

DATES AND CONDITIONS OF THE SPAWNING OF THE SKIPJACK, KATSUWONUS PELAMIS (L.),
BASED ON THE DISTRIBUTION OF THEIR LARVAE IN THE TROPICAL ATLANTIC

G. P. Rudomiotkina

Atlantiro

SUMMARY

The spawning areas of skipjack in the near-equatorial waters are located in the system of the trade wind currents and are confined to divergence regions of the inter-trade wind (Equatorial) countercurrent and to the southwestern periphery of the "Angolan Dome." Usually, spawning occurs during the warm season at the surface water temperature over 24.4°C with the salinity ranging between 31.4 and 36.0‰.

RESUME

Les zones de ponte du listao dans les eaux proches de l'équateur se situent dans le réseau des courants des alizés, et sont limitées aux zones de divergence du contre-courant (équatorial) des alizés et à la périphérie sud-ouest du "Dôme d'Angola". La ponte a normalement lieu durant la saison chaude, lorsque la température de l'eau de surface atteint plus de 24,4°C, avec une salinité de 31,4 à 36‰.

RESUMEN

Las zonas de desove del listado en aguas cercanas al Ecuador se encuentran dentro del sistema de corrientes de los vientos alisios y confinadas en las regiones de divergencia de la contracorriente ecuatorial y en la periferia de la zona Sudoeste de la "Angolan dome". En general, el desove tiene lugar durante la temporada cálida, en aguas de superficie con temperaturas superiores a 24.4°C y una salinidad entre 31.4 y 36.0‰.

The skipjack is a traditional commercial species fished by the Soviet and foreign fleets. However only a few studies have been published on the biology of the skipjack, in particular, on their spawning and distribution of the larval tuna. Ehrenbaum (1924), Richards (1969), Simmons (1969), Richards and Simmons (1971) reported on the occurrence of the larvae in the Gulf of Guinea and adjacent waters. The first and the only attempt so far to give the counts of the larvae was made in the papers by the Japanese authors (Nishikawa, Kikawa, Honma, Yeyanagi, 1978; Kikawa, Nishikawa, 1979). These papers are based on the data from the ichthyoplankton surveys conducted in the World Ocean during the 1956 to 1975 period. The collections were taken with the single or double nets varying in size from the surface and from the 0-50 m depth, and the results are given as the number of the larvae per haul by 5°-side square (see charts). Marshall (1963), Postel (1963), Frade and Postel (1965), Chur, Grudinin and Zharov (1980) gave records of the collected pre-spawning and spawning tunas. The evidence on the times of the skipjack reproduction based on the physiological condition of the gonads are given by Chur (1977), Alekseev and Alekseeva (1978).

Below, the results of our studies of the dates, thermal and haline conditions of the skipjack spawning based on the distribution of small larval tunas in the tropical Atlantic are presented (fig. 1, Table 1), which are supplemented with the pertinent data found in the literature.

This paper is based on the analysis of the ichthyoplankton collections taken during the expeditions of the AtlantNIRO vessels in the 1963 to 1981 period. Usually, the larval tunas were caught with the IKS -100 net (No. 140 gauze) without the lock. Three nets were used simultaneously at the surface and at 50 m and 100 m depths. A total of 1543 ichthyoplankton samples were taken and processed.

Results

In the Central Atlantic, north of 5°N off Cabo Verde, the mature fish were found from July to September (Postel, 1963), and from May to September (Frade, Postel, 1955; Chur, 1977).

Larval tunas were observed in August and September (Richards, 1969). Ehrenbaum (1924) reported on the occurrence of small larval tunas in the Central Atlantic in summer. Judging by the occurrence of the mature fish in the Sierra Leone area, the spawning there started in April and terminated in summer (Chur, 1977; Alekseev and Alekseeva, 1978). Richards and Simmons (1971) reported on the presence of tuna larvae in February and March during the Jeronimo-5 surveys, and Richards (1969) found the tuna larvae at one of the stations made during the Equalant-I survey (February-April). As is evident from our data (fig. 2-III), in the area north of 5°N the tuna larvae were chiefly reported from the divergence zone of the inter-trade wind (Equatorial) countercurrent south of Cabo Verde in the summer period (July-September) at the temperature over 25°C and with the salinity ranging between 34.3 - 36.2‰. Only two collections of the larvae were taken in winter - in December (fig. 2-IV) and February (fig. 2-I) - in warm waters with the temperature of 24.8°C and the salinity of 35.6-36.0‰.

In the Gulf of Guinea pre-spawning and spawning females were observed from January to April, in September and December (Simmons, 1969), and post-spawners from December to April (Chur, 1977). In the Fernando-Po Island area the spawning is likely to occur in winter or in spring (Alekseev, Alekseeva, 1979). The juveniles were found in February, March and May (Marshall, 1963). The larval tunas were recorded everywhere during the Equalant-I survey (February-April) at the surface water temperature over 26°C, and at the salinity of 31.4-36.4‰ (Richards, 1969). During the Equalant-II survey (August-October) the range of the larvae was mainly confined to the waters north of the equator. South of the equator larval tunas were scarce (Richards, 1969). According to the Jeronimo survey data (Richards, Simmons, 1971), the larvae were collected in numbers during the warmest time of the year (February-April) at the temperatures ranging between 27.6 and 29.6°C and at the salinity of 34.4 to 35.5‰; in August-September (cold season) the larvae were scarce, and were reported from the waters adjacent to the northern coast of the Gulf of Guinea, where the temperature ranged between 24.4 and 25.8°C. No tuna larvae were reported from the

waters south of 3°N. During the surveys conducted in the vicinity of the Fernando-Po Island in June, August and December the larvae were found all the time except for August (the coldest month) at the temperature over 25°C and salinity of 33.0-34.5‰; the largest tuna larvae collections were recorded in March (Simmons, 1969). Japanese investigators (Nishikawa et al., 1978) reported that tuna larvae in the Gulf of Guinea and adjacent oceanic waters were found throughout the warm season (from October to March). In our collections the larvae were mainly found in the warm season, from October to June (fig. 2-I, II, IV) at the temperature ranging between 25.5 and 27.5°C, and the salinity of 34.3-36.2‰. Only three small larvae were recorded in the cold season in August (fig. 2-III), but the thermohaline conditions then corresponded to those typical of the warm season: the temperature was 24.9°C. The largest collections of tuna larvae (5 sp./haul) for that period (October-June) were taken in two regions. The first is located between the north-western coast of the Gulf of Guinea and the equator (fig. 2-I) and is in the zone of the equatorial upwelling. The second (10-15°S, 0-5°W square) is located in the south-western periphery of the anticyclonic eddy southwest of the Congo River mouth (Bubnov, Bulatov, Moroshkin, 1973).

In the waters off the Congo-Angola coast around Pointe Noire pre-spawning and spawning tunas were found in the warm season from September to May (Chur, 1977; Alekseev, Alekseeva, 1979; Chur, Grudinina, Zharov, 1980). It is of interest that the spawning of the skipjack began in different months in different years: in December 1943 and 1977 the mature and spawning individuals were predominant, in 1976 the immatures, or maturity stages II and III prevailed (Alekseev, Alekseeva, 1979). The larvae were caught in February-April (Richards, 1969) and in January-June (our data, fig. 2-I, II), and were absent the rest of the year despite intensive sampling. Spacial distribution of tuna larvae near the Congo-Angola coast in the north-eastern periphery of the anticyclonic eddy south-west of the Congo River mouth is worth noting, Firstly, with the same sampling

intensity (fig. 1-I, II) in January-March the larvae were only taken north of 5°S (fig. 2-I), and from April to June south of this latitude (fig. 2-II). In our opinion this can be related to periodicity of the Congo River discharge (World water balance and water resources of the Earth, 1974). In January-March, that is in the period of the most powerful discharge of the Congo River (November-January), the skipjack larvae avoided the waters south of its mouth, however, they were attracted by suitable conditions in the April to June period - a transition period between high - and low water seasons. Secondly, no larvae were found in April-June in the Biafra Bay in spite of high sampling intensity (fig. 1-II) and favourable temperatures at the surface (26-29°C). A likely reason of the absence of the larvae may be low salinity of the inshore waters (28-30‰), which freshen the offshore part of the region as well.

The analysis of the above-stated makes it possible to conclude that the spawning areas of the skipjack in the near-equatorial waters are located in the system of trade wind currents and are confined to marginal divergence regions of the Inter-trade wind (Equatorial) countercurrent and to the anticyclonic eddy south-west of the Congo River takes place.

Reproduction periods usually coincide with the warmest season in the area: May-September near Dakar and Cabo Verde Islands; April-September in the Sierra Leone-Liberia area; October-March in the Gulf of Guinea; November-April off Congo-Angola (table 2).

The spawning takes place in warm waters with the surface temperature over 24.4°C, which is typical of the warm season, with the salinity ranging between 31.4 and 36.0‰.

References

- Bubnov V.N., Bulatov R.P., Moroshkin K.V. 1973. Circulation of the surface waters in the south-eastern part of the Atlantic Ocean.-Trans. of the Ocean. Inst. of the Acad. of Sc. USSR, vol.95, pp. 14-13.
- World water balance and water resources of the Earth. 1974. I.Gidrometeoizdat, pp. 1-638.
- Chur V.N. 1977. Biology and fishing of skipjack, little tunny, frigate mackerel and bullet mackerel in the eastern part of the Atlantic Ocean. Theses, INEYUM, Sevastopol, pp. 1-24.
- Alekseev F.E., Alekseeva E.I. 1979. Some problems of reproductive biology of oceanic and neritic tunas of the Tropical Atlantic. ICCAT SCRS/79/37, 1979, 16p.
- Chur V.N., Grudin V.B., Zharov V.L. 1980. Data on length-age composition and gonad maturity stages of skipjack (*Katsuwonus pelamis*) of the eastern tropical Atlantic.-ICCAT, Madrid, N°IV, vol. IX (SCRS-1979-), N°1-Tropical spp., 1980, pp. 245-254.
- Ehrenbaum E. 1924. Scombriformes.-Rep. Danish. Oceanogr. Exped. Medit., N°2(S), Biology II, p.30.
- Frade F., Postel E. 1965. Contribution el étude de la reproduction des Scombrides et Thonides de l'Atlantique tropical.-Rapp.et Proc.-Verb., vol. 137, 1965, pp. 33-35.
- Kikawa S., Nishikawa Y. 1980. Distribution of larvae of yellowfin tuna and skipjack in the Atlantic Ocean (Preliminary). ICCAT, Madrid IV, vol. IX, (SCRS-1979), N°1-Tropical spp., pp.138-142.
- Marshall B.G. 1963. Expose synoptique des données biologiques sur la thonine Euthynnus alleteratus (Rafinesque, 1810). FAO. Fish. Report, 6, vol.2, pp. 647-662.
- Nishikawa Y., Kikawa S., Honma M., Yeyanagi S. 1978. Distribution atlas of larval tunas, billfishes and related species.-Result of larval surveys by N/V Shinyo Maru and Shoyo Maru (1956-1975). Far Seas Fisheries Research Shimizu 424, Japan, ser.9, pp. 33-37.
- Postel E. 1963. Expose synoptique des données biologiques sur la bonite éventre raye Katsuwonus pelamis (Linne) 1758 (Atlantique et Mediterranum). FAO Fish Repts, vol.2, N°6, pp. 515-537.
- Richards W.J. 1969. Tropical Atlantic tuna larvae collected during Equalant surveys. Commercial Fish Rev., vol.31, N°11, pp. 33-37.
- Richards W.J.a. Simmons D.C. 1971. Distribution of tuna larvae (Pisces, Scombroidea) in the Northwestern Gulf of Guinea and off Sierra Leone.-Fish. Bull. vol. 69, N°3, pp. 555-568.
- Simmons D.C. 1969. Maturity and spawning of skipjack tuna (Katsuwonus pelamis) in the Atlantic Ocean with comments on nematode infestation of the ovaries.-Spec.Scient.Rep.Fish, 580, pp.1-17.

Table 1

Occurrence of larvae

Positions		Date	Time of day	Surface		table 1 (continued)					
				temperature	salinity						
1	2	3	4	5	1	2	3	4	5		
06°18N	23°20W	22.02.63	17.37	21.8	36.02	08°13S	07°36W	08.03.72	20.08	26.7	36.02
01°56S	29°00W	25.02.63	18.56	27.1	36.24	03°00S	10°00W	17.03.72	02.32	-	-
08°34S	33°35W	01.03.63	12.08	27.8	36.78	04°42N	05°18W	05.08.72	-	-	-
08°39N	23°28W	12.08.64	04.30	-	35.57	10°25S	04°28W	25.02.73	00.23	26.3	-
16.01N	26°03W	16.08.64	19.50	25.7	36.24	09°58S	02°32W	26.02.73	01.05	25.3	-
07°00N	35°00W	15.09.64	18.50	27.5	34.29	06°34S	02°36W	02.03.73	00.20	24.2	-
07°45N	36°53W	18.09.64	02.10	26.3	36.00	10°38S	05°23W	11.03.73	23.30	26.7	-
08°35N	39°00W	18.09.64	19.00	23.8	35.97	10°17S	07°44W	13.03.73	00.40	26.9	-
14°00N	40°02W	22.09.64	02.10	24.4	36.65	07°54S	07°30W	14.03.73	23.50	26.7	-
15°36N	40°07W	23.09.64	04.00	26.7	36.60	05°13S	07°24W	15.03.73	22.40	28.0	-
06°51N	19°37W	23.05.65	14.37	25.4	-	03°02S	07°31W	17.03.73	20.50	-	-
03°00N	09°54W	04.01.65	11.25	27.2	34.23	03°27S	10°00W	19.03.73	23.30	-	-
04°01N	09°50W	05.01.65	03.40	27.3	33.45	06.04S	09°51W	23.03.73	00.50	28.3	-
04°04N	04°58W	14.02.65	23.30	26.9	34.29	06°32S	10°03W	26.03.73	00.50	28.4	-
01°00N	05°00W	16.02.65	04.00	27.7	34.44	06°20S	09°58W	27.03.73	00.55	-	-
01°00S	10°00W	04.03.65	00.35	27.2	35.02	09°58S	12°30W	31.03.73	01.45	27.3	-
02°03N	10°00W	05.03.65	23.30	28.3	35.20	06°00S	02°30W	31.01.75	02.00	-	-
03°00N	10°00W	03.08.65	02.00	24.9	34.88	06°00S	05°00W	06.02.75	22.40	-	-
01°44N	07°32E	01.12.65	18.15	-	35.82	06°00S	05°00W	08.02.75	00.45	-	-
01°26N	03°40W	31.12.66	11.00	-	35.48	09°30S	05°00W	08.02.75	23.45	24.8	36.44
02°41N	06°25W	02.01.67	11.15	-	35.66	04°37S	07°43W	21.02.75	19.50	-	-
01°12S	04°35E	21.01.67	10.50	-	35.91	06°48S	10°00W	26.02.75	00.40	-	-
02°54S	04°38E	02.02.67	11.00	-	35.81	08°12S	09°12W	27.02.75	01.35	-	-
00°39S	05°25E	07.02.67	11.00	-	35.99	07°44S	10°32W	05.03.75	19.15	-	-
07°00N	24°20W	15.11.68	22.12	-	35.57						
03°51N	26°56W	17.12.68	04.28	27.5	35.93						
09°28S	11°55W	11.02.69	08.45	25.0	-						
03°36S	15°18W	23.03.70	06.48	-	-						
09°01S	09°02 E	11.04.70	06.18	28.3	31.22						
06°53S	02°30E	28.02.72	20.10	-	36.01						
06°13S	07°35W	06.03.72	20.41	26.9	35.80						

Table 2

Times of skipjack spawning

Area	Northern seasons											Author
	spring			summer					autumn			
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	
Cabo Verde Is.					X	X	X	X	X			Postel, 1963; Frade, Postel, 1965 Richards, 1969 Chur, 1977
Central Atlantic							X	X	X			Ehrenbaum, 1924; our data
Sierra Leone-Liberia				X	X	X	X	X	X			Richards, 1969; Richards, Simmons, 1971; Chur, 1977; Alekseev, Alekseeva, 1979; our data
Gulf of Guinea				X	X	X	X	X	X			Marchall, 1963; Richards, 1969; Simmons, 1969; Richards, Simmons, 1971; Chur, 1977; Alekseev, Alekseeva, 1979; our data
Congo-Angola				X	X	X	X	X	X			Chur, 1977; Alekseev, Alekseeva, 1979; our data

Southern seasons											
spring			summer					autumn			
VII	VIII	IX	X	XI	XII	I	II	III	IV	V	VI

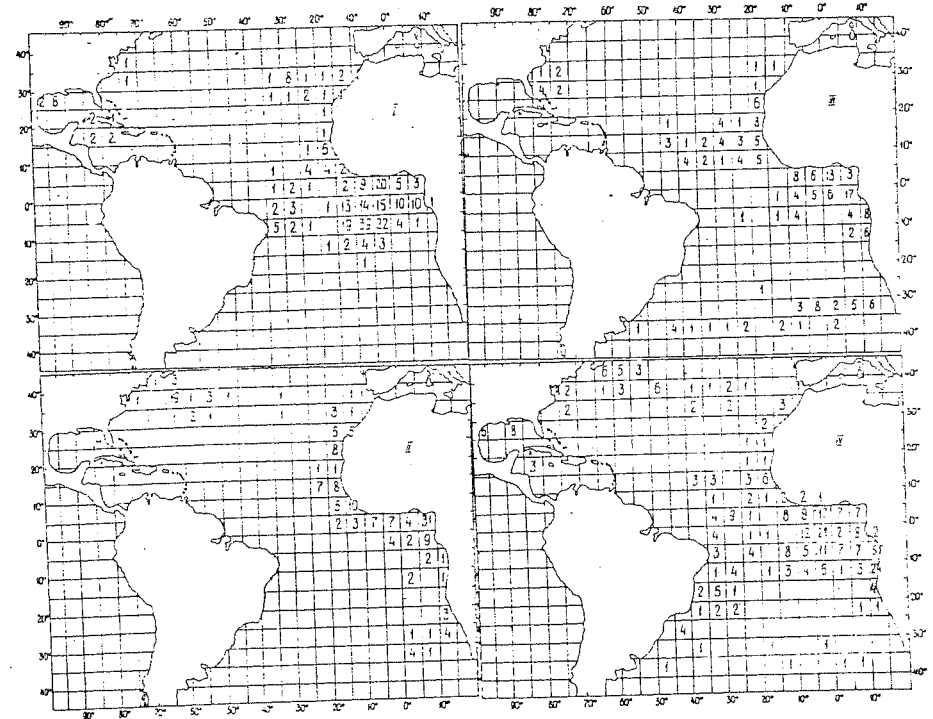


Fig.1. Distribution of ichthyoplankton collections:

I - January-March; II - April-June;

III - July-September; IV - October-December.

Note. Figures denote the number of ichthyoplankton collections by 5°-side square.

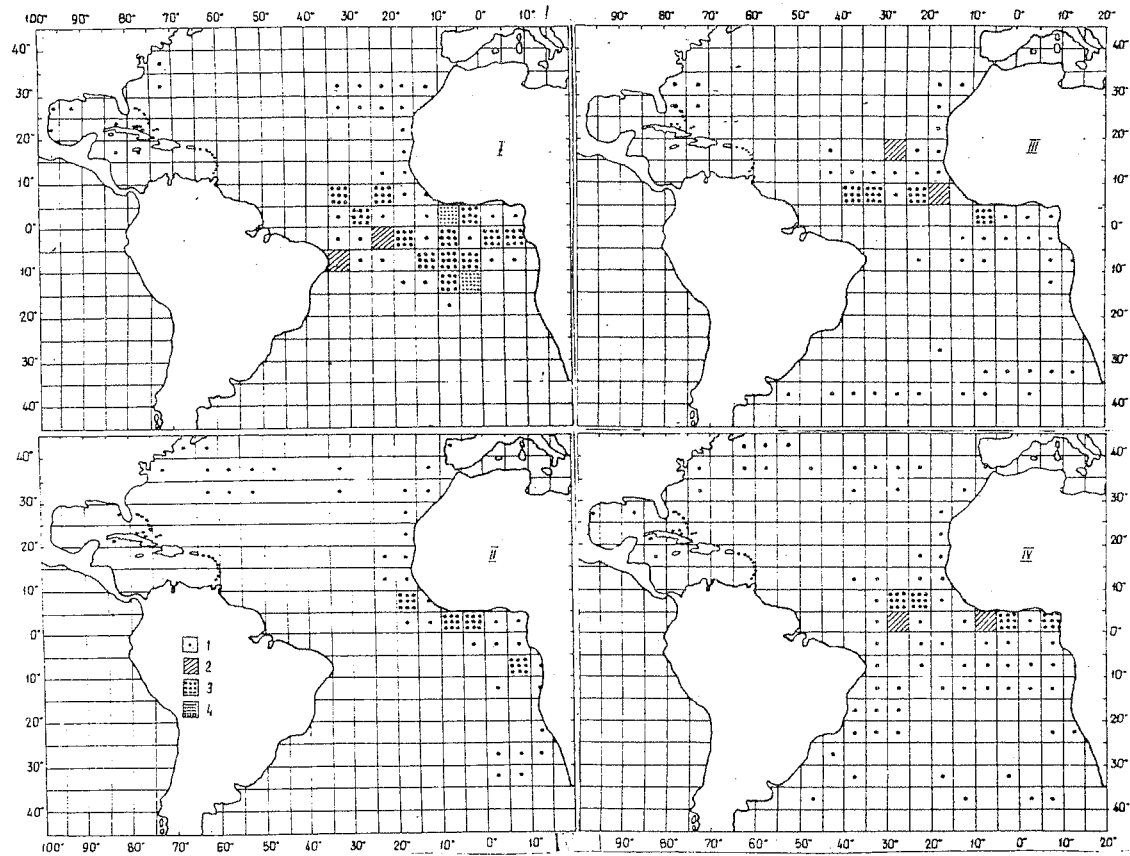


Fig.2. Distribution of larvae in January-March (I);
 April-June (II); July-September (III);
 October-December (IV).

Definitions: 1- larvae absent;
 2- less than 0.09 larva per haul;
 3- 0.1-1.0 larva per haul;
 4- 1.1-5.0 larvae per haul