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SYNOPSIS OF BIOLOGICAL DATA ON BLACK SKIPJACK
Euthynnus lineatus Kishinouye 1920

Exposé synoptique sur la biologie de la thonine
Euthynnus lineatus Kishinouye 1920

Sinopsis sobre la biología del barrilete negro
Euthynnus lineatus Kishinouye 1920

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1 IDENTITY

1.1 Taxonomy

1.1.1 Definition

Order Perciformes
Suborder Scombroidei
Family Scombridae
Subfamily Scombrinae
Genus Euthynnus Jordan & Gilbert 1882
Species Euthynnus lineatus Kishinouye 1920

The classification of the species of the genus Euthynnus is in dispute. In this paper the organization of the genus suggested by Godsil (1954), and by Matsumoto (1959), will be accepted. These authors devide the genus into three species;

Euthynnus lineatus	Eastern Pacific
Euthynnus yaito	Central & Western Pacific
Euthynnus alletteratus	Atlantic

The black skipjack, Euthynnus lineatus, is a marine, pelagic fish inhabiting the tropical and subtropical waters of the Eastern Pacific. It occurs, roughly, from the area of the U.S. - Mexican border to Peru, in fairly close association with the mainland and offshore islands.

1.1.2 Description

- Genus Euthynnus Jordan & Gilbert 1882

The fishes of this genus have the fusiform, streamlined body and lunate caudal fin common to all tuna-like fishes. The body is devoid of scales except for the corselet. Euthynnus can be distinguished from Katsuwonus by the presence of a series of oblique or longitudinal black markings above the lateral line (Katsuwonus has stripes on the belly). The dorsal fins are contiguous or nearly so. This latter feature distinguishes Euthynnus from Auxis whose dorsal fins are widely separated. The distal margin of the first dorsal is concave. This character distinguishes Euthynnus from Sarda, the bonitos, whose first dorsal has a margin that is nearly straight. There are usually eight dorsal and seven anal finlets. The intestine is straight, without a fold. There are 37 or 39 vertebrae. Teeth are present on the palatines in all species and on the vomer in two of the three species. A detailed description of the generic characters of the skeleton is given by Godsil (1954).

Species Euthynnus lineatus Kishinouye 1920

The following description is taken from Godsil (1954).

This species can usually be separated from others of the genus by the dorsal markings. "The general pattern consists of a series of three, four, or five broad continuous black stripes running horizontally on the back from the corselet to the caudal fin. The most ventral of these stripes invariably starts anteriorly below the lateral line and generally crosses this in its path to the caudal region. Variations consist mainly of interruptions in the continuity of the stripes or branchings of individual stripes with supplementary short irregular markings between. However, variations can be sufficiently extreme to preclude a positive identification and such variations widely overlap the markings of other described species." A specimen with typical markings is shown in Fig. 1. The dorsal stripes of Euthynnus yaito and E. alletteratus are typically more broken, irregular and oblique. "These black dorsal stripes are superimposed upon a background of blue, deepening into black dorsally and shading into grey and silver below. The belly of the fish is dusky or silvery with an irregular number (usually from 2 to 6) of black spots between the pectoral and pelvic fins. Such spots are not diagnostic or invariable for specimens are occasionally seen with no apparent spots." Specimens occasionally are found which have oblique stripes on the belly.

Meristic counts are given in the following table.

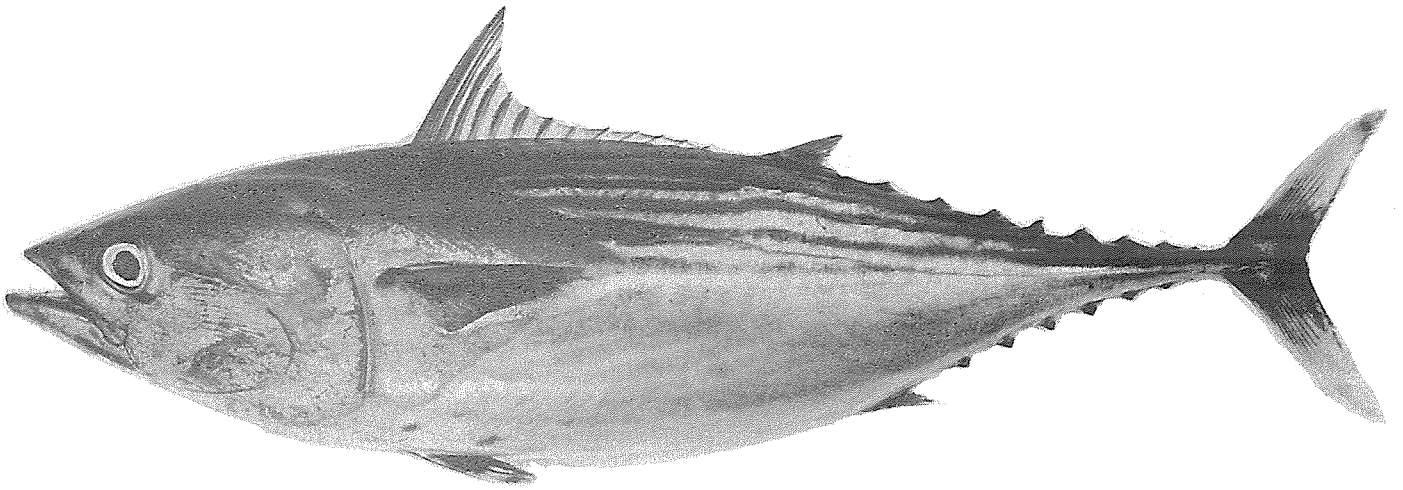


Fig. 1 Black skipjack, Euthynnus lineatus. Fish caught by D.C. Vann at Socorro Island; total length 512 mm, weight 4 lb. 10 oz. (2.14 kg). Photograph by J.C. Brown.

MERISTIC COUNTS OF Euthynnus lineatus *

Meristic Character	Count		No. Specimens
	Range	Most Common	
1st dorsal spines	13-15	14-15	20
2nd dorsal rays	11-12	11	10
Dorsal finlets	8-9	8	20
Anal rays	11-13	11-12	18
Anal finlets	7-8	7	20
Gill-rakers - 1st arch: Upper limb	7-11	9-10	30
Angle	1	1	28
Lower limb	23-29	26-27	30
Total:	32-41	35-38	30
Number of vertebrae	36-38	37	27
Precaudal vertebrae	19-20	20	24
1st complete haemal arch on Vert. No.	15-17	15-16	23

* Taken from Godsil (1954)

"The caecal mass and the liver are the dominant organs in the ventral view of the viscera". The liver has three lobes, the right lobe being about twice as long as the other two. It extends the full length of the body cavity.

The most important skeletal features which are diagnostic for this species are the vertebral count of 37 (36-38), as opposed to 39 in the other two species, and the presence of four protuberances which occur on the 31st and 32nd vertebrae.

1.2 Nomenclature

1.2.1 Valid scientific names

Euthynnus lineatus Kishinouye 1920

1.2.2 Synonyms

Euthynnus affinis lineatus Fraser Brunner 1949

1.2.3 Standard common names, vernacular names

Negra, Bonito negro	Ecuador
Barrilete negro	Mexico, Peru
Black skipjack; cross-bred mackerel	United States; U.S. sports-fishermen
Mexican little tunny	Kishinouye

1.3 General variability

1.3.1 Subspecific fragmentation (races, varieties, hybrids)

There are no recognized subspecies of Euthynnus lineatus. Fraser-Brunner (1949) proposed that E. lineatus and E. yaito are subspecies of E. affinis. Other authors have suggested that E. affinis and E. yaito are the same species but that E. lineatus is a separate species. All seem to agree that E. alletteratus

is a distinct species which may or may not have subspecies.

Races or subpopulations of E. lineatus may exist but none have yet been defined. Godsil (1954) reported considerable variation in the external markings of E. lineatus. Some of the atypical specimens which he examined had dorsal markings of the E. yaito or E. alletteratus type. However, there was no variation in internal features in the specimens of atypical appearance and all could be positively identified as E. lineatus. The variation in external markings was not confined to specific geographical areas, but seemed to be general throughout the range of the species. Considerable variation in dorsal markings between two sides of the same fish sometimes occurs.

The existence of hybrids has never been observed or investigated.

The blood (erythrocytes) of two E. lineatus was tested with a series of 540 bean extracts, by Dr. C. W. Cotterman and the junior author, as part of the preliminary work on a program for typing fish blood. On the basis of agglutinations, the blood of the black skipjack can be differentiated from that of six other scombroids from the Eastern Tropical Pacific which were tested with the same series of reagents.

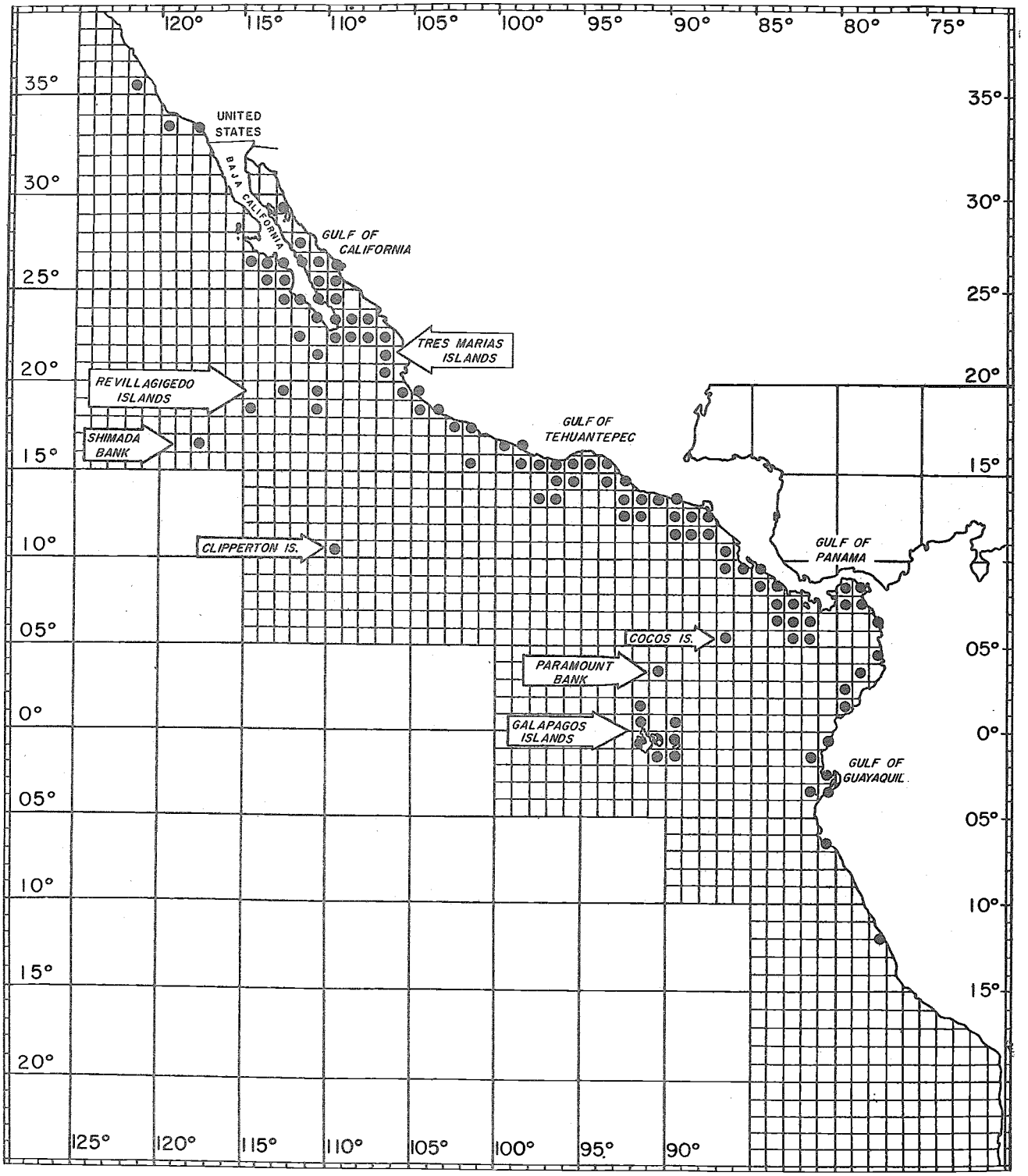


Fig. 2 Records of adult black skipjack, Euthynnus lineatus, charted by one-degree squares.

2 DISTRIBUTION

2.1 Delimitation of the total area of distribution and ecological characterization of this area

Black skipjack are known to occur along the Pacific coast of the Americas from southern California to Peru. The present northern records for this species, off San Simeon, California (35°20 'N by 121°40 'W), was reported by Nowell (1961). There have been two other reports from California waters (Roedel 1948, and Fitch 1952). Black skipjack have been taken off Baja California (Godsil 1954), from the Tres Marias Islands, 21°30 'N on the Mexican coast (Fowler 1944) near Acapulco, Mexico (Mais and Jow, 1960), off Costa Rica (Schaefer and Marr, 1948), from Colombia Bank, 2°N by 79°W, and from Guayaquil Bank, 3°35'S by 80°55'W (Godsil 1954, and Clemens, 1957). There are numerous reports of black skipjack from the Galapagos Islands (Fowler 1938 and 1944; Seale 1940; Schmitt and Schultz, 1940; Godsil 1954). They have been reported from northern Peru (Hildebrand 1946).

The occurrence of black skipjack is sometimes reported in the logbooks of commercial tuna fishing vessels, although this species is not taken by these vessels. A search of the tuna boat logbook records of the Inter-American Tropical Tuna Commission (IATTC) revealed that this species has been encountered, at various times, nearly everywhere along the coast from the middle of Baja California to Guayaquil Bank, off northern Peru. They have frequently been reported from the Gulf of California, the Revillagigedo Islands, all along the coast of Mexico and Central America, and the Galapagos Islands. In addition, black skipjack have occasionally been reported from Clipperton and Cocos Islands and there is a single report from Shimada Bank (16°52'N by 117°30'W), 180 miles southwest of Clarion Island. Logbook reports of black skipjack from the waters south of Guayaquil Bank are rare. This may be due not to scarcity of the species in these waters but, rather, to reduced coverage by the tuna fleet. Locations where black skipjack have been found as reported in the literature, from tuna vessel logbooks and from scientific logs of oceanographic cruises by the Scripps Institution of Oceanography, the Bureau of Commercial Fisheries of the U.S. Fish and Wildlife Service and the field-books of Dr. C. L. Hubbs and Dr. D. P. De Sylva, are shown in Fig. 2. Locations are shown to the nearest one-degree square of latitude and longitude.

The major portion of the waters in which black skipjack occur is tropical. The Equatorial Pacific Water mass extends approximately from 23° - 24°N to northern Peru and the Galapagos Islands. To the north and south of this tropical water mass are transition regions which are influenced by the cool California Current in the north and by the cool Peru Current in the south. The principal warm currents are the North Equatorial, the Equatorial Countercurrent, and the South Equatorial. Near the coast, where black skipjack are most frequently found, these currents are usually weak and variable.

The well-developed thermocline, which is a characteristic of most tropical waters, tends to hinder the renewal of nutrients in the surface layer and thereby limits biological productivity. However, in the area which comprises the range of the black skipjack the thermocline is relatively shallow (10-50) meters. In general, the thermocline shoals from west to east and there are areas near shore where the thermocline is sufficiently shallow to permit the exchange of nutrients between the deep layer and the euphotic zone. There is a thermal dome located off Central America (9°N by 90°W) where the thermocline is frequently less than 10 m and sometimes reaches the surface. In the Gulf of Panama and in the Gulf of Tehuantepec seasonal high winds bring about upwelling which contributes to productivity. The Gulf of Guayaquil and the Galapagos are in the transition area between tropical water and the cool rich water of the Peru Current. Upwelling enriches the inshore waters off Baja California but the waters farther offshore in this area are very poor in nutrients and standing crop. The waters of the Gulf of California are warmer and more saline than adjacent waters. Upwelling also occurs in the Gulf of California and the thermocline is generally not deeper that 20 m. This description was compiled from the following references: Brandhorst 1958; Cromwell and Bennett, 1959; Cromwell 1958; Holmes, Schaefer and Shimada, 1957; Sund and Renner, 1959.

2.2 Differential distribution

2.2.1 Areas occupied by eggs, larvae and other junior stages: annual variations in these patterns, and seasonal variation for stages persisting over two or more seasons. Areas occupied by adult stages: seasonal and annual variations of these.

The eggs of black skipjack are pelagic but they have never been specifically identified in plankton collections. Mature and running ripe adults have occasionally been encountered and larvae and juveniles have been collected and identified.

Larval and post-larval black skipjack have been collected from Point Antonio, Baja California (29°45'N) to the vicinity of Malpelo Island (4°00'N by 81°35'W). In the Gulf of California they have been collected both from near the head and from the mouth. The sites of collection form a continuous band from the Tres Marias Islands, near the entrance of the Gulf of California to the Gulf of Panama. Larvae and juveniles of black skipjack have, to date, only been encountered within approximately, 150 miles of the mainland. The only exception is one individual captured near Malpelo Island (Klawe, in press). The location of capture of larval and juvenile black skipjack is shown in Fig. 3.

Collections have not been extensive enough to reveal annual variation in the distribution of larvae and juveniles.

The areas occupied by adult stages have been discussed in section 2.1. Since black skipjack are not sought by commercial fishing vessels, it is difficult to detect seasonal and annual variations in the distribution of adult stages. However, when the logbook reports of occurrence and those from other sources are analyzed by quarters of the year, there are some noticeable differences in distribution. In the first quarter of the year, black skipjack have been encountered most often off the coast of Central America and near the southern tip of Baja California. In the second quarter there have been fewer reports from Central American waters and a great increase of reports from the lower Gulf of California and from the Revillagigedo Islands. In third quarters the majority of reports has been from the banks off the west coast of Baja California. The reports of black skipjack from California waters have all come in third quarters. In fourth quarters the reports have been scattered from Baja California to central Peru with not much concentration in any area. There have been more reports from the Galapagos Islands during fourth quarters than at other times of the year.

It should be noted that these apparent changes in seasonal distribution may not be due to actual shifts in the population but may have resulted from seasonal changes in the concentration of the commercial tuna fleet which is largely governed by the regional availability of yellowfin and oceanic skipjack. The reports of black skipjack from logbooks and from the literature indicate only the presence of black skipjack in a particular area and furnish no accurate information as to quantity. It is a certainty that only a part of black skipjack sightings are reported in the logbooks, since these fish are, at the present time, of no commercial value and there has been no program for collecting information on this species.

2.3 Behavioristic and ecological determinants of the general limits of distribution and of the variations of these limits and of differential distribution

Temperature, as for related species, is probably an important determining factor for the limits of distribution of black skipjack. Black skipjack have been reported from waters ranging from 60°F to 87°F (IATTC logbook records). They have been reported most frequently from waters with surface temperatures between 75°F and 85°F. There have not been any experiments performed to determine the absolute range of temperature which can be tolerated by this species.

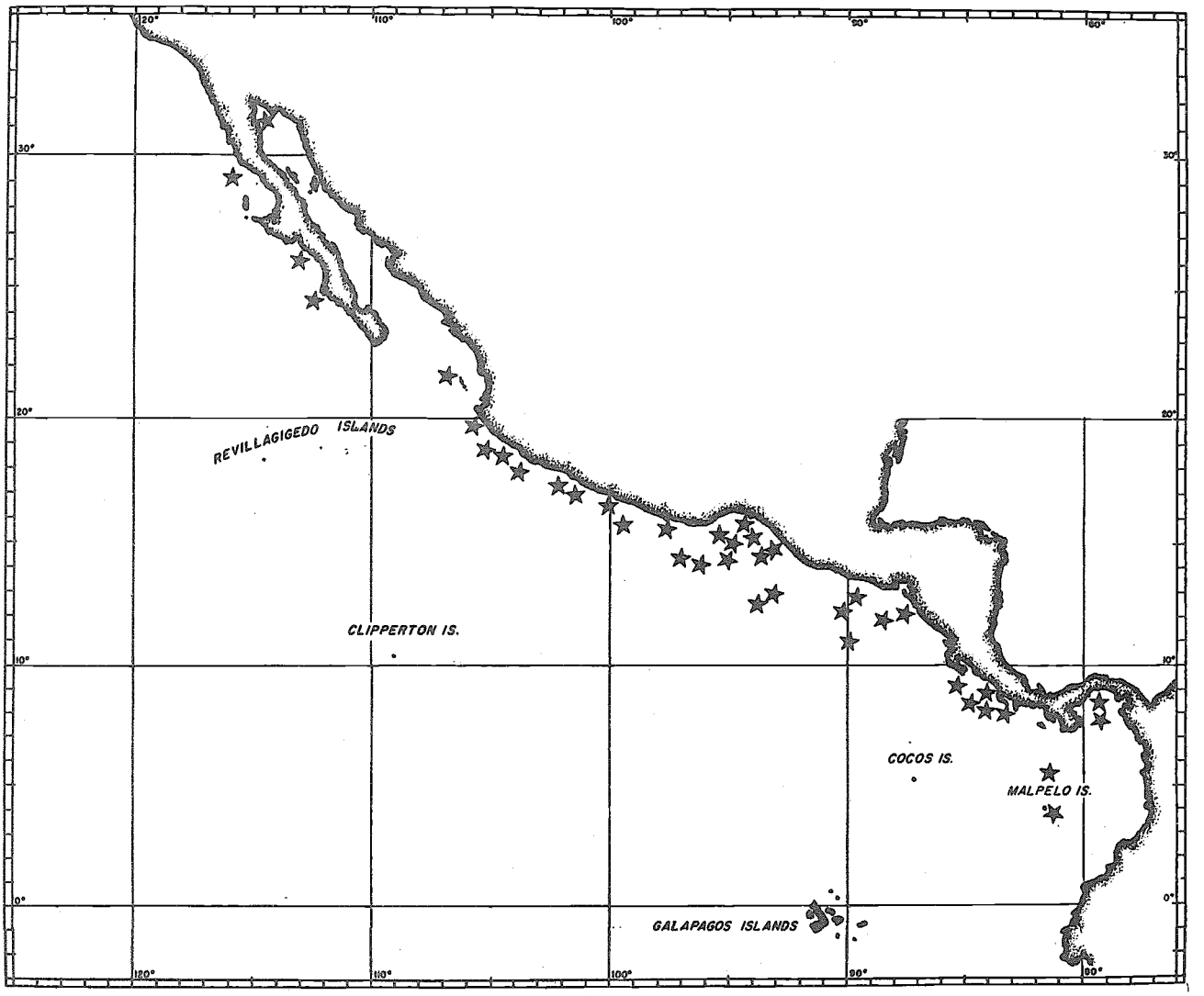


Fig. 3 Localities of capture of larvae and juveniles of black skipjack, Euthynnus lineatus.

3 BIONOMICS AND LIFE HISTORY

3.1 Reproduction

3.1.1 Sexuality (hermaphroditism, heterosexuality, intersexuality)

Black skipjack are heterosexual. Males and females do not differ in external appearance.

3.1.2 Maturity (age and size)

The number of mature black skipjack that have been examined and reported on is very small. Mead (1951) examined two females, taken off Central America, whose ovaries were swollen and turgid. The lengths were 54.4 and 55.0 cm (fork length). It seems probable that some individuals would reach maturity at a smaller size. De Sylva and Rathjen (1961), in their study of E. alletteratus, the Atlantic species, give the usual length at first spawning as 350 mm. The age of black skipjack (E. lineatus) at maturity is unknown.

3.1.3 Mating (monogamous, polygamous, promiscuous)

The spawning of black skipjack has never been observed. However, from examination of the eggs and from what is known of its life history and that of closely related species, it is certain that spawning is pelagic.

3.1.4 Fertilization (internal, external)

Fertilization is external.

3.1.5 Fecundity

The fecundity of black skipjack has never been investigated. It seems logical that the number of eggs produced and the relation of this to size of fish is in the same order of magnitude as that of related species. For example, Vildoso (1960) estimated that the fecundity of the bonito Sarda chilensis is 288.2 thousand for 500 mm fork length; 413.3 for 550 mm; 754.2 for 600 mm; 771.1 for 650 mm. In mature oceanic skipjack, Katsuwonus pelamis, between 610 and 700 mm, the number of ova in the maturing group has been found to range between 330.0 thousand and 1,000.0 thousand (J. Joseph, unpublished data).

3.1.6 Spawning

- Spawning seasons (beginning, end, peak)

In the waters off Central America there is considerable evidence that spawning takes place in winter and spring. Schaefer and Marr (1948) reported taking two adults in an advanced stage of maturity in the Gulf of Nicoya, Costa Rica, in February 1947. Ripe adults were taken in April of the same year from the inshore waters of Costa Rica. Juveniles were collected further offshore in March. Clemens (1956) collected "post larvae" black skipjack from Central America in January 1955. Mead (1951) reported taking larvae and ripening adults off Central America in May 1949. Although these collections were all made in the winter and spring it is probable that black skipjack spawn all year in this area with the peak in early spring. Klawe (in press) compiled the following table of the average number of larvae caught off Cape Blanco, Costa Rica, per hour of surface tow during different months:

Month	No. of larvae	Month	No. of larvae
I	1.5	VII	0.1
II	0.1	VIII	0.2
III	3.2	IX	1.4
IV	14.9	X	0.0
V	0.6	XI	0.2
VI	0.0	XII	0.7

Spawning in the Gulf of Panama may extend over a considerable part of the year. Matsumoto (1959) identified black skipjack larvae and juveniles in material from the "Dana Expeditions", collected in the gulf in January 1922 and in September 1928. The specimens ranged in size down to 5.0 mm, indicating that spawning could not have been far removed in time and location.

Larvae collected during Scripps Institution of Oceanography and California Cooperative Oceanic Fisheries Investigations cruises indicate that spawning also takes place all year off the southern Mexican coast with a peak in the early spring but in more northern waters, off Baja California, spawning is limited to summer months (Klawe, in press).

- Number of spawnings per year, frequency

It is not known whether individual black skipjack spawn more than once a year. Most likely the black skipjack, like other tropical tunas have an extended spawning season in warmer waters, and individual fish do not spawn all ova at once.

- Spawning time of day

The time of day in which spawning takes place is unknown

- Induction of spawning, artificial fertilization

The factors which induce spawning are unknown.

The junior author collected running ripe black skipjack of both sexes off Central America in April 1957 and attempted to fertilize the eggs. No development resulted, however.

3.1.7 Spawning grounds

Since black skipjack eggs are pelagic and the adults are encountered near the surface it seems likely that spawning takes place in open water near the surface. The spawning grounds appear to be in the open ocean but in close proximity to land masses. For the location of probable spawning areas see section 2.2.1.

3.1.8 Egg: structure, size, hatching type, parasites and predators

The egg of black skipjack is spherical and contains a single oil globule. In appearance and structure it is similar to those of other tunas. The junior author measured a small sample of preserved eggs taken from a running ripe female, and found that the egg diameter was between 0.90 and 0.95 mm. The diameter of the oil globule ranged from 0.23 to 0.26 mm.

There is no information on parasites and predators of black skipjack eggs. The eggs are undoubtedly eaten by a wide variety of organisms.

3.2 Larval history

3.2.1 Account of embryonic and juvenile life (prelarva, larva, postlarva, juvenile)

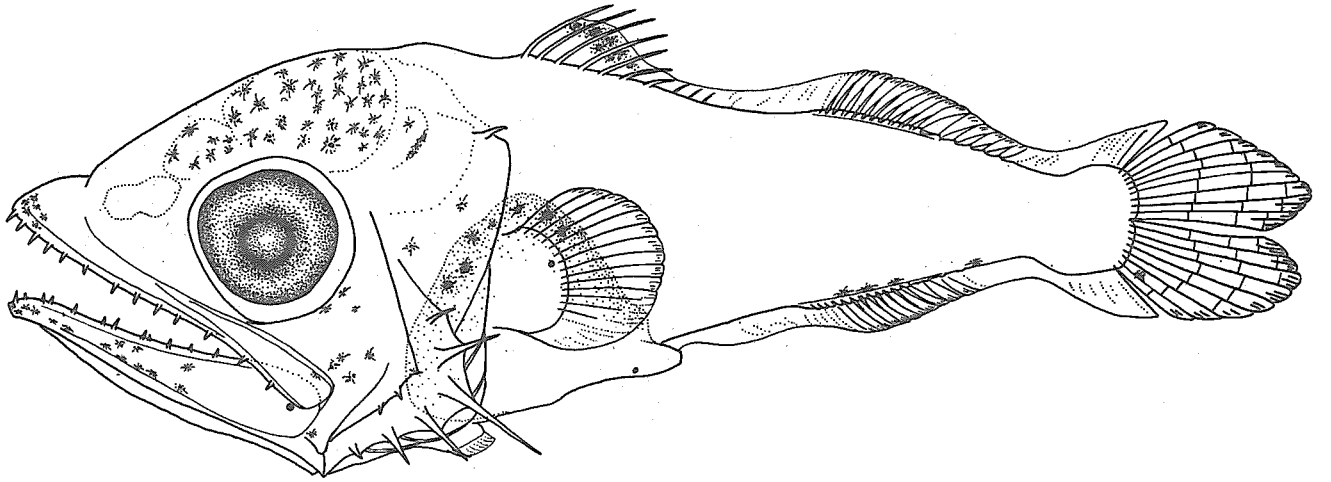
Young black skipjack, like other tuna-like fishes, do not pass through a sharply defined metamorphosis marking transition from larva to postlarva to juvenile. The definition of each stage, therefore, must be somewhat arbitrary. Matsumoto (1959) defines larvae as individuals with less than a full fin-ray count, especially in the first dorsal. These fish are usually 11 mm or less in total length. The size range of postlarvae is approximately 12 to 18 mm. In this size range the anal opening moves back from mid-way between the pelvic and anal fins to the origin of the anal fin. Young tunas larger than 18 mm are classed by Matsumoto as juveniles.

The larva of E. lineatus is similar in appearance to that of other tunas (see Fig. 4). It would be difficult to separate the larvae of this species from that of other related species, unless a size-series is available.

Matsumoto (1959) described a series of young black skipjack ranging in size from 5.0 to 27.0 mm. The following description is based largely on his work.

At 5.0 mm the head is large - about 37 percent of total length and the mouth is also proportionately large. The anal opening is near the middle of the body. There is no spine or ray development. Between 6 and 12 mm the body elongates and increases in size in relation to the head. The dorsal spines develop and pigment appears on the first dorsal fin. When length has reached 10-12 mm all of the unpaired fins are almost fully developed. The fins and finlets become more clearly defined. The number of rays in the pectoral fins comes within the adult range. By length 22 mm the dorsal half of the body is dark as far back as the caudal peduncle (Mead, 1951). In the larger juveniles, vertical bars appear faintly along the dorsal region.

Schaefer and Marr (1948) state that juveniles of black skipjack are less deep bodied than yellowfin tuna of the same size. Below 44 mm in length,



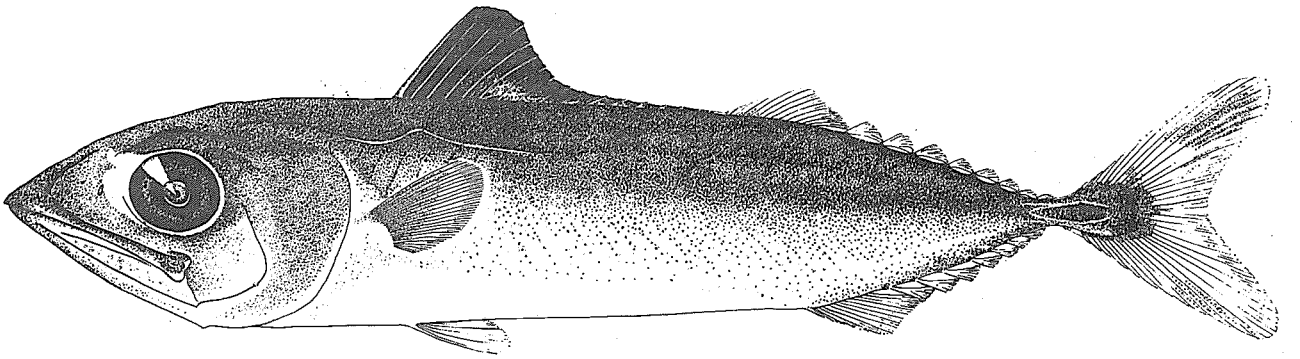


Fig. 4 7.1 mm larva of black skipjack, Euthynnus lineatus. From Matsumoto (1959).

Fig. 5 45 mm juvenile black skipjack, Euthynnus lineatus. Drawing by Sheila K. Hillsdon.

the juveniles of black skipjack can be distinguished from those of oceanic skipjack by the heavier pigmentation of the dorsal fin in the former. At 86 mm the second dorsal is pigmented from the origin of the rays to half-way to their distal end. The head and body are more darkly pigmented than yellowfin and oceanic skipjack of the same size. A juvenile black skipjack is shown in Fig. 5.

- Feeding

Clemens (1956) held juvenile black skipjack in ship-board aquaria and offered them various food items such as ground fish flesh, planktonic fish eggs and living zooplankton. The subjects displayed more interest in the live zooplankton than in the non-living material, but did not feed until actively swimming larval blennies were offered. After feeding on larval blennies, the subjects were induced to feed on planktonic fish eggs and ground fish flesh by gradually substituting the non-living matter in the diet. The juvenile black skipjack fed until their stomachs were greatly distended. Feeding periods were adjusted so that the subjects were fed again when their stomachs had returned to normal in five to six hours.

- Rates of: development and survival

Clemens (1956) was able to hold some juvenile black skipjack (see above) for as long as ten days. In that period their weight increased eleven times and length increased approximately 1.4 times over that at the beginning of the holding period. The author felt that this growth rate would have represented a minimum in nature because of the unnatural conditions of confinement.

Nothing is known as to the rates of development or survival of the larval or postlarval stages.

- Parental care

None.

- Parasites and predators

There is no information on the parasites of black skipjack larvae, postlarvae or juveniles. There is no specific information on predators of these stages, however, it would be surprising if, like almost everything in the sea, they were not preyed upon by almost every organism which is able to catch and swallow them.

3.3 Adult history

3.3.2 Hardiness

The hardiness of black skipjack is similar to that of other tuna-like fishes. They are hardy enough to be successful in their natural environment, but they can only stand a minimum of handling.

3.3.3 Competitors

Black skipjack are found in close association with yellowfin tuna, oceanic skipjack, and dolphin fish, among others. All of these species undoubtedly compete with the black skipjack for food. Whether this competition is in any way harmful to any of the species concerned is unknown.

3.3.4 Predators

The large bill-fishes undoubtedly prey on black skipjack, and they have been found in the stomach contents of yellowfin tuna (Alverson, in press).

3.3.5 Parasites and diseases

The parasitic copepods Caligus coryphaene (see Shiino, 1959a) and Caligus macarovi (see Shiino, 1959b) are known external parasites of black skipjack. The trematode Hirudinella marina was found to be parasitic in the stomachs of several black skipjack examined by the authors.

There is no information available on diseases of black skipjack.

3.3.6 Greatest size

The largest black skipjack collected by the junior author was a running ripe male of fork length 636 mm and weighing 10 lb. 8oz. (4.75 kg). Since only few individuals have been examined for length and weight (compared to other tuna-like fishes), it is likely that individuals larger than the above occur.

3.4 Nutrition and growth

3.4.1 Feeding (time, place, manner, season)

Black skipjack feed throughout their lives and in all seasons of the year. Like related species, feeding is probably by sight and therefore confined to the daylight hours and to the surface layer.

3.4.2 Food (type, volume)

According to Walford (1937), the black skipjack is a feeder of "voracious habits and insatiable appetite." The stomach contents he examined consisted of small fish and squid. One stomach contained fourteen small fish and thirty squid. One of the species of fish consumed by black skipjack is the frigate mackerel (Auxis thazard). Sixteen Auxis three to five inches long were found by F. G. Alverson in the stomach of a black skipjack taken in the Gulf of Tehuantepec (Klawe, in press). The displacement volume was 127 ml. The pelagic crab (Pleuroncodes planipes) has been found in the stomachs of black skipjack from the banks off Baja California. A juvenile sierra mackerel (Scomberomorus sierra) was identified in the stomach contents of a black skipjack collected in the Gulf of Panama by IATTC personnel.

3.4.3. Relative and absolute growth patterns and rates.

The growth rate of adult black skipjack has never been investigated. Some information on the growth of juveniles is given in section 3.2.1.

3.5 Behavior

3.5.1 Migration and local movements

There have been no tagging programs conducted with this species and therefore there is no exact information on migrations. Possible seasonal movements have been discussed in section 2.2.1.

3.5.2 Schooling

Black skipjack, like other tuna-like fishes, tend to school by size. Bini (1952) stated that, in Peruvian waters, black skipjack are frequently found schooled with yellowfin tuna and oceanic skipjack of the same size. They were present in smaller quantities than the commercially important species, however.

Commercial tuna fishermen have observed that black skipjack will frequently gather around drifting or anchored tuna boats. Yellowfin and oceanic skipjack also display this type of behavior, but it is believed to be more pronounced with black skipjack.

3.5.3 Reproductive habits

Spawning is pelagic; outside of that nothing is known of the reproductive habits of this species.

4 POPULATION (STOCK)

4.1 Structure

4.1.1 Sex ratio

There is no information on the sex ratio of E. lineatus. De Sylva and Rathjen (1961) found that the sex ratio of E. alletteratus landed in Florida did not differ significantly from 1:1.

5 EXPLOITATION

5.1 Fishing equipment

5.1.1 Fishing gear

There is no fishing gear specifically used for E. lineatus; however, this species is incidentally taken by gear engaged in exploiting other species. Black skipjack have been taken by tuna purse-seines, live-bait pole and line gear, commercial trolling gear, and sport fishing gear. In various places in Latin America black skipjack are taken by trolled hand lines. Walford (1937) stated that "they will strike any lure trolled at any speed up to eight or ten miles an hour."

5.1.2 Fishing boats

There are no boats specifically designed for fishing for black skipjack. This species is occasionally taken by all types and sizes of commercial tuna vessels from small albacore trollers to the largest live-bait and purse-seine vessels. In Ecuador and Peru, black skipjack are taken by canoe and raft fishermen as well as by the other types of boats mentioned above.

5.2 Fishing areas

5.2.1 General geographical distribution

Black skipjack are distributed over a wide area in the Eastern Pacific (see section 2.1); however, they are not fished commercially anywhere except for a few caught in Latin American waters which are sold fresh in the local markets. Virtually all of the black skipjack landed are caught within a few miles of the coast.

5.2.2 Geographical ranges (latitudes, distances from coast, etc.)

See sections 2.1 and 5.2.1.

5.2.3 Depth ranges

Black skipjack are taken in the surface layer.

5.3 Fishing seasons

5.3.1 General pattern of fishing season

There is no fishing season as such for black skipjack. They are encountered more by chance than by design.

5.3.2 Duration of fishing season

Black skipjack are caught all year throughout most of their range.

5.3.3 Dates of beginning, peak and end of season

The landed catch is probably very small and very little of what is landed is reported. Therefore, it is impossible to designate a beginning, peak or end of the fishing season except in very localized areas. In 1954 the Republic of Ecuador made a census of fishermen in the course of which, among other things, the fishermen were questioned on the seasonal abundance of the various species landed. The black skipjack was listed as being most abundant from May to September in the open coastal areas and from January to March in the Gulf of Guayaquil (Ecuador, n.d.).

5.3.4 Variation in time or duration of fishing season

The fishery is not sufficiently developed for variations in time or duration of fishing season to be apparent.

5.4 Fishing operations and results

5.4.1 Effort and intensity

Negligible.

5.4.2 Selectivity

Black skipjack are taken by non-selective gear.

5.4.3 Catches

Catch statistics for black skipjack are sparse. Most of the landings are probably made by small boats in Latin America and go unrecorded. Landings have occasionally been recorded at Mancora, Peru, but it is unknown what proportion they are of the total landings even in that immediate area.

Tuna purse-seiners sometimes set on black skipjack by mistake. These catches are dumped overboard but estimates of the tonnage have been

recorded in the logbooks. These references show that some fairly large schools of black skipjack are occasionally encountered and accidental catches from 1 - 100 tons have been recorded.

5.4.4 Past and present factors of effect on operations and results

The principal factor, past and present, affecting fishing operations and results is the lack of a market for black skipjack.

5.5 Fisheries management and regulations

None.

5.6 Fish farming, transplanting and other intervention.

None.