Indian J. Fish., 60(3) : 119-122, 2013

Note

Observations on fishery and biology of yellowfin tuna *Thunnus albacares* (Bonnaterre, 1788) from Lakshadweep waters

K. P. SAID KOYA, U. GANGA, J. JAYASANKAR, R. GIREESH, T. B. RETHEESH, R. THANGARAJA AND E. M. ABDUSSAMAD

Central Marine Fisheries Research Institute, Ernakulam North P. O., Kochi-682 018, Kerala, India
e-mail: kpskoya@yahoo.com

ABSTRACT

The yellowfin tuna *Thunnus albacares* is a high value oceanic resource for which targeted fishing was initiated in 2008 in Lakshadweep islands. Pole and line, troll line and drift gillnet are the major gears operated in the islands using traditionally designed mechanised Pablo boats of 25 to 34 feet overall length. Fishing operation is mainly practised during September to May. The estimated landing of total fish from three islands of Lakshadweep (Minicoy, Androth and Agatti) during January–December, 2011 was 1555 t, of which tuna contributed 83%. Maximum yellowfin tuna landing was recorded from Minicoy (84%) followed by Agatti (9 %) and Androth (7%). Smaller sized yellowfin tuna with fork length (FL) measuring 42-46 cm were observed throughout the year. Swarming crab, *Charybdis smithii* was the dominant food component with index of relative importance (IRI) of 87.5 followed by *Auxis thazard* (IRI - 5.3) and *Cheilopogon* sp. (IRI - 0.8). Since the inception of the World Bank aided National Agricultural Innovation Project (NAIP) by the Indian Council of Agricultural Research (ICAR), on 'Developing a value chain for oceanic tunas in Lakshadweep islands', targeted fishing for yellowfin tuna has resulted in 37% increase in the landing of this species.

Keywords: Biology, Feeding, Fishery, Lakshadweep, *Thunnus albacares*, Yellowfin tuna

The Lakshadweep seas (8º 00´-12º 30´ N; 71º 00-74° 00 E) are very productive, supporting a rich and diverse fish fauna. However, highly valued yellowfin tuna resources are not efficiently harvested due to various reasons such as lack of infrastructure in the islands as well as limited transportation facilities to mainland. Pole and line fishing using live baits and trolling for skipjack tuna has been traditionally followed. The introduction of an eco-friendly monofilament longline fishing method in Pablo boat, development of value added products as well as byproducts from tuna wastes have encouraged yellowfin fishing in Lakshadweep islands. Though the fishery and biology of skipjack tuna have been reported from Lakshadweep islands by several workers, very little information is available on the yellowfin tuna stocks (Madan and Kunhikoya, 1985; Silas *et al*., 1985, 1986; Sudarsan and John 1994; Yohannan and Pillai 1994; Nasser *et al*., 2002; Pillai *et al*., 2002; Sivadas, 2002; Varghese *et al*., 2002). The food and feeding behaviour of yellowfin tuna has not so far been described from this region. The present study was carried out mainly to address this aspect which is a prerequisite for understanding the dynamics of yellowfin tuna fishery from an ecosystem perspective.

Daily observations on the yellowfin tuna fishery were made during January to December 2011 from three major islands of Lakshadweep namely Agatti, Androth and Minicoy, where active tuna fishing is observed. Yellowfin tuna landing estimates from different craft-gear combinations were obtained on a monthly basis, based on 15-20 daily observations per month. Fork length (FL in cm) recorded in the field were tabulated into 4 cm length groups, raised appropriately and the monthly length frequency distribution arrived at.

For diet studies, 218 specimens were sampled from the tuna processing factory. After recording FL and sex/maturity stage, individual stomachs were removed, marked and fixed in 10% formalin for analysing gut content. The samples were classified into four size groups of FL 40-70 cm (n = 42), 70-100 cm (n = 71), 100-130 cm (n= 62) and 130-160 cm (n = 43). Based on visual observation of the stomach distension, stomachs were classified as full, three-fourth full, half-full, one-fourth full and empty (Job, 1940). The individual food items in each stomach were counted and weighed to the possible extent depending on its stage of digestion. The index of relative importance (IRI) was calculated as follows:

$$IRI = (\%N + \%W) \times \%F$$

where, %N = Percentage of the number of each food item to the total number of all food items identified, %W = Percentage wet weight of each food item to the total wet weight of all food items identified and %F = Frequency

of occurrence of each food item in the total number of stomachs examined.

The length-weight relationship of the yellowfin tuna landed in Lakshadweep was calculated using the equation $W = aFL^b$ where W = weight in grams and FL is the fork length in cm.

About 350-400 mechanised boats are actively engaged in fishing at Lakshadweep islands. Although pole and line fishing for skipjack tuna (*Katsuwonus pelamis*) is established, yellow fin tuna fishing has gained popularity only recently since the inception of the National Agricultural Innovation Project on 'Developing a value chain for oceanic tunas in Lakshadweep islands by ICAR, New Delhi. During the period 2007 to 2010, annual fish landing in Lakshadweep islands ranged between 7550 t and 7883 t of which yellowfin tuna ranged between 987 t and 1571 t (Fig. 1). The total tuna landing during the year 2011 from the three islands was estimated as 1296 t of which yellowfin tuna contributed 738 t. Though tuna fishing was carried out throughout the year, peak landings were observed during November to March. Maximum yellowfin tuna landing was recorded from Minicoy (84%) followed by Agatti (9%) and Androth (7%).

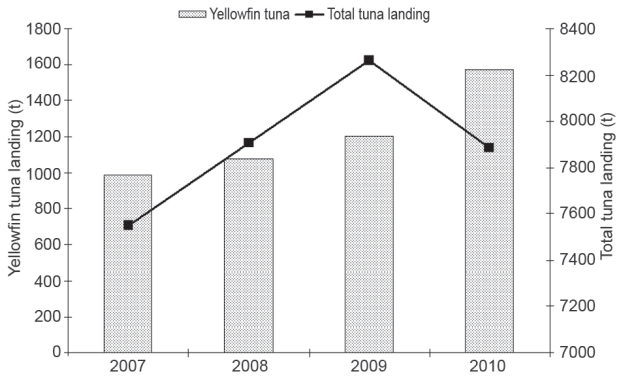

Fig. 1. Total tuna and yellowfin tuna landings in Lakshadweep islands during 2007-2010

Lack of infrastructure such as cold storage facilities, ice plants, domestic market and transportation facilities to main land have thus far restricted the exploitation of yellowfin tuna in Lakshadweep Sea. The World Bank aided NAIP which envisaged the overall development of the fishery sector of Lakshadweep islands especially through exploitation of oceanic yellowfin tuna using ecofriendly monofilament longlining method in Pablo boats has played a significant role in developing yellowfin tuna fishery in Lakshadweep. The increasing trend in targeted fishing of yellowfin tuna using converted Pablo boat longliners as well as production of value added products and byproducts from tuna wastes have encouraged fishermen for targeting yellowfin tuna from Lakshadweep Sea

The fork length of *T. albacares* ranged from 28-180 cm with 40-50 cm as the modal class. The contribution of yellowfin tuna in different size frequency varied in each gear. The modal length class of yellowfin tuna obtained in the pole & line, troll line and drift gillnet were 40-50 cm, 70-80 and 60-70 respectively (Fig. 2). The length range recorded in the present study is similar to that reported by earlier workers (John and Sudharsan, 1993; Pillai *et al*., 1993). Prathiba and Rammohan (2009) reported a length range of 30-190 cm from Andhra coast. The dominance of smaller size class of yellowfin tuna in the fishery is due to greater reliance on pole and line gear for which the approximate exploitable size is less than 5 kg.

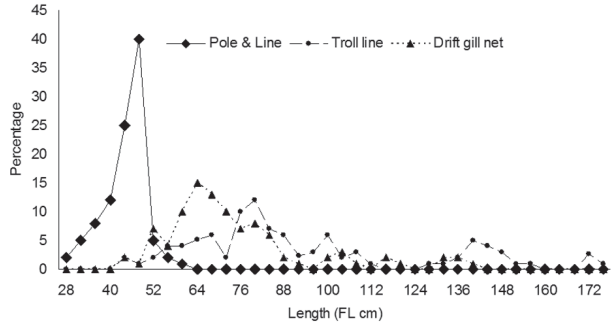

Fig. 2. Length size frequency of yellowfin tuna landed by different gears in Lakshadweep

The fork length and weight of yellowfin tuna landed in Lakshadweep island ranged from 30-163 cm and 0.380 kg to 82.6 kg. Length-weight relationship was established with '*a*' = 0.00003 and '*b*' = 2.916 (r^2 = 0.9847) (Fig. 3). The '*b*' value obtained in the present study is comparable to value obtained by earlier workers (Madanmohan and Kunhikoya, 1985; Sudharsan and John, 1994; Prathiba and Rammohan, 2009).

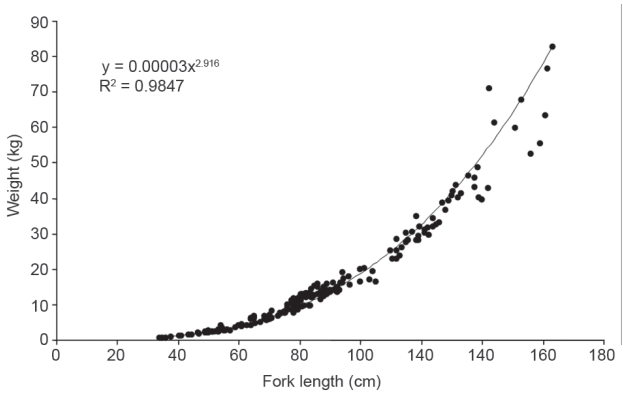

Fig. 3. Length - weight relationship of yellowfin tuna from Lakshadweep islands

Of the 218 stomachs analysed, 45% were found to be empty, 7% one-fourth full, 16% half-full, 6% three-fourth and 26% full. The index of relative importance (IRI)

indicated that food mainly consisted of crab *Charybdis smithii* (87.54), *Auxis thazard* (5.31), flying fish (0.14) and squid (0.51) (Table 1). Stomach fullness of different size groups of yellowfin tuna varied from 8.33% to 66.67% in 40-70 cm and 130-160 FL cm respectively. This shows high feeding rate in larger adults compared to juveniles and immature individuals (40-70 FL cm). The most important prey group was *C. smithii* in terms of number (791) and frequency of occurrence (71). The second important prey item was *A. thazard* in terms of number (81) and frequency of occurrence (16). Squid was also observed as a prey item with low frequency of occurrence. Variation in food composition of yellowfin tuna was observed in different size groups (Table 1). Small size groups (40-70 cm) preferred all the organisms in equal proportion as per the availability.

Table 1. Index of relative importance in different size groups of yellowfin tuna (IRI%)

Diet group	Size class cm (FL)				Combined size class
	40-70	70-100	100-130	130-160	(40-160 cm FL)
Auxis thazard	-	19.27	17.67	37.24	5.31
Amplygaster	9.22	-	2.80	-	0.14
Charybdis smithii	13.42	59.10	56.50	34.30	87.54
Decapterus russeli	12.51		-	-	0.02
Digested fish	10.97	12.19	13.32	18.66	5.20
Lujanus kasmira	-	4.19	-	-	0.09
Octopus	8.78	-	-	-	0.01
Penaeid prawn	5.49	-	-	-	0.08
Spratelloides spp.	13.27	-	-	-	0.24
Squilla	6.80	-	-	-	0.07
Squid	19.55	5.25	-	-	0.51
Flying fish	-	-	9.70	9.79	9.0

Earlier reports have also showed that crustaceans are the major component of the diet of yellowfin tuna (Silas *et al*., 1985; Pon siraimeetan, 1985; John and Sudarshan, 1993; Prathiba and Rammohan, 2009). Our results reveals that small size groups of yellowfin tuna (40-70 cm) feed on a variety of organisms, mainly on epipelagic species associated with coral reefs, irrespective of the size of the organisms, while large size groups preferred mostly crabs, squids and medium size fishes (such as *A. thazard*, *Decapterus* sp., *Exocetus* sp.).

It is expected that with the collection of more data on the biology of yellowfin tuna and other key species of the Lakshadweep Sea as part of NAIP, further valuable information can be added to our knowledge of the oceanic ecosystem of the seas around Lakshadweep.

Acknowlegements

The authors are grateful to the Director, Central Marine Fisheries Research Institute for providing facilities and encouragement. We also thank National Agricultural Innovation Project (NAIP), ICAR, New Delhi for funding the project.

References

CMFRI 2010. *Annual Report 2010-2011*. Central Marine Fisheries Research Institute, Cochin, 169 pp.

Gopakumar, G. 1991. The tuna live bait scarcity problem in Lakshadweep and the options for solving it. *Mar. Fish. Infor. Serv., T & E Ser.*, 109: 1-5.

Gopakumar, G., Pillai, P. P. and Koya, K. P. S. 1991. Population characteristics of tuna live baits in Lakshadweep. *J. Mar. Biol. Assoc. India*, 33(1&2): 255-277.

James, P. S. B. R., Gopakumar, G. and Pillai, P. P.. 1987. Small scale pole and line tuna fishery in Lakshadweep - Present trend, constraints and strategies for future development. *Mar. Fish. Infor. Serv., T & E Ser*., 77: 1-10.

Job, T. J. 1940. Nutrition of Madras perches. *Rec. Indian Museum*, 42: 286-364.

John, M. E. and Sudarsan, D. 1993. Fishery and biology of yellowfin tuna occurring in oceanic fishery in Indian Seas. In: Sudarsan, D. and John, M. E. (Eds.), *Tuna research in India*. Fishery Survey of India, Bombay, p. 97-122.

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

Jones, S. 1960. Further notes on *Spratelloides delicatulus* (Bennett) as a tuna live bait with a record of *S. japonicus* (Houttuyn) from the Laccadive Sea. *J. Mar. Biol. Assoc. India*, 2(2): 267-268.

Mohan, M. and Kunhikoya, K. K. 1985. Age and growth of *Katsuwonus pelamis* (Linnaeus) and *Thunnus albacares* (Bonnaterre) from Minicoy waters. *Bull. Cent. Mar. Fish. Res. Inst*., 36: 143-148.

Mohan, M., Livingston, P and Kunhikoya, K. K. 1985. Fishery and bionomics of tunas at Minicoy Island. *Bull. Cent. Mar. Fish. Res. Inst*., 36: 122-137.

Nasser, A. V. K., Sivadas, M., Gopakumar, G. and Pillai, P. P. 2002. Tuan live-bait fishes - Their exploitation, conservation and management in Lakshadweep. In: Pillai, N. G. K., Menon, N. G., Pillai, P. P. and Ganga, U. (Eds.), *Management of Scombroid Fisheries*, Central Marine Fisheries Research Institute, Kochi, p. 148-154.

Pillai, P. P., Said Koya, K. P., Pillai, N. G. K. and Jayaprakash, A. A. 1993. Fishery and biology of yellowfin tuna occurring in coastal fishery in Lakshadweep Seas. In: Sudarsan, D. and John, M. E. (Eds.), *Tuna research in India*, Fisheries Survey of India, Bombay, p. 23-38.

Pillai, P. P., Pillai, N. G. K., Muthiah, C., Yohannan, T. M., Kasim, H. M., Gopakumar, G., Saidkoya, K. P., Manojkumar, B., Sivadas, M., Ganga, U., Bhaskaran, M. M., Elayathu, M. N. K., Balasubramaniam, T. S., Manimaran, C., Kunhikoya, V. A. and Ajithkumar, T. T. 2002. Stock assessment of coastal tunas in the Indian Seas. In: Pillai, N. G. K., Menon, N. G., Pillai, P. P. and Ganga, U. (Eds.), *Management of Scombroid Fisheries*, Central Marine Fisheries Research Institute, Kochi, p. 125-130.

Pon Siraimeetan 1985. Fishery and bionomics of tunas at Tuticorin. *Bull. Cent. Mar. Fish. Res. Inst*., 36: 86-103.

Prathibha, R. and Rammohan, K. 2009. Fishery and biological aspects of yellowfin tuna *Thunnus albacares* along Andhra Coast, India. *Asian Fish. Sci*., 22(1): 235-244.

Silas, E. G. and Pillai, P. P. 1982. Resources of tunas and related species and their fisheries in Indian Ocean. *Bull. Cent. Mar. Fish. Res. Inst*., 32: 174.

Silas, E. G., Pillai, P. P., Jayaprakash, A. A. and Pillai, M. A. 1985. Observations on the fishery and certain aspects of the biology of yellowfin tuna, *Thunnus albacares* (Bonnaterre) taken by long line gear in the EEZ of India. *IATTC Bull*., 19(5): 176-183.

Silas, E. G., Rao, K. V. N., Pillai, P. P., Mohan, M., Gopakumar, G., Livingston, P. and Srinath, M. 1986. Exploited and potential resources of tunas of Lakshadweep. *Mar. Fish. Infor. Serv., T & E Ser*., 68: 15-25.

Sivadas, M. 1998. Association of tunas with flotsam. In: Balachandran, K. K., Iyer, T. S. G., Madhavan, P., Joseph, J., Perigreen, P. A., Raghunath, M. R. and Verghese, M. D. (Eds.), *Proc. Symp.Adv. Priorities Fish. Tech*., Society of Fisheries Technologists (India), Cochin, p. 38-43.

Sivadas, M. 2002. Present status of tuna fishery in Minicoy, Lakshadweep. In: Pillai, N. G. K., Menon, N. G., Pillai, P. P. and Ganga, U. (Eds.), *Management of Scombroid Fisheries*. Central Marine Fisheries Research Institute, Kochi, p. 62-68.

Sivadas, M., Pillai, P. P. and Ganga, U. 2002. Stock assessment of the oceanic skipjack, *Katsuwonus pelamis* in Minicoy, Lakshadweep. In: Pillai, N. G. K., Menon, N. G., Pillai, P. P. and Ganga, U. (Eds.), *Management of Scombroid Fisheries*, Central Marine Fisheries Research Institute, Kochi, p. 177-186.

Sudarsan, D. and John, M. E. 1994. Further studies on biological aspects of yellowfin tuna in the Indian EEZ. *IPTP Coll. Vol. Work. Doc*., 8: TWS/93/2/15: 135-140.

Varghese, S., Bhargawa, A. K. and Somvanshi, V. S. 2002. Biological aspects of yellowfin tuna (*Thunnus albacares*) form the Indian EEZ. In: Pillai, N. G. K., Menon, N. G., Pillai, P. P. and Ganga, U. (Eds.), *Management of scombroid fisheries*, Central Marine Fisheries Research Institute, Kochi, p. 74-81.

Yohannan, T. M. and Pillai, P. P.. 1994. Status of stocks of skipjack tuna and yellowfin tuna at Minicoy (Lakshadweep), *IPTP Coll. Vol. Work. Doc*., 8, TWS/93/2/13: 128-130.

Date of Receipt : 11.11.2012
Date of Acceptance : 17.04.2013