Cah. O.R.S.T.O.M., sér. Océanogr., Vol. VII, N° 3, 1969.

AN HYPOTHESIS ON YELLOWFIN TUNA MIGRATIONS IN THE EASTERN GULF OF GUINEA*

by Williams J. RICHARDS

Résumé

A partir des données sur la pêche et de l'étude de la distribution des larves, une hypothèse a été formulée sur la migration des albacores dans la partie est du Golfe de Guinée. Les albacores adultes viennent pondre dans le Golfe en saison chaude; les larves et les juvéniles y demeurent environ un an. Puis cette classe d'âge migre vers le Sud jusqu'en Angola pour retourner ensuite au Nord dans les eaux chaudes de la région d'Anno Bon, São Tomé. Ce mouvement a lieu chaque année pour les poissons de moins de trois ans. A partir de la troisième année les albacores effectuent une migration vers l'Ouest dans l'Atlantique central tropical, puis reviennent pondre en saison chaude dans le Golfe de Guinée.

Abstract

An hypothesis is formed on the migration of yellowfin tuna in the eastern Gulf of Guinea, from an evaluation of fishery data and an analysis of the distribution of larvae. Adult yellowfin tunas enter the Gulf to spawn during the warm season; the resulting larvae and the juveniles remain there for about one year. That year class then moves south to Angola and subsequently returns north to warm water. The movement takes place annually until the fish are older than two years, at which time they move westward into the central tropical Atlantic; they return to the Gulf of Guinea in the warm season to spawn.

In areas where fishery data are relatively complete and information on the distribution of larvae is available, some inferences can be drawn concerning the migration or movements of the fish. Sufficient data have been collected in the eastern Gulf of Guinea off the west african coast to form an hypothesis on migrations of yellowfin tuna, *Thunnus albacares* (Bonnaterre). This paper presents the information used to formulate such an hypothesis.

---

* Contribution No. 95, Bureau of Commercial Fisheries Tropical Atlantic Biological Laboratory, Miami, Florida 33149.

The broad region under consideration consists of the eastern Gulf of Guinea and the waters of the northeastern Benguela area, described by WISE and LE GUEN (in press). Fishing in the region is primarily for yellowfin tuna by longline, purse seine, and pole. Large adults are caught by longline and small adults and juveniles are caught by surface fishing.

The data on the longline fishery were obtained from a 1° square summary of longline catch data from 1957 to 1962 by SHIOHAMA, MYOJIN and SAKAMOTO (1965) and from compilations by 5° squares from 1963 to 1965, by the Fisheries Agency of Japan (1966; 1967 a; 1967b). The catch rate of the longline fishery is given as the number of fish caught per hundred hooks. The surface fishery data, which includes purse-seine and pole fisheries for 1963 to 1967, is from LE GUEN, POINSARD, and TROADEC (1965); LE GUEN and POINSARD (1966); POINSARD (1967) and LE GUEN, POINSARD and GAYDE (1968). The general trend is for the longline fishing fleet to begin to move into the eastern Gulf of Guinea in November and become highly concentrated there through January, February, and March. In April, the fleet begins a westward movement. By June the yellowfin tuna catch is practically non-existent and remains so through June, July, August, September, and October. The surface fishery fleet begins operating in January north of Annobon Island (1°30′ S latitude, 5°30′ E longitude) and catches are good in the area through July. In August, the fleet begins a southerly movement, and catches are abundant southeast of Annobon Island in September. By October the fleet has moved well to the south, off Angola and the mouth of the Congo River, where it remains through November. The surface fishery is non-operative in December, not because of a lack of fish but because the fishermen leave Pointe-Noire for traditional fishing grounds off Abidjan.

From this fishing information, an hypothesis may be made to account for the movements of the adult yellowfin tunas. The large adults enter the Gulf of Guinea during the warm season (November to March) and spawn there. The yellowfins tuna probably remain in the area for their first year. At 1 year of age, some of the fish are caught by the surface fishery as they move southward and exploitation by this fishery continues (LE GUEN and CHAMPAGNAT, 1968); the tuna then move northward late in the year, back to the warm water. Again the fish are caught by the surface fishery while they remain in the Gulf of Guinea and as they move south later in the year (LE GUEN and CHAMPAGNAT, 1968). On the basis of LE GUEN's and CHAMPAGNAT's data, it appears that 2-years-old yellowfin tunas move farther south than do the 1-year-old or perhaps the 1-year-old fish leave the fishing area and move northward about a month earlier, in October instead of November. When the 2-years-old return to the eastern Gulf of Guinea a year later, they probably enter the longline fishery and may spawn at the same time. The yellowfin tunas older than 2 years apparently leave the area in the cold season and move westward into the central tropical Atlantic. Few of these older fish appear to move southward. (Doubt may be cast on this hypothesis by the 1968 American and French seine catch which included very large fishes- 1.30 to 1.50 m.) The belief that the 3-years-old fish enter the longline fishery is strengthened by the high coefficients of correlation found between catch per unit effort of the Dakar surface fishery and the longline catch per unit effort 2 years later (CHAMPAGNAT, 1968).

Not only does the fishery evidence support my hypothesis, but available information on yellowfin tuna spawning seems corroborative. The presence or absence of yellowfin tuna larvae in the tropical Atlantic appears to be temperature-dependent, as shown from the larval distributions during EQUALANT Surveys I and II (RICHARDS, in press). In those surveys yellowfin tuna larvae were found only in waters warmer than 26.0 °C. In 1966 and 1967, 99 plankton collections were made from the R/V OMBANGO in a small area (1° square) around Annobon Island (1°30′ S latitude, 5°30′ E longitude) in the eastern Gulf of Guinea. The larval fishes collected included the yellowfin tuna, *Thunnus albacares* (Bonnaterre); the bigeye tuna, *Thunnus obesus* Lowe; the skipjack tuna, *Katsuwonus pelamis* (Linnaeus); the little tuna, *Euthynnus alletteratus* (Rafinesque); and either the frigate or bullet mackerel (*Auxis* spp.).

These larvae were collected on five expeditions to Annobon Island by the staff of the O.R.S.T.O.M., Centre de Pointe-Noire, Republic of the Congo, aboard the R/V OMBANGO, as follows :

Expedition	*R/V OMBANGO Cruise No.*	*Number of Plankton Collections*	*Dates*
Anno Bon I	26	18	15-18 June 1966
Anno Bon II	27	12	31 July-3 Aug. 1966
Anno Bon III	29	33	12-17 Dec. 1966
Anno Bon IV	30	19	25-28 March 1967
Anno Bon V	32	14	14-17 June 1967

The larvae were caught by three different nets which were fished at various depths for different amounts of time. An ICITA plankton net, a Rigosha net, and a large Schmidt net were used. All these nets, which have different catching efficiencies, were fished horizontally at the surface, and obliquely and vertically to various depths. Ideally, comparisons of the number of larvae treat the number of larvae under an unit area of sea surface (if the collecting device fishes to the maximum depth at which the larvae occur). Since such treatment is not possible with the present data, I have treated the larvae as the number caught per unit of time (in this case, number per hour). It should be understood that the method is not a highly accurate basis for comparison.

In Table 1, I compare the distribution of tuna larvae and the tuna fisheries in the 1° square surrounding Annobon Island. Unfortunately the lack of fishing data for several months and the lack of larval data make comparisons difficult, but at least the trend is apparent as it relates to the yellowfin tuna. Yellowfin tuna larvae were found only in the March samples (63 % of the collections), when the surface temperature ranged from 28.4 to 29.8 °C (see Table 1). The only other Annobon collections in which surface temperatures were above 26 °C were in December (26.4 to 27.2 °C). The abundance of yellowfin tuna larvae in March occurred near the end of the peak of the longline fishery (warm season) in the Gulf of Guinea area. No yellowfin tuna larvae were found in December, although the adults were abundant and the water temperature was above 26 °C.

TABLE 1

A comparison of the distribution of tuna larvae and the tuna fisheries in the 1° square surrounding Annobon Island. YF = yellowfin tuna, BE = bigeye tuna, and SJ = skipjack tuna

Month	Water temperature °C	Salinity ‰	Larvae Number/hour			Pole caught 1967 Tons/day (Mostly YF)	Seine caught 1967 Tons/day (Mostly YF)	Japanese longline 1957-62 Fish/100 hooks	
			YF	BE	SJ			YF	BE
March.......	28.42—29.80	33.04—33.57	28.0	2.3	14.9	2-5	2-5	6—6+	0—0.4
June........	21.9—25.0	34.26—36.09	0	0	0.2	No fishing	No fishing	No fishing	No fishing
August......	22.3—23.3	34.31—34.87	0	0	0	0—2	No fishing	No fishing	No fishing
December....	26.4—27.2	34.19—34.46	0	0	0.3	No fishing	No fishing	6—6+	0—0.4

Other species of larval tuna found in the Annobon collections are also worthy of mention. As fishing data become available for additional species of tuna, hypotheses similar to mine can be made. Bigeye tuna larvae were found only during March (16 % of the collections), in low numbers compared with yellowfin tuna (Table 1). Although the bigeye tuna is the third most important tuna caught by the longline fishery, the surface fishery does not report bigeye tuna in March and records only incidental amounts at other times (LE GUEN, POINSARD, and GAYDE, 1968). Catches of bigeye tuna possibly could be greater than those reported because of the extreme difficulty of separating the species from yellowfin tuna, particularly at small sizes (less than 70 cm fork length). In any event the species is not sought and, judged by the larval captures, spawning appears to be limited in the eastern Atlantic (RICHARDS, in press). Larvae of skipjack tuna were abundant in March (42 % of the collections), scarce in June (3 % of the collections) and December (6 % of the collections), and absent in August (Table 1). Based on the evidence, it can be assumed that skipjack tuna spawning is at a peak around March and sporadic in other months. An earlier paper (RICHARDS, in press) demonstrated a similar pattern for the entire tropical Atlantic but unfortunately no widespread fishery data are available for comparison, because almost no skipjack tuna are caught. The surface fishery takes some skipjack tuna but concentrates mainly on yellowfin tuna, and skipjack tuna is not caught by longliners. Little tuna larvae were found only in June (3 % of the collections), at the rate of 0.2 per hour. Low numbers of little tuna were caught incidentally by the surface fishery, and catches may not reflect abundance. *Auxis* larvae were present in each month in which sampling occurred, at rates of 0.6 per hour in March (11 % of the collections), 5.1 per hour in June (31 % of the collections), 27.5 per hour in August (67 % of the collections), and 0.3 per hour in December (6 % of the collections). It is apparent that *Auxis* spawn in cool waters. Only a small fishery in Angola presently exists for the species.

The hypothesis of the movement of yellowfin tuna can be tested by additional sampling for larvae in the eastern Gulf of Guinea region and farther south, to Angola. Studies of gonads of yellowfin tuna are needed to determine spawning age and time, and tagging experiments on 2-years-old fish primarily would delineate their movements. The interesting questions to be answered are: Why do these fish migrate? Why do the large fish leave after they have entered the area to spawn? Why do the prespawning fish move north and south along the coast? Food supply is probably the most logical explanation. Study of the productivity of the water would help to verify this assumption. Many such studies are greatly needed to produce sound assessments of the stocks of yellowfin tuna—the fishing pressure placed on these fish at all ages has a definite effect on the population structure (WISE, 1968).

LITERATURE CITED

CHAMPAGNAT (C.), 1968. — Les campagnes thonières de « Pêche Fraîche » à Dakar (1955-1967). *Doc. Centre ORSTOM d'Océanogr. Dakar-Thiaroye,* No. 015, 53 p. multigr.

FISHERIES AGENCY OF JAPAN, 1966. — Annual report of effort and catch statistics by area on Japanese tuna long line fishery, 1963. *Fish. Agency Japan, Res. Div.,* 322 p.

FISHERIES AGENCY OF JAPAN, 1967 a. — Annual report of effort and catch statistics by area on Japanese tuna long line fishery, 1964. *Fish. Agency Japan, Res. Div.,* 379 p.

FISHERIES AGENCY OF JAPAN, 1967 b. — Annual report of effort and catch statistics by area on Japanese long line fishery, 1965. *Fish. Agency Japan, Res. Div.,* 375 p.

LE GUEN (J. C.) et CHAMPAGNAT (C.), 1968. — Croissance des albacores *(Thunnus albacares)* dans les régions de Pointe-Noire et Dakar. *Doc. Centre ORSTOM Pointe-Noire* No. 431, 24 p. multigr.

LE GUEN (J. C.) et POINSARD (F.), 1966. — La pêche de l'albacore *(Thunnus albacares)* dans le sud du Golfe de Guinée. Résultats de la campagne 1965. *Doc. Centre ORSTOM Pointe-Noire,* No. 331, 20 p. multigr.

Le Guen (J. C.), Poinsard (F.) et Gayde (J.), 1968. — La campagne thonière 1967 à Pointe-Noire (Congo). *Doc. Centre ORSTOM Pointe-Noire,* No. 428, 29 p. multigr.

Le Guen (J. C.), Poinsard (F.) et Troadec (J. P.), 1965. — La pêche de l'albacore (*Neothunnus albacares* Bonnaterre) dans la zone orientale de l'Atlantique intertropical. Étude préliminaire. *Doc. Centre ORSTOM Pointe-Noire,* No. 263, 27 p. multigr.

Poinsard (F.), 1967. La pêche du yellowfin *(Thunnus albacares)* dans le Golfe de Guinée. Résultats de la campagne de 1966. *Doc. Centre ORSTOM Pointe-Noire,* No. 375, 29 p. multigr.

Richards (W. J.). — In press. Distribution and relative apparent abundance of larval tunas collected in the tropical Atlantic during Equalant Surveys I and II. *Proc. Symp. Oceanogr. Fish. Resour. Trop. Atl.* — UNESCO/FAO.

Shiohama, Toshiom Masako Myojin, Hisao Sakamoto, 1965. -- The catch statistic data for the Japanese tuna long-line fishery in the Atlantic Ocean and some simple considerations on it. *Nankai Reg. Fish. Res. Lab. Rept.* No. 21, 131 p.

Wise (J. P.), 1968. — The Japanese Atlantic longline fishery, 1964, and the status of the yellowfin tuna. stocks. *U.S. Fish Wildl. Serv. Spec. Sci. Rept. — Fish.* No. 568, 5 p.

Wise (J. P.) and Le Guen (J. C.). — In press. The Japanese Atlantic longline fishery, 1956-1963. *Proc Symp. Oceanogr. Fish. Resour. Trop. Atl.* — UNESCO/FAO.