKSHADWEEP —

An Indicative Survey With Suggestions For Development

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5. LIVE-BAIT RESOURCES AND DEVELOPMENT

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INTRODUCTION

The success of the pole and line fishery of Lakshadweep depends, among other factors, directly on the availability in sufficient quantities of suitable live-bait fishes around the islands. Information on the live-bait resources of Lakshadweep is limited to a few reports from Minicoy. Jones (1958, 1964) described the fishing method, storage and utilisation of bait fish and listed the various species of live-bait fishes of Lakshadweep. Jones (1961 a, 1961 b) has predicted the potentialities of *Spratelloides delicatulus* and *S. japonicus* as live-bait for pole and line fishery for skipjack much earlier than mechanised fishing was introduced in the northern islands of Lakshadweep. Thomas (1964) made some observations on the fluctuations in the live-bait fishes at Minicoy. Fluctuations in the seasonal availability of live-baits at Minicoy during the years 1981-85 has been presented by Pillai *et al.* (1986). However, details of exploited bait fish resources and seasonal abundance of different bait species around the various islands is still lacking.

Exploratory surveys for live-baits covering all the lagoons and adjacent shallow reef areas of the islands have not been attempted till now. The important findings of the survey of tuna live-bait resources to assess the availability and abundance forming part of the survey of the fisheries potential of Lakshadweep carried out from January to March 1987 is presented in this paper. The results of exploratory tuna live-bait resources survey by the staff of the Research Centre at Minicoy around some of the islands and reef areas from October 1986 to March 1987 have also been incorporated in this report to make the same more comprehensive.

METHOD OF SURVEY

Observations and collections were made in the intertidal regions, lagoons, reef flats and windward and leeward slopes of the islands. The data on the occurrence and relative abundance of potentially important species were collected by operating bait fishing nets used in pole and line fishing by professional fishermen, supplemented by visual observations and by operating drag nets and velon screen.

CRAFTS AND GEARS

Mechanised boats of 7.62 and 9,14 m OAL were used for tuna live-bait survey in different islands. Bait tank measuring 1.6 x 0.8x 0.8m fitted in front of the engine room is divided into two compartments by a movable partition in the middle of the tank. Sea water circulation in the bait tank is maintained by specially devised water circulation system, the intake position of which is near the hull along the bottom. The quarter deck which is about 1m broad is constructed on the top of the quadrant which serves as the pole and line fishing platform. The space between the engine room and the fishing platform is used as the fish hold.

Two types of bait fish nets operated traditionally for bait fishing in the islands and drag nets measuring 12 m x 1.5 m were employed for the survey. In Minicoy, "Engala dhau", a rectangular net measuring 5.8 x 5.3m made of nylon webbing having mesh size of 6 mm is used for collection of bait fishes like sprats, apogonids, caesiodids, pomacentrids etc. from the deeper parts of the lagoon and from the nearshore waters on the leeward side. After locating bait fish concentrations, the net is lowered and spread near the bottom with the help of four poles tied to its corners. Bait fishes are lured by fish meat paste and the net is quickly hauled up when sufficient quantity of bait fishes are gathered over the net, and the baits transferred to the bait tank of the boat. This traditional method of bait fish capture is not practised in any of the other islands.

For collection of bait fishes, "Hondeli dhau" made of nylon webbing 30 x 1.5 m having mesh size of 6 mm with wooden floats and lead sinkers is used in all the islands where pole and line fishing is carried out. This net is used as an encircling net (Fig. 1 A) to collect baits

especially sprats atherinids and apogonids from shallow areas of the lagoon. The shoal is encircled by a scare line with coconut leaves by about 6 persons who drive the bait fishes to the nylon net operated by two persons. A small netting made of organdie or mosquito curtain cloth is used for collection and transfer to the bait tank.

SPECIES COMPOSITION OF LIVE-BAITS

The data collected during the surveys indicate that the species belonging to the families Dussumieriidae, Apogonidae, Caesiodidae, Pomacentridae, Emmelichthyidae and Atherinidae are present in varying proportions in the collections made by encircling nets, lift bait fishing

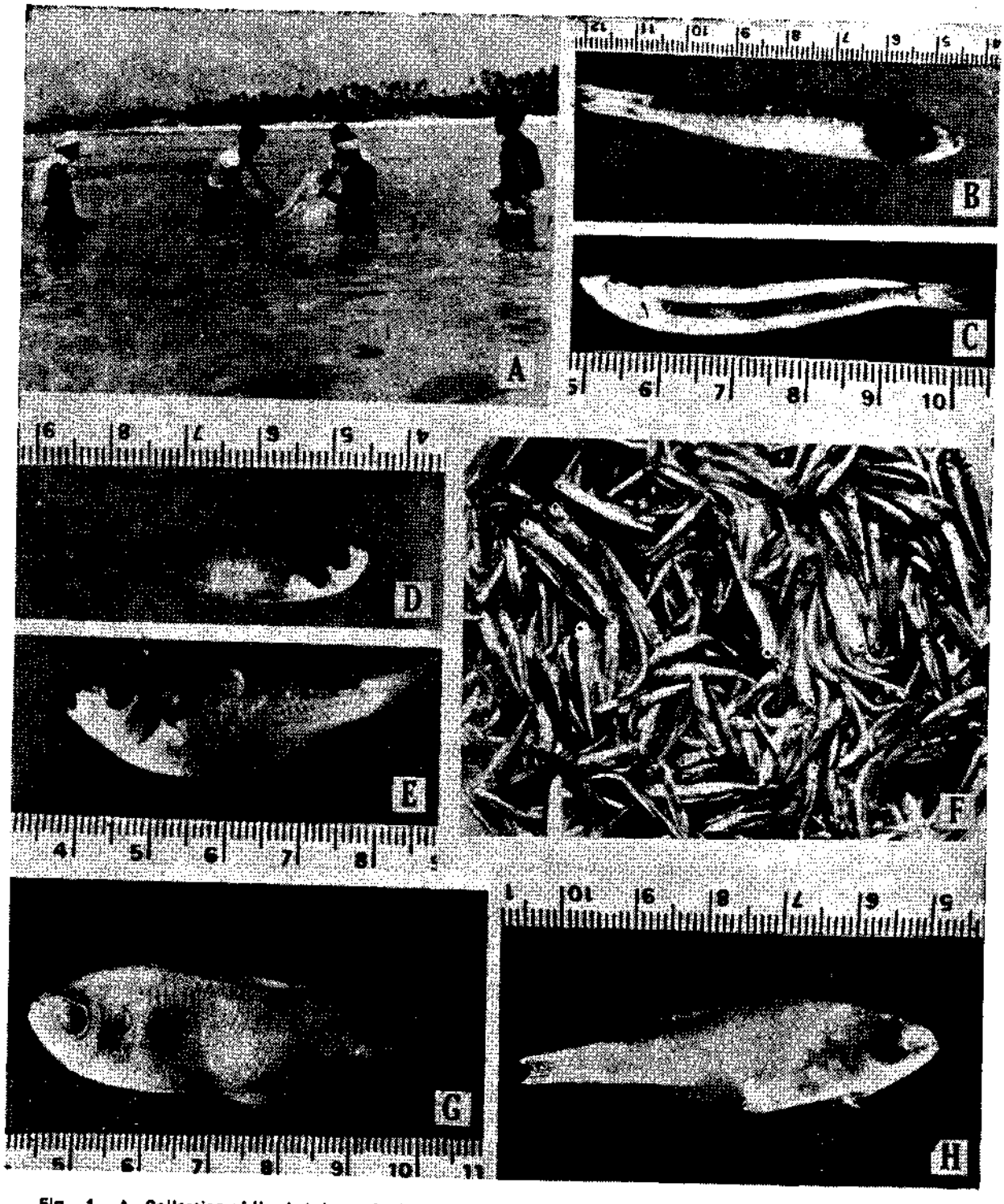

Fig. 1. A. Collection of live bait by encircling net at Chetlat. B. *Gymnocaesio argenteus* C. *Spratelloides japonicus*. D. *Lepidozygus tapeinosoma*. E. *Chromis caeruleus*. F. Mixed catch of *Spratelloides delicatulus* and *Allanetta barnesi* at Kadmat Island. G. *Archamia fucata*. H. *Ostorhynchus apogonides*.

nets and drag nets from different islands and reef areas. The species which are abundant and commonly occurring are listed in Table 1. It could be seen that *Spratelloides delicatulus, S. japonicus. Archamia fucata, Apogon leptacanthus, A. sangiensis, Dipterygonotus leucogrammicus, Gymnocaesio argenteus, Caesio chrysozona, Lepidozygus tapeinosoma* and *Chromis caeruleus* are the most important bait species abundantly occurring in the Islands. *Spratelloides delicatulus* which is the most widely used and sought after species of bait fish is available at all the islands except Amini and was abundant at Perumal Par, Bitra, Suheli, Minicoy and Kalpeni. The length range observed in the collections during the survey is 20-55mm. *Spratelloides japonicus* (Fig. 1 C) is abundant at Perumal Par, Bangaram and Minicoy. The length ranged from 22-65 mm in the collections. Apogonids are abundant at Kavaratti, Minicoy, Kadmat and Agatti and the catches are low at Amini, Androth, Chetlat and Kiltan. Atherinids are abundant at Amini, Bitra and Kadmat. The length range of *Allanetta barnesi* is 18-65 mm. *Chromis caeruleus* is either abundant or common at most of the islands except Androth, the length range being 22-63 mm.

The percentage composition of major groups of live-baits collected during the resources survey from October 1986 to March 1987 given in Table 2 indicates that pomacentrids and sprats are most abundant around most of the islands. When the live-bait collections from each island are considered separately, the percentage composition of pomacentrids collected from different islands varied from 9.40% to 76.35%, sprats from 11.93% to 51.0% and apogonids from 1.02% to 63.22%. Sprats are more abundant at Chetlat (51.0%), Perumal Par (45.0%), Bitra (37.50%), Suheli (34.60%), Minicoy (33.43%) and Kalpeni (30.65%). The percentage composition of sprats around the islands Kadmat and Kavaratti is low. Pomacentrids are abundant at Bangaram (76.35%), Suheli (45.47%), Perumal Par (41.0%), Chetlat (40.23%), Kalpeni (35.

TABLE 1. *Distribution and abundance of live-baits collected during October 1986 to March 1987*

Species	Agatti	Amini	Androth	Perumal Par	Bangaram, Tinnakara Parli	Bitra	Chetlat	Kadmat	Kalpeni Cheriyam, Thilakkam	Kavaratti	Kiltan	Minicoy	Suheli Par
1. *Spratelloides delicatulus*	XXX		XXX	XXX	XXX	XXX	XXX	XX	XXX	XX	XX	XXX	XXX
2. *Spratelloides japonicus*	XX		XX	XX	XXX	XX						XXX	XX
3. *Stenatherina temmincki*		XX				XXX	XX						
4. *Allanetta barnesi*		XXX				XX		XXX			XX		
5. *Pranesus pinguis*		XX	XX				XXX	XX		XX		XX	
6. *Rhabdamia cypselurus*	XXX			XX		XX			XX				
7. *Rhabdamia gracilis*	XX			XX				XXX	XX	XX			XX
8. *Archamia fucata*	XX			XXX	XX			XXX		XXX		XXX	
9 *Apogon leptacanthus*	XXX	XX			XX	XXX		XXX	XX			XX	XX
10. *Apogon sangiensis*	XX		XX		XX	XXX	XX		XXX	XX		XXX	XX
11. *Ostorhynchus novemfasciatus*		XX	XX			XXX	XX		XX	XX		XX	XX
12. *Ostcrhynchus apogonides*	XX		XX	XX	XX			XX	XX				XX
13 *Dipterygonotus leucogrammicus*			XX			XX		XX				XXX	
14. *Gymnocaesio argenteus*	XX		XX	XX					XX			XXX	
15 *Caesio chrysozona*	XXX	XX		XXX	XX	XX			XX	XX		XX	XX
16 *Caesio pisang*				XX		XX		XX	XX				XX
17. *Caesio coerulaureus*	XX			XX	XX			XX			XX	XXX	
18. *Lepidozygus tapeinosoma*			XX					XX				XXX	
19. *Chromis caeuleus*	XXX	XX		XXX	XXX	XXX	XXX	XX	XXX	XX	XXX	XX	xXX
20. *Chromis nigrurus*	XX			XXX	XX		XX	XXX	XX	XX			XX
21. *Pomacentrus pavo*	XX			XX	XX		XX	XX				XX	

xxx Abundant
xx Common

TABLE 2. *Percentage composition of live-bait collected during the live-bait resources survey (October 1986 to March 1987)*

Island	Sprats	Apogonids	Caesiodids	Pomacentrids	Atherinids
Agatti	12.24	38.33	15.38	34.05	—
Bangaram, Tinnakara,. Parli	22.63	1.02	—	76.35	—
Bitra	37.50	16.35	0.96	32.69	12.50
Chetlat	51.0	—	—	40.23	8.77
Kadmat	11.93	38.53	10.09	29.05	10.4
Kalpeni, Cheriyam, Thilakkam	30.65	22.21	9.89	35.21	2.04
Kavaratti	12.36	63.22	1.44	22.98	—
Minicoy	33.43	40.19	14.98	9.40	2.00
Perumal Par	45.00	6.50	7.50	41.00	—
Suheli Par	34.60	9.81	3.63	45.47	6.50

21%), Agatti (34.05%) and Bitra (32.69%) and scarce at Minicoy. Apogonids are abundant at Kavaratti (63.22%), Minicoy (40.19%), Kadmat (38.53%) and Agatti (38.33%) whereas the percentage was low at Suheli Par, Perumal Par and Bangaram and absent at Chetlat. Caesiodids are common at Agatti (15.38%), Minicoy (14. 98%), and Kadmat (10.09) and scarce or absent at other islands. Atherinids are common at Bitra (12.5%) and Kadmat (10.4%) and the percentage was very low in other islands during the period of survey.

ISLANDWISE PRODUCTION OF LIVE-BAITS

Reliable data are not available on the exploitation and seasonal abundance of bait fishes from different islands in the Lakshadweep except at Minicoy. The seasonal pattern of exploitation of live-baits from October 1986 to March 1987 at Minicoy is given in Table 3. The total live-baits caught at Minicoy during the above period is estimated as 3994 kg. The trend of production of live-baits at Minicoy indicates that the total catch was relatively less during November-December and the highest in March (1254 Kg). Catch per unit effort of bait fishes at Minicoy varied during the above period from 1.47 to 3.10 kg with low values during November-December and the highest C/E was in March, being 3.10 Kg. The cumulative values of C/E for the period of survey was 2.23 kg. In other islands, the C/E varied considerably and the observed values in order of abundance are given in Table 4. It could be inferred from the catch per unit effort of fishing conducted during the survey that fairly good concentrations of bait fishes were available at Minicoy, Kadmat, Bitra, Agatti and Suheli Par whereas the availability of bait fishes was low at Kavaratti and Chetlat.

TABLE 3. *Tuna live-bait production at Minicoy during October 1936 to March 1987*

Month	Total live-bait (kg)
October	629.5
November	387.5
December	561.0
January	691.5
February	410.5
March	1254.0

TABLE 4. *Catch/unit effort of bait fishes in different islands.*

Island	C/E (kg)
Kadmat	1.30
Bitra	0.87
Agatti	0.82
Suheli Par	0.79
Bangaram	0.69
Kalpeni	0.61
Perumal Par	0.40
Kavaratti	0.35
Chetlat	0.28

The highly fluctuating nature of bait fish catch at Minicoy has already been dealt with by Pillai *et al.* (1986). The abundance of different species vary highly in different years and seasons. According to the above authors, during 1981-82 season, *Spratelloides delicatulus* formed 64.16% followed by *Archamia fucata*, 22.23% whereas during 1983-84 season, these constituted 32.68% and 30.56% respectively and in 1984-85 season, *S. delicatulus* consisted of 36.1%, the second position being taken by *Caesio coerulaureus*, 18.5%. During the present survey at Minicoy, apogonids, sprats and caesiodids constituted 40.19%, 33.43% and 14.98% respectively. When the total catches from all the islands and reefs surveyed is considered as a whole, *Spratelloides delicatulus* constituted 27.0%, apogonids 26.0%, pomacentrids, chiefly *Chromis caeruleus* 32.4%, caesiodids 8.0% and atherinids 6.6%. *Lepidozygus tapeinosoma*, *Gymnocaesio argenteus* and *Dipterygonotus leucogrammicus* which used to be important constituents of bait fish catches at Minicoy in the past has either declined considerably or absent in the catches in recent years. Pillai *et al.* (1986) stated that during 1981-82 fishing season there was a gradual decline in the live-bait catches at Minicoy from November to March 1982, whereas during 1982-83 season live-bait catches increased from November to January and declined in February and March. However, during 1984-85 season, the highest catch was recorded during March and this agrees with the langings in 1987. In general, the premonsoon period of January-April is more productive with regard to live-bait fishery when compared to the post-monsoon months.

In Minicoy, a wide variety of bait fishes collected from the vicinity of the reefs and from the lagoon are used for pole and line fishery, whereas in other islands of the Lakshadweep mostly *Spratelloides* spp. are in common use and apogonids and atherinids are used only when the former is not available in good quantities. The present exploitation of tuna live-bait and consequently that of skipjack by pole and line fishing at Amini, Chetlat, Kalpeni and Kiltan is low when compared to that of Suheli Par, Agatti, Minicoy and Kavaratti.

SPAWNING OF LIVE-BAITS

Information on the spawning of tuna live-baits is restricted to only three or four species (Madan Mohan and Kunhikoya, 1986; Madan Mohan *et al.*, 1986 and Pillai *et. al.*, 1986). The blue sprat, *Spratelloides delicatulus* is found in scattered shoals in clear water in the shallow regions of the lagoon. Specimens in all stages of maturity were recorded at Minicoy and ripe group of ova ranged in diameter from 0.44 mm to 0.76 mm with a discernible mode at 0.61mm. Based on the information on the avilability of fishes in different maturity stages in different months, it is presumed that the species spawns in Minicoy lagoon more than once in a spawning season which is during March-April to December.

The silver sprat, *S. gracilis* occurs in Minicoy waters during post- and pre-monsoon months. Specimens in all stages of maturity were recorded and in mature ovaries ova ranged in diameter from 0.38 mm to 0.61 mm with a mode at 0.51 mm. The species spawns more than once in a spawning season which is from September to April.

Madan Mohan *et al.* (1986) observed that mature specimens and juveniles of the blue puller, *Chromis caeruleus* almost throughout the year and indicated that breeding in this species is continuous from August to April. Spent fishes were not observed during January to April and based on the occurrence of "high percentage of matured and ripe spawning fishes along with recovering stages" it was also presumed that spawning takes place during the above period.

HABIT AND HABITAT OF TUNA LIVE-BAITS

In all the islands, live baits are mostly caught from the lagoon. Only occasionally, tuna boats have been found to catch live-baits outside the reef on the north eastern side of Minicoy island. Some species like *Caesio coerulaureus*, *Dipterygonotus leucogrammicus*, *Gymnocaesio argenteus* and *Lepidozygus tapeinosoma* and *Dipterygonotus leucogrammicus* which formed the major constituents of live baits at Minicoy some years ago failed to appear in good quantities from 1981-82 fishing season onwards. These are found in the deeper parts of the lagoon and also on the north-eastern

side of Minicoy. *Caesio* spp. are found in deeper areas of the northern part of Minicoy lagoon and in the reef area. They are generally fished towards the close of the fishing season from the outer part of the lagoon and northern side of Ragandi point. These migrant species cause high fluctuations in the live-bait fishery and their disappearance from the lagoon during some fishing seasons is probably due to adverse changes in environmental conditions.

Some live-bait species inhabit the lagoon throughout their life. *Spratelloides delicatulus* generally occurs in scattered shoals near the inner reef area in the lagoons of the islands. Young fish found on shoal sand and coral flats in clear water are easily caught by encircling net. Mature specimens have been observed to occur occasionally in the coastal area of the lagoon. The species begins to appear in the lagoon of the islands just after the south-west monsoon. *S. japonicus* found in the lagoon near coral colonies have been found to move to deeper waters during low tide. Apogonids which show wide annual fluctuations in the live-bait catches often live in the vicinity of coral colonies in the lagoon of most of the islands. Atherinids, especially *Paranesus pinguis, Stenatherina temminicki* and *Allanetta barnesi* are found mostly closer to the shore in the lagoon of the islands. These are sometimes caught in good quantities during the peak tuna fishing season and towards the close of the fishing season. Sometimes *Allanetta barnesi* and *Spratelloides delicatulus* have been observed in mixed schools. Many species found in the reef areas are used as live-bait in Minicoy. Whichever species is available in the bait collections at Minicoy are used as bait fish even though only a few of them are considered good for pole and line fisheries.

EXPLOITATION PRESSURE AND ENVIRONMENTAL DAMAGE

In the absence of live-bait landing data from different islands over a long span of years, it is difficult to find out whether there is a decline in the live-bait catch or not. Silas *et al.* (1986) were of the view that scarcity of live-baits is a limiting factor for the expansion of tuna fishery and James et al. (1986) have adduced several reasons for the acute shortage of live-baits like desertion of live-bait populations resulting from damage caused to coral reef, lack of recruitment of young ones to the population and increased demand for live-baits.

Coral colonies which are ideal for the survival of live-bait fishes are prone to natural senescence. Blasting the reefs and dredging for deepening the boat channels in the islands results in siltation in the areas of coral growth, thereby causing the death of coral colonies and the associated live-bait species. However, the present survey indicates that resources of live-baits, both migrant and resident forms available around Kadmat, Bitra, Agatti, Suheli Par, Bangaram, Minicoy and Perumal Par are not fully exploited.

The requirement of live-bait for pole and line fisheries has increased considerably in recent years owing to the increased use of mechanised boats in pole and line fishing operations in most of the islands. Tuna fishing by pole and line using live-baits in an organised manner was in vogue only in Minicoy island till 1963. The pole and line fleet which consisted of 9 boats in 1963 (exclusively in Minicoy) has now increased to about 130 boats and the tuna landing has reached 4807 tonnes in 1986. There is a greater demand for live-baits than in the past and the fishermen exploit the easily accessible stocks of resident species to the possible extent. This is evident from the exploitation pressure on *Chromis caeruleus* at Minicoy and *Spratelloides delicatulus* in the northern islands, especially at Agathi, Bangaram, Suheli Par and Bitra. The production of live-baits at Minicoy has recorded an increase of about 130% from the level of 2799 kg in 1981-82 to 6457 kg in 1986-87 which shows that there is no scarcity in availability. There is only a marginal increase of five tuna fishing boats at Minicoy from those present in 1981-82 (31) and hence it is clear that the catch per boat in 1986-87 is much higher than in 1981-82. Due to the fluctuations in abundance of different live-bait species during different seasons, it is possible that the major species generally preferred are not available easily to the fishermen and this gives an impression that ther is shortage of live-baits for the existing tuna fishing boats. It is probable that seasonal viriation in the recruitment of migrant species such as *Caesio*

spp., *Dipterygonotus leucogrammicus* and *Lepidozygus tapeinosoma* into the lagoonal environment is due to the altered habitat which is not conducive for their survival Consequently there will be increased fishing pressure on the available stocks of resident forms in the lagoon.

CONCLUSION

Generally, live-baits remaining after the day's fishing are stored in the storage tank floated in the lagoon. Mortality of live-baits stored in the bait tank of the boat and also in the storage tank floated in the lagon is very high due to overstocking. Measures have to be taken to find out the optimum requirement of tuna live bait for a day's tuna fishing as well as the maximum storage capacity of fhe storage tanks in order to avoid wastage.

From the extensive coral boulders and coral debris found along the reefs and also close to some of the islands, it appears that the damage to the coral colonies and thereby to the live-bait populations by cyclonic storms and siltation caused by the fury of nature is much more deleterious than the damage to corals by dredging the boat channel.

For obtaining maximum sustainable yield of tuna from Lakshadweep waters which is reportedly as high as 50,000 tonnes (George *et al.* 1977), knowlege of exploited and potential resources of live-baits is required. The total area of the lagoons in the Lakshadweep is not very extensive (420 km) to support live-baits sufficient enough to capture the skipjack resources available in the Laccadive sea. It would appear that suitable live-bait resources are also available in the islands of Lakshadweep in regions not exploited at present as is evident from the fact that mostly *Spratelloides* spp. and atherinids are only collected by pole and line fishermen from islands other than Minicoy. The leeward side of the islands which is generally more protected from strong winds and currents are likely to harbour some migrant species and the possibility of exploiting the same by lift nets as used in Minicoy when other bait fishes are scarce in the lagoons have to be explored.

REFERENCES

CMFRI 1986. Live-bait resources of Lakshadweep. *In*: *CMFRI* Newsletter. 34: 5 pp.

GEORGE, P. C., B. T. ANTONY RAJA AND K. C. GEORGE 1977. Fishery resources of the Indian Economic Zone. *Silver Jubilee Souvenir*, *IFP*: 79-116.

JAMES, P. S. B. R., T. JACOB, C. S. GOPINATHA PILLAI AND P. P. PILLAI 1986. Prospects of development of marine fisheries resource in Lakshadweep. *Mar. Fish. Infor. Serv. T & E Ser.*, **68**: 51-54.

JONES, S. 1958. Tuna live bait fishery of Minicoy Island. *Indian J. Fish.*, **5** (2): 300-307.

JONES, S. 1961 a. *Spratelloides delicatulus* (Bennett) as a potential live bait for tuna in the Laccadives. *J. mar. biol. Ass. India*. **2** (2) : (1) : 103-104.

JONES, S. 1961 b. Further notes on *Spratelloides delicatulus* (Bennett) as a tuna live bait with a record of S. *japonicus* (Houttuyn) from the Laccadive Sea. *Ibid.*, **2** (2) : 267-268.

JONES, S. 1964. A preliminary survey of the common tuna bait fishes of Minicoy and their distribution in the Laccadive in the Laccadive Archipelago. *Proc. Symp. Scomb. Fishes*. Mar. Biol. Ass. India, Mandapam Camp, **2** : 643-680.

MADAN MOHAN AND K. K. KUNHIKOYA 1986. Biology of the bait fishes *Spratelloides delicatulus* (Bennett) and S. *japonicus* (Houttuyn) from Minicoy waters. *Bull. Cent. Mar. Fish. Res. Inst.*, **36**: 196-200.

MADAN MOHAN, C. S. GOPINATHA PILLAI AND K. K. KUNHIKOYA 1986. The Biology of the blue-puller *Chromis caeruleus* (Cuvier) from Minicoy Atoll. *Indian J. Fish.*, **33** (4) : 457-470.

PILLAI, P. P., M. KUMARAN, C. S. G. PILLAI, MADAN MOHAN, G. GOPAKUMAR, P. LIVINGSTON AND M. SRINATH 1986. Exploited and potential resources of live-bait fishes of Lakshadweep. *Mar. Fish. Inf. Serv. T & E Ser.*, **68**. 1815, 15-25

THOMAS, P. T. 1964. A study on the fluctuations of the major tuna live-bait fishes of Minicoy. *Proc. Symp. Scomb. Fishes* Mar. Biol. Ass. India' Mandapam Camp, **2** : 626-630.