

THE DISTRIBUTION OF JUVENILES OF FOUR SPECIES OF TUNAS
IN THE PACIFIC OCEAN

by

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ABSTRACT

Juvenile (12-300 mm) skipjack tuna (*Katsuwonus pelamis*) have been collected throughout the western and central Pacific Ocean in tropical and subtropical waters, and a few have been taken in the eastern tropical Pacific. Juvenile yellowfin tuna (*Thunnus albacares*) are more common than skipjack tuna in the eastern tropical Pacific, but are reported from fewer locations in the central and western Pacific. Juvenile albacore (*T. alalunga*) have been found only at high latitudes in the western and central Pacific. The few recorded captures of juvenile bigeye tuna (*T. obesus*) are from the western tropical Pacific. Present methods of collecting juvenile tunas have several deficiencies that greatly hinder their effectiveness. Midwater trawls offer certain advantages over other methods, but further experimentation with small-mesh nets of large size is needed.

INTRODUCTION

Quantitative information on the spatial and temporal distribution and abundance of tunas in their early life stages is essential to the analysis of population dynamics on the basis of size and mortality of the recruitment stocks. Dependent on such information are solutions to problems such as success or failure of year classes, differential distribution and availability of age groups, and reproductive isolation on subpopulations. Two requirements are basic to the acquisition of additional knowledge about immature tunas. First, we must obtain the young at many stages of development, preferably in a complete series from egg to adult. Second, we must be able to identify the developing tunas.

Tuna eggs are often collected in plankton nets, but it is not yet possible to identify most scombrid eggs to species (Ueyanagi and Ahlstrom, 1963). On the other hand, identification of larval tunas, which are also frequently taken in plankton nets, has received considerable attention in recent years (e.g., Matsumoto, 1958, 1962, 1963; Ueyanagi and Watanabe, 1964; Yabe and Ueyanagi, 1962). Juvenile tunas, particularly skipjack tuna, may also be identified with fair certainty, by using larval and adult characters. Schaefer and Marr (1948), Eckles (1949), Wade (1950), Mead (1951), Matsumoto (1961), Yoshida (1965), and others have described juveniles of several species of tunas. Despite progress in identification, however, collection continues to be a serious problem. Juvenile tunas are exceedingly difficult to capture between the time at which fins are completely formed (at a length of about 15 mm) and the time at which a few adolescent fish begin to appear in commercial catches in some areas (at lengths of about 35 cm).

OBJECTIVES

In this review I summarize what has been published, to the best of my knowledge, on the capture of juvenile skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*), albacore (*T. alalunga*) and bigeye tuna (*T. obesus*). For the purpose of this paper, I designate juvenile tunas as those not longer than 300 mm, and include them in the distributional records unless they were taken by commercial fishing. I exclude most tunas shorter than about 12 mm from distributional records, but include a few records of shorter tunas because they were caught by a method other than towing a plankton net (which I consider a sampling device for tuna larvae, rather than juveniles).

Before the geographical distribution of the four species is considered, some of the merits and deficiencies are discussed for three methods that have been used to collect juvenile tunas.

COLLECTING METHODS AND LIMITATIONS

Existing information on distribution of juvenile tunas has resulted primarily from the extensive but sporadic use of three collecting methods: (1) "dip netting" at "night-light" stations (scooping up the fish with a long-handled net as they swim to an artificial light suspended at the surface as the vessel drifts at night); (2) searching the stomach contents of pelagic predators; and (3) towing various sizes of small-mesh midwater trawls at the surface and in deeper water.

Dip netting at night-light stations has been rather successful for juvenile yellowfin tuna in the eastern Pacific. But in the same area, the method has taken very few juvenile skipjack tuna and no juvenile albacore or bigeye tuna. In the central and western Pacific areas, dip net collections account for less than one-fifth of the juvenile skipjack tuna and none of the juvenile albacore or bigeye tuna upon which this review is

based. Perhaps the major difficulty associated with this collecting method is that the adverse weather commonly encountered on the open sea prevents night-light stations, except in lagoons or on the leeward side of islands. Dip netting will undoubtedly continue to supply us with juvenile tunas from certain protected locations, but the requirement for calm water severely restricts its use.

Were it not for their presence in stomach contents, our knowledge of the occurrence of juvenile tunas in the Pacific would be far more meager than it is. Most records of albacore and bigeye tuna reported here have resulted from examining stomach contents. Juvenile skipjack tuna tend to be even more common than other juvenile tunas in stomach of adult tunas and billfishes (Nakamura, 1965; Koga, 1958). But stomach sampling has a few obvious deficiencies. Specimens are sometimes in such poor condition that further biological studies are difficult or impossible, even though hard parts alone are commonly sufficient for identification. Moreover, in contrast to dip netting or trawling, the exact depth of capture frequently is unknown. Finally, it is conceivable that juveniles of one species of scombrid might be eaten more often than another for reasons other than its greater abundance in an area. Watanabe (1958) observed, for example, that juvenile "Katsuwonidae" (probably skipjack tuna) were eaten by yellowfin tuna but not by bigeye tuna in the western equatorial Pacific. Such a situation might arise because of greater similarity of predator and prey distributions in one instance than in another.

Dip netting and stomach sampling have provided practically all the juvenile tunas upon which our present knowledge is based, but the several deficiencies associated with these techniques have long suggested the need for a better method--one which will allow us to sample whenever and wherever we choose, and will give some measure of effort for quantitative comparisons of abundance of each species within and among the various areas at selected depths and times. In recent years, the Bureau of Commercial Fisheries Biological Laboratory, Honolulu, has paid particular attention to midwater trawls. King and Iversen (1962) and Matsumoto (1961) have discussed the effectiveness of various sizes of trawls for collecting juvenile tunas in the central Pacific. In general, the larger "Nanaimo" trawl used by Matsumoto in 1958 was more effective in collecting juvenile tunas than the smaller nets used by King and Iversen in 1951-56. More recent trials with other large nets indicate that further experimentation with large, small-mesh nets should be productive.

As a sampling method for juvenile tunas, trawling seems particularly desirable, even though several men are required to set and retrieve the net for each tow. Trawls are capable of capturing juvenile tunas without having to rely on their attraction to light or their consumption by predators. Tows can be made at any chosen depth, time, or place without undue regard for the weather. Finally, juvenile tunas collected with trawls are usually in excellent condition. Identification is thus facilitated, and it is possible to carry out biological studies that require whole, unutilated specimens.

GEOGRAPHICAL DISTRIBUTION

Pacific Ocean records of collection of juvenile skipjack tuna, yellowfin tuna, albacore and bigeye tuna are discussed according to area of capture. For this purpose, I arbitrarily divided the Pacific into three areas: western (long. 120° E to 180°), central (long. 180° to 120° W), and eastern (long. 120° W to west coast of Americas).

Positions of capture of juvenile tunas are plotted on distribution maps. If an author did not specify an exact location of capture, the record was not included on a distribution map unless the place of collection was reported to be close to an island or other land feature for which the geographical position is known.

Juvenile skipjack tuna

In the western North Pacific, many juvenile skipjack tuna have been taken from stomachs of pelagic fishes caught from the Equator to lat. 32° N, except in the area surrounding Wake Island (lat. 19°17' N, long. 166°35' E) (Table I and Fig. 1). In the southwestern Pacific, Sun (1960) recorded the capture of one small skipjack tuna (actually a larva) just south of the Equator. Yabe, Yabuta, and Ueyanagi (1963) indicated (their Fig. 11) that juvenile skipjack tuna have been collected northeast of Australia and in the vicinity of the Philippine Islands and New Guinea. Unfortunately, exact positions of capture and other catch data have not been published and are not available (S. Ueyanagi, personal communication).

In the central Pacific, juvenile skipjack tuna have been collected from lat. 22° N near Hawaii to lat. 23° S near the Tonga Islands, but there are large gaps in the distributional record. Apparently no juvenile skipjack tuna have been taken near Johnston Island in the North Pacific (lat. 17° N, long. 168°30' W). None have been recorded in the Southern Hemisphere between lat. 9° S and 23° S, although several food studies have indicated that juvenile skipjack tuna occur there. Koga (1958) found juveniles in the stomachs of tunas and billfishes caught near the Fiji Islands, and Nakamura (1965) remarked that juvenile skipjack tuna are a very important food of adults of that species around the Tuamotu Archipelago. Juvenile skipjack tuna have also been found in the stomachs of billfishes near Samoa (H.O. Yoshida, personal communication).

In the eastern tropical Pacific, only 10 skipjack tuna were taken by dip netting during 1948-61 (Klawe, 1963). At the same night-light stations, 136 yellowfin tuna, 229 black skipjack (*Euthynnus lineatus*), and 3,464 frigate mackerel (*Auris thazard*) were taken. Alverson (1963) found only one skipjack tuna in the stomachs of 3,856 yellowfin and skipjack tuna caught in the eastern Pacific. In the same stomachs he found 3 yellowfin tuna, 5 black skipjack and 103 frigate mackerel. From the relatively infrequent occurrence of skipjack tuna it would seem, as Klawe (1963) and others have suggested, that the eastern tropical Pacific is not an important spawning area for the species.

Table I. Pacific Ocean records of collection of juvenile skipjack tuna (Katsuwonus pelamis).

Location of collection ^{1/}		Date	Number collected	Total or fork length (mm) ^{2/}	Method of collection ^{3/}	Reference or collector
Latitude	Longitude					
<u>Western Pacific</u>						
32°04' N	177°45' E	Jan. 1949-50	3	230-300	S (BE)	Suda (1953)
32°00' N	177°57' E	Jan. 1949-50	1	285	S (BE)	Suda (1953)
31°55' N	177°53' E	Jan. 1949-50	1	300	S (BE)	Suda (1953)
31°55' N	177°45' E	Jan. 1949-50	2	ca 300	S (BE)	Suda (1953)
31°16' N	130°19' E	June 1924	3	100-140	D	Kishinouye (1926)
29°51' N	129°52' E	19 May 1924	2	60, 80	S (SJ or YF)	Kishinouye (1924)
29°50' N	129°10' E	17 May 1951	3	72-123	S (SJ)	Hotta (1953)
29°47' N	129°25' E	14 Apr. 1924	1	26	S (SJ)	Kishinouye (1926)
29°47' N	129°25' E	21 May 1924	3	63-85	S (SJ or YF)	Kishinouye (1924)
Ryukyu Islands area		early June 1924	2	120, 153	S (SJ or YF)	Kishinouye (1924)
Ryukyu Islands area		July 1923	2	105, 125	S (SJ or YF)	Kishinouye (1924)
Ryukyu Islands area		Aug. 1923	1	210	S (SJ or YF)	Kishinouye (1924)
<u>Satsunan Sea,</u>						
<u>Tokara area</u>						
29°33' N	129°38' E	May 1950-52	1	128	S (SJ)	Hotta & Ogawa (1955)
29°30' N	174°19' E	30 Oct. 1951	5	140-180	S (SJ)	Hotta (1953)
29°19' N	174°49' E	Mar. 1949-50	1	240	S (BE)	Suda (1953)
29°05' N	127°50' E	Mar. 1949-50	1	300	S (BM)	Suda (1953)
28°10' N	129°15' E	12 May 1952	2	65	S (SJ)	Hotta (1953)
27°30' N	150°21' E	16 May 1924	1	58	S (SJ or YF)	Kishinouye (1924)
26°43' N	126°31' E	Feb. 1949-50	1	300	S (BM)	Suda (1953)
Ryukyu Islands area		19 June 1952	13	80-112	S (SJ)	Hotta (1953)
<u>(Okinawa)</u>						
<u>Satsunan Sea,</u>						
Okinawa area		Aug. 1916	1	210	?	Kishinouye (1923)
<u>Satsunan Sea,</u>						
Okinawa area		May 1950-52	11	20-154	S (SJ)	Hotta & Ogawa (1955)
<u>Satsunan Sea,</u>						
Okinawa area		July 1950-52	1	<80	S (SJ)	Hotta & Ogawa (1955)
26°25' N	126°25' E	17 June 1952	5	67-85	S (SJ)	Hotta (1953)
26°13' N	126°29' E	9 June 1937	2	87, 110	S (SJ)	Hotta (1953)
25°30' N	152°07' E	Feb. 1949-50	1	300	S (BM)	Suda (1953)
25°18' N	141°10' E	Dec. 1949-50	1	100	S (Bkm)	Suda (1953)
25°17' N	156°51' E	Apr. 1949-50	1	170	S (BM)	Suda (1953)
25°07' N	160°50' E	Apr. 1949-50	1	125	S (Bkm)	Suda (1953)

Explanation of footnotes at end of table.

Table I. Pacific Ocean records of collection of juvenile skipjack tuna (*Katsuwonus pelamis*). (con.)

Location of collection ^{1/}		Date	Number collected	Total or fork length (mm) ^{2/}	Method of collection ^{3/}	Reference or collector
Latitude	Longitude					
25°03.5' N	153°47' E	Apr. 1949-50	1	135	S (BM)	Suda (1953)
24°57' N	156°53' E	Apr. 1949-50	2	114, 120	S (BKM)	Suda (1953)
24°53' N	156°58' E	Apr. 1949-50	8	100-275	S (BM)	Suda (1953)
24°53' N	156°53' E	Apr. 1949-50	5	80-300	S (BE, BM, BKM)	Suda (1953)
Bonin Islands area						
(Iwo Jima)		16-20 Sept. 1951	1	65	S (SJ)	Hotta & Ogawa (1955)
Bonin Islands area						
(Iwo Jima)		22 Oct. 1951	1	49	S (SJ)	Hotta & Ogawa (1955)
24°34' N	143°49' E	June 1949-50	4	100-130	S (BKM)	Suda (1953)
24°30' N	144°15' E	Apr. 1949-50	3	100-125	S (BE, BM)	Suda (1953)
24°26' N	143°52' E	June 1949-50	4	210-240	S (YF, BM)	Suda (1953)
24°16' N	144°39' E	June 1949-50	3	230-250	S (BM, BKM)	Suda (1953)
24°00' N	143°56' E	Apr. 1949-50	1	90	S (BM)	Suda (1953)
24°00' N	154°00' E	7 July 1957	1	8.96	D	Sun (1960)
23°58' N	145°23' E	June 1949-50	1	200	S (BKM)	Suda (1953)
23°44' N	143°01' E	20 Aug. 1953	1	190	S (SJ)	Hotta & Ogawa (1955)
23°38' N	146°23' E	Apr. 1949-50	2	200	S (BM)	Suda (1953)
23°10' N	145°40' E	Mar. 1949-50	1	200	S (BM)	Suda (1953)
23°00' N	145°50' E	Mar. 1949-50	1	125	S (BM)	Suda (1953)
22°58' N	152°48' E	June 1949-50	1	95	S (BKM)	Suda (1953)
22°56' N	148°52' E	June 1949-50	3	110-200	S (BKM)	Suda (1953)
22°53' N	148°59' E	May 1949-50	2	230, 240	S (BM)	Suda (1953)
22°53' N	148°59' E	June 1949-50	6	82-250	S (BKM)	Suda (1953)
22°50' N	152°42' E	June 1949-50	15	105-210	S (BKM)	Suda (1953)
22°47' N	152°54' E	July 1949-50	3	125-150	S (BKM)	Suda (1953)
22°45' N	141°50' E	19 Aug. 1953	1	172	S (SJ)	Hotta & Ogawa (1955)
22°37' N	144°53' E	Mar. 1949-50	1	123	S (BM)	Suda (1953)
22°28' N	152°40' E	June 1949-50	25	90-265	S (BKM)	Suda (1953)
22°02' N	150°20' E	Mar. 1949-50	1	80	S (BM)	Suda (1953)
21°56' N	152°06' E	July 1949-50	11	105-280	S (BKM)	Suda (1953)
20°44' N	124°47' E	26 Aug. 1951	2	?	S (SJ)	Hotta (1953)
19°46' N	149°46' E	May 1949-50	1	100	S (BKM)	Suda (1953)
19°19' N	148°53' E	May 1949-50	2	70, 80	S (BM, BKM)	Suda (1953)
19°09' N	151°59' E	May 1949-50	1	220	S (BKM)	Suda (1953)

Explanation of footnotes at end of table.

Table I. Pacific Ocean records of collection of juvenile skipjack tuna (Katsuwonus pelamis). (con.)

Location of collection ^{1/}		Date	Number collected	Total or fork length (mm) ^{2/}	Method of collection ^{3/}	Reference or collector
Latitude	Longitude					
18°56' N	150°52' E	May 1949-50	1	200	S (BKM)	Suda (1953)
18°38' N	151°26' E	May 1949-50	2	100, 150	S (BKM)	Suda (1953)
18°35' N	151°50' E	May 1949-50	2	80, 150	S (YF)	Suda (1953)
18°35' N	151°38' E	May 1949-50	4	120-240	S (BKM)	Suda (1953)
18°26' N	151°40' E	May 1949-50	4	250-300	S (BKM)	Suda (1953)
18°20' N	152°02' E	May 1949-50	4	120	S (BKM)	Suda (1953)
18°18' N	151°28' E	May 1949-50	2	200, 300	S (BKM)	Suda (1953)
*Near Bikini Atoll,						
Marshall Islands						
8°21' N	150°42' E	24 July 1947	2	45, 50	S (SJ)	Marr (1948)
8°00' N	147°30' E	Aug. 1949-50	6	60-165	S (YF, BKM)	Suda (1953)
7°56' N	162°34' E	July 1949-50	20	140-280	S (YF, BKM)	Suda (1953)
7°50' N	147°25' E	Aug. 1949-50	3	190-300	S (BKM)	Suda (1953)
		July 1949-50	13	110-250	S (YF, BKM)	Suda (1953)
*Near Truk Islands						
6°55' N	146°02' E	3 May 1940	1	45	S (SJ)	Inanami (1942)
6°37.2' N	121°31' E	July 1949-50	3	100-200	S (BKM)	Suda (1953)
5°52' N	148°00' E	7 May 1948	6	13-27	D	Wade (1950)
5°22' N	164°37' E	July 1949-50	9	90-140	S (YF, BKM)	Suda (1953)
5°18' N	159°49' E	Aug. 1949-50	1	130	S (BKM)	Suda (1953)
5°03' N	165°53' E	30 May 1951	12	21-49	D	Matsumoto (1961)
5°00' N	150°48' E	Aug. 1949-50	2	180, 200	S (BKM)	Suda (1953)
4°52' N	166°40' E	Aug. 1949-50	5	120-180	S (YF, BKM)	Suda (1953)
4°18' N	161°44' E	Aug. 1949-50	1	200	S (YF)	Suda (1953)
3°35' N	155°00' E	Aug. 1949-50	2	137, 140	S (YF, BKM)	Suda (1953)
2°57' N	154°08' E	July 1949-50	9	95-150	S (YF, BKM)	Suda (1953)
2°51' N	157°03' E	July 1949-50	4	155-165	S (YF, BKM)	Suda (1953)
2°28' N	155°01' E	25 May 1951	6	23-55	D	Matsumoto (1961)
2°15' N	153°50' E	24 July 1950	2	132, 169	S (SF)	Shimada (1951a)
2°15' N	154°20' E	July 1949-50	3	140-160	S (BKM)	Suda (1953)
2°12' N	152°12' E	July 1949-50	4	70-150	S (BKM)	Suda (1953)
2°11' N	153°08' E	July 1949-50	1	95	S (YF)	Suda (1953)
2°09' N	154°11' E	25 Apr. 1951	5	39-44	D	Matsumoto (1961)
1°47' N	153°00' E	July 1949-50	13	85-200	S (BKM)	Suda (1953)
1°42' N	153°16' E	July 1949-50	2	58, 120	S (YF, BKM)	Suda (1953)
1°31' N	154°09' E	July 1949-50	10	67-165	S (YF)	Suda (1953)
1°30' N	154°08' E	July 1949-50	1	180	S (BKM)	Suda (1953)
		21 July 1950	1	130	S (BKM)	Shimada (1951a)

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Location of collection ^{1/}		Date	Number collected	Total or fork length (mm) ^{2/}	Method of collection ^{3/}	Reference or collector
Latitude	Longitude					
1°25' N	153°14' E	July 1949-50	5	90-145	S (YF, BKM)	Suda (1953)
1°16' N	153°27' E	July 1949-50	2	155, 170	S (BKM)	Suda (1953)
1°14' N	153°00' E	July 1949-50	2	110, 125	S (YF, BKM)	Suda (1953)
1°14' N	157°28' E	8 Aug. 1950	2	132, 148	S (YF)	Shimada (1951a)
1°13' N	150°11' E	Aug. 1949-50	2	110, 180	S (YF, BKM)	Suda (1953)
1°10' N	157°29' E	4 Aug. 1950	2	81, 94	S (YF)	Shimada (1951a)
1°07.5' N	150°17' E	Aug. 1949-50	2	120, 125	S (YF)	Suda (1953)
0°04'3" S	171°53'2" E	6 Feb. 1958	1	5.84	T (Sav)	Sun (1960)
<u>Central Pacific</u>						
21°25.9' N	158°18' W	11 Aug. 1964	2	?	T (Cobb)	W. M. Matsumoto
20°47' N	157°28' W	22 May 1959	1	49	B	Matsumoto (1961)
20°35' N	157°32' W	9 Apr. 1953	1	18	T (1-m)	King & Iversen (1962)
20°30' N	158°45' W	13 July 1948	6	113-118	S (SJ)	Eckles (1949)
Vicinity of Oahu,						
Hawaiian Islands						
19°39' N	156°13' W	13 Aug. 1959	6	? (30-73)	S (SJ)	Matsumoto (1961)
19°39' N	156°13' W	20 Aug. 1964	1	?	T (Cobb)	W. M. Matsumoto
19°33' N	156°00' W	21 Aug. 1964	3	?	T (Cobb)	W. M. Matsumoto
12°13' N	149°56' W	3 Sept. 1948	1	183	S (SJ)	Eckles (1949)
8°10' N	178°07' W	7 Nov. 1958	1	6.8	T (Nan)	Matsumoto (1961)
		13 Oct. 1963	1	36.0 (SL)	D	H. O. Yoshida, W. M. Matsumoto
7°39' N	150°16' W	6 Nov. 1958	1	24.1	T (Nan)	Matsumoto (1961)
6°20.5' N	162°22' W	5 Feb. 1956	5	45-58	D	Matsumoto (1961)
6°20.5' N	162°22' W	3 May 1951	34	20-34	D	Matsumoto (1961)
6°06' N	150°28' W	5 Nov. 1958	1	? (14.6-22.6)	T (Nan)	Matsumoto (1961)
5°58' N	173°32'53" W	27 Nov. 1957	1	22.8	T (Sav)	Matsumoto (1961)
5°56' N	139°26' W	21 June 1952	1	18	T (6 ft)	King & Iversen (1962)
3°28' N	157°43' W	26 Jan. 1966	3	24-31	T (Nan)	B. E. Higgins, W. M. Matsumoto
2°56' N	150°03' W	4 Nov. 1958	1	13.9	T (Nan)	Matsumoto (1961)
2°01.5' N	171°37' W	20 June 1951	4	? (16-19)	D	Matsumoto (1961)
0°53' N	140°02' W	31 May 1952	1	19.0	P	Matsumoto (1958)
0°02' N	159°50' W	26 Sept. 1956	1	22	T (IKMT)	King & Iversen (1962)
0°37' S	149°58' W	3 Nov. 1958	3	19.9-21.7	T (Nan)	Matsumoto (1961)
0°44' S	149°46' W	2 Nov. 1958	4	18.5-52.5	T (Nan)	Matsumoto (1961)

Explanation of footnotes at end of table.

Table I. Pacific Ocean records of collection of juvenile skipjack tuna (*Katsuwonus pelamis*). (con.)

Location of collection ^{1/} Latitude Longitude	Date	Number collected	Total or fork length (mm) ^{2/}	Method of collection ^{3/}	Reference or collector
2°09' S 149°47' W	2 Nov. 1958	3	23-29	T (Nan)	Matsumoto (1961)
2°59' S 167°51' W	15 Feb. 1966	1	14	T (Nan)	B. E. Higgins, W. M. Matsumoto
3°50.5' S 171°48.5' W	18 July 1950	2	35, 48	D	Shimada (1951b)
4°00' S 172°06' W	2 Mar. 1951	4	5.1-20.1	P	Matsumoto (1958)
4°30' S 172°11' W	5 Aug. 1950	3	20-36	D	Shimada (1951b)
4°57' S 172°36' W	4 Dec. 1957	7	27.6-47.5	D	Sun (1960)
4°58' S 150°00' W	30 Oct. 1958	12	14.5-26	T (Nan)	Matsumoto (1961)
5°00' S 149°58' W	1 Nov. 1958	7	10-30	T (Nan)	Matsumoto (1961)
5°57' S 157°24' W	31 Jan. 1966	1	40	T (Nan)	B. E. Higgins, W. M. Matsumoto
5°57' S 167°47' W	14 Feb. 1966	1	12	T (Nan)	B. E. Higgins, W. M. Matsumoto
7°42' S 140°10' W	28 Feb. 1958	3	? (31-52)	S (YF)	Matsumoto (1961)
8°49' S 140°04.5' W	27 Jan. 1958	7	23.5-34	S (YF)	Matsumoto (1961)
23°17' S 174°46'54" W	26 Dec. 1957	1	96	T (535 cm)	Sun (1960)
<u>Eastern Pacific</u>					
9°22.5' N 85°47.5' W	28 Jan. 1947	1	21	D	Schaefer & Marr (1948)
9°10' N 85°20' W	20 Mar. 1947	1	44	D	Schaefer & Marr (1948)
7°12.5' N 95°52.5' W	11 May 1958	1	18	D	Klawe (1963)
0°23' S 80°50' W	18 Apr. 1958	6	11.5-17.0	D	Klawe (1963)
0°45' S 80°41' W	17 Apr. 1958	1	13	D	Klawe (1963)
*Near Galápagos Islands	? July 1957- Dec. 1959	1	?	S (YF)	Alverson (1963)

^{1/} Collections are grouped into three areas: (1) "Western Pacific" (long. 120° E to 180°), (2) "Central Pacific" (long. 180° to 120° W), and (3) "Eastern Pacific" (long. 120° W to west coast of the Americas). Collections are listed in each general area according to latitude, from the northernmost to the southernmost record. Each collection for which I estimated a position for the distributional map (fig. 1) is denoted by an asterisk (*). General areas without asterisks are not represented on fig. 1.

^{2/} Ranges of length that include more than one species are given in parentheses preceded by a question mark; SL = standard length.

^{3/} B = tuna bait seine, D = dip net, P = plankton net. For collections from stomachs (S), the predator is shown in parentheses: BE = bigeye tuna, BM = blue marlin, BM = black marlin, SF = sailfin, SJ = skipjack tuna, YF = yellowfin tuna. The various kinds of midwater trawls (T) are indicated in parentheses: Cobb = Cobb pelagic trawl, IKMT = 10-ft. Isaacs-Kidd midwater trawl, Nan = Nanaimo net, Sav = Savilov's net, 1-m = 1-m ring trawl, 6 ft. = 6-ft. beam trawl, 535 cm = 535-cm diameter conical net.

Juvenile skipjack tuna are apparently absent in the vast expanse of ocean between the Hawaiian, Line, Marquesas, and Tuamotu Islands in the Central Pacific and the west coast of the Americas. To judge from the scarcity of larval skipjack tuna as compared with larval yellowfin tuna in the same area (Matsumoto, in press), this absence may be real. But in this area, as in many others, the effort to collect juveniles must be intensified before meaningful conclusions can be drawn.

Juvenile yellowfin tuna

In the western and central Pacific, juvenile yellowfin tuna have been collected in about the same general area as skipjack tuna, but much less frequently (Table II, Fig 2). They are known to occur as far north as approximately lat. 31° N near Japan and lat. 23° N near Hawaii. There are two records from as far south as lat. 23° S. In the central tropical Pacific, yellowfin tuna have been reported only from two locations at about lat. 2° and 6° N.

In the eastern Pacific, the northernmost record for juvenile yellowfin tuna is from about lat. 24° N, just off Baja California. No juveniles are recorded from farther south of the Equator than about lat. 2° S, just off the coast of Ecuador. I found no records of juvenile yellowfin tuna from the area between long. 150° W and 112° W, but this hiatus probably again reflects to some degree the relatively limited sampling effort in this area. Larvae of yellowfin tuna have been taken throughout this region, as well as around the Marquesas and Tuamotu Islands (Matsumoto, in press).

Juvenile albacore

There are few records of juvenile albacore from the Pacific Ocean, and most of these are from stomachs of tunas and billfishes caught at high latitudes (Table III, Fig 2). Yabe et al. (1958) found five juvenile albacore in the stomachs of yellowfin tuna and billfishes caught in subtropical waters near the Marianas Islands, Fiji Islands, and just east of Australia. Yoshida (1965) identified five albacore from stomachs of billfishes caught near Hawaii, and seven from stomachs of fish caught near the Ellice and Fiji Islands. In August and September 1963 several young albacore (25-43 cm) were taken by live-bait fishing in the north-eastern sea area of Japan (Asano, 1964).

Insofar as I can determine, there is no record of collection of juvenile albacore in the eastern Pacific. Otsu and Uchida (1963) mentioned, however, that albacore of about 35 cm appeared in the American fishery during the summer of 1954.

Juvenile bigeye tuna

Records of capture of juvenile bigeye tuna are extremely rare (Table IV, Fig. 2). In the western Pacific, Marukawa mentioned finding small bigeye tuna in stomachs of yellowfin tuna caught in the Palau Islands area (Hatai et al., 1941). Juvenile bigeye tuna have also been removed from stomachs of fish caught northwest of Australia and near the Philippine Islands (Yabe et al., 1958).

Table II. Pacific Ocean records of collection of juvenile yellowfin tuna (Thunnus albacares).

Location of collection ^{1/}		Date	Number collected	Total or fork length (mm) ^{2/}	Method of collection ^{3/}	Reference or collector
Latitude	Longitude					
<u>Western Pacific</u>						
31°17' N	131°46' E	29 Oct. 1952	1	195 (SL)	S (YF)	Yabe et al (1958)
Gonsone, Ryukyu Islands		26 May 1925	1	63	S (SJ)	Kishinouye (1926)
29°30' N	129°05' E	10 May 1924	1	100	S (SJ)	Kishinouye (1926) (identification uncertain)
18°00' N	153°52' E	23 July 1952	1	130 (SL)	S (SNS)	Yabe et al (1958)
11°05'8" N	139°58'6" E	20 May 1958	1	6.6	T (Sav)	Sun (1960)
*9-10° N	176-177° E	Feb. 1953	1	ca 140 (SL)	S (BKM)	Yabe et al (1958)
**5-8° N	133-134° E	Oct. 1957	4	ca 170-195 (SL)	S (BKM)	Yabe et al (1958)
6°44.5' N	125°36.7' E	13 May 1948	13	9.8-35	D	Wade (1950)
6°37.2' N	121°31' E	7 May 1948	5	14-20	D	Wade (1950)
6°33.5' N	138°57' E	1 Dec. 1958	2	ca 200	S	S. Ueyanagi
3°45' N	140°17' E	26 Nov. 1958	1	ca 100	S	S. Ueyanagi
10°07' S	121°26' E	21 Feb. 1953	1	147 (SL)	S (WM)	Yabe et al (1958)
15°54' S	146°15' E	22 Nov. 1956	1	107 (SL)	S (WM)	Yabe et al (1958)
23°29' S	170°39' E	26 Feb. 1958	1	12.04	T (Sav)	Sun (1960)
<u>Central Pacific</u>						
23°18' N	163°00' W	16 Aug. 1948	3	216-219	G	Greenhood (1952)
*Near Oahu, Hawaiian Islands		13 Aug. 1959	1	? (30-73)	S (SJ)	Matsumoto (1961)
6°06' N	150°28' W	5 Nov. 1958	2	? (14.6-22.6)	T (Nan)	Matsumoto (1961)
2°01.5' N	171°37' W	20 June 1951	2	? (16-19)	D	Matsumoto (1961)
23°17' S	174°47' W	26 Dec. 1957	5	5.25-8.52	T (535 cm)	Sun (1960)
<u>Eastern Pacific</u>						
23°48' N	112°02' W	4 Nov. 1956	1	29	D	Klawe (1963)
18°30' N	104°30' W	May 1959	2	35, 40	S (YF)	Klawe (1963)
*Near Revillagigedo Islands			3	?	S (YF)	Alverson (1963)
18°00' N	105°47' W	28 June 1941	2	31, 135	D	Klawe (1959)

Explanation of footnotes at end of table.

Table II. Pacific Ocean records of collection of juvenile yellowfin tuna (Thunnus albacares). (con.)

Location of collection ^{1/}		Date	Number collected	Total or fork length (mm) ^{2/}	Method of collection ^{3/}	Reference or collector
Latitude	Longitude					
13°33' N	92°43' W	12 Sept. 1960	16	9.5-15.5	D	Klawe (1963)
12°39' N	91°40' W	5 Apr. 1957	1	11	D	Klawe (1963)
12°34' N	91°38' W	4 Apr. 1957	1	12	D	Klawe (1963)
12°16' N	89°31' W	17 May 1949	25	15.5-25.0	D	Mead (1951)
12°11' N	90°18' W	30 May 1949	5	19.5-26.5	D	Mead (1951)
12°08' N	88°18' W	8 Aug. 1960	2	16.5, 17.0	D	Klawe (1963)
11°05' N	89°55' W	28 May 1949	12	10.5-16.0	D	Mead (1951)
10°20' N	86°20' W	20 May 1958	23	7-11	D	Klawe (1963)
*10 mi. west of Cape Blanco, Costa Rica		5-6 June 1959	1	18	D	Klawe (1963)
*5 mi. southeast of Cape Blanco, Costa Rica		9-10 Apr. 1959	2	12, 14	D	Klawe (1963)
*10 mi. southeast of Cape Blanco, Costa Rica		6-7 May 1959	3	12-16	D	Klawe (1963)
*10 mi. south of Cape Blanco, Costa Rica		22 Jan. 1960	8	10-14	D	Klawe (1963)
*10 mi. south of Cape Blanco, Costa Rica		30 Mar. 1960	7	7-31	D	Klawe (1963)
*10 mi. south of Cape Blanco, Costa Rica		21 Sept. 1960	22	11.0-11.5	D	Klawe (1963)
*10 mi. south of Cape Blanco, Costa Rica		21 Oct. 1960	7	10.5-30.0	D	Klawe (1963)
*9°22.5' N 85°47.5' W		28 Jan. 1947	2	14, 15	D	Schaefer & Marr (1948)
*15 mi. south southeast of Cape Blanco, Costa Rica		25 Feb. 1960	5	11.5-13.0	D	Klawe (1963)
*9°20' N 85°10' W		1 Apr. 1947	20	10-24	D	Schaefer & Marr (1948)
*15 mi. south of Cape Blanco, Costa Rica		26-27 Dec. 1958	1	27	D	Klawe (1963)
*20 mi. south southwest of Cape Blanco, Costa Rica		24 Feb. 1960	54	11-26	D	Klawe (1963)
*20 mi. south of Cape Blanco, Costa Rica		11-12 Feb. 1959	2	23, 24	D	Klawe (1963)
*20 mi. south of Cape Blanco, Costa Rica		29 Mar. 1960	2	22, 29	D	Klawe (1963)

Explanation of footnotes at end of table.

Table II. Pacific Ocean records of collection of juvenile yellowfin tuna (Thunnus albacares). (con.)

Location of collection ^{1/} Latitude Longitude	Date	Number collected	Total or fork length (mm) ^{2/}	Method of collection ^{3/}	Reference or collector
*20 mi. south of Cape Blanco, Costa Rica	8-9 Apr. 1959	12	16-20	D	Klawe (1963)
*20 mi. south of Cape Blanco, Costa Rica	26-27 Dec. 1958	1	26	D	Klawe (1963)
9°10' N 85°20' W	20 Mar. 1947	6	26-43	D	Schaefer & Marr (1948)
*30 mi. south of Cape Blanco, Costa Rica	20 Oct. 1960	10	13-21	D	Klawe (1963)
8°45' N 83°55' W	June 1938	8	ca 50	S (PP)	Klawe (1963)
8°12' N 83°17' W	5 Apr. 1959	1	12	D	Klawe (1963)
8°07.5' N 83°08.5' W	7 May 1947	1	41	D	Schaefer & Marr (1948)
7°30' N 82°30' W	12 Apr. 1959	1	37	D	Klawe (1963)
5°30' N 86°57' W	3 Dec. 1959	7	11.5-16	D	Klawe (1963)
0°23' S 80°50' W	18 Apr. 1958	8	11-18	D	Klawe (1963)
0°45' S 80°41' W	17 Apr. 1958	1	16	D	Klawe (1963)
2°12' S 81°11' W	22 Apr. 1958	1	11.5	D	Klawe (1963)

1/ Collections are grouped into three areas: (1) "Western Pacific" (long. 120° E to 180°), (2) "Central Pacific" long. 180° to 120° W), and (3) "Eastern Pacific" (long. 120° W to west coast of the Americas). Collections are listed in each general area according to latitude, from the northernmost to the southernmost record. Each collection for which I estimated a position(s) for the distributional map (fig. 2) is denoted by an asterisk(s) (*).

2/ Ranges of length that include more than one species are given in parentheses preceded by a question mark; SL = standard length.

3/ D = dip net, G = gill net. For collection from stomachs (S), the predator is shown in parentheses: BkM = black marlin, PP = Pelamis platurus, SJ = skipjack tuna, SNS = shortnose spearfish, WM = white marlin, YF = yellowfin tuna. The various kinds of midwater trawls are indicated in parentheses: Nan = Nanaimo net, Sav = Savilov's net, 535 cm = 535-cm diameter conical net.

Table III. Pacific Ocean records of collection of juvenile albacore (Thunnus alalunga).

Location of collection ^{1/} Latitude Longitude	Date	Number collected	Standard length (mm)	Method of collection ^{2/}	Reference or collector
<u>Western Pacific</u>					
23°46' N 171°02' E	11 Aug. 1960	2	131	S (BM)	Yoshida (1965)
20°57' N 149°36' E	11 June 1952	1	124	S (BKM)	Yabe et al. (1958)
18°38' N 151°26' E	15 May 1949	1	188	S (BKM)	Yabe et al. (1958)
10°43' S 178°46' E	25 Feb. 1962	1	85	S (BM)	Yoshida (1965)
18°44' S 176°54' E	1 Feb. 1955	1	ca 170	S (YF)	Yabe et al. (1958)
18°58' S 176°27' E	2 Feb. 1955	1	ca 170	S (YF)	Yabe et al. (1958)
20°50' S 155°30' E	6 Dec. 1956	1	234	S (SM)	Yabe et al. (1958)
<u>Central Pacific</u>					
*Off Waianae, Oahu, Hawaiian Islands	13 Aug. 1962	1	135	S (SM)	Yoshida (1965)
*Off Waianae, Oahu, Hawaiian Islands	13 Sept. 1962	1	184	S (BM)	Yoshida (1965)
*Off Waianae, Oahu, Hawaiian Islands	2 Nov. 1962	2	257, 283	S (SM)	Yoshida (1965)
*Off Kona, Hawaii, Hawaiian Islands	1 Aug. 1962	1	184	S (BM)	Yoshida (1965)
6°32' S 162°45' W	24 Mar. 1962	1	74	S (WH)	Yoshida (1965)
13°25' S 179°15' W	26 Feb. 1962	2	61, 75	S (YF)	Yoshida (1965)
15°35' S 171°16' W	13 Mar. 1962	1	88	S (BM)	Yoshida (1965)
19-26° S 128-139° W	Feb-Mar. 1958	2	157.5, 204(TL) ^{3/}	S	S. Ueyanagi

^{1/} Collections are grouped into two areas: (1) "Western Pacific" (long. 120° E to 180°) and (2) "Central Pacific" (long. 180° to 120° W). Collections are listed in each general area according to latitude, from the northernmost to the southernmost record. Each collection for which I estimated a position for the distributional map is denoted by an asterisk (*). General areas without asterisks are not represented on figure 2.

^{2/} For collections from stomachs (S), predators are shown in parentheses: BM = blue marlin, BKM = black marlin, SM = striped marlin, WH = wahoo, YF = yellowfin tuna.

^{3/} Total or fork length.

Table IV. Pacific Ocean records of collection of juvenile bigeye tuna (Thunnus obesus).

Location of collection ^{1/}		Date	Number collected	Standard length (mm)	Capture method ^{2/}	Reference or collector
Latitude	Longitude					
<u>Western Pacific</u>						
**5-8° N	133-134° E	Oct. 1957	1	ca 195	S (BKM)	Yabe et al. (1958)
*Tokobei area,		1939 (?)	?	107-109	S (YF)	H. Marukawa (Hatai et al. 1941)
Palau Island						
1°16' N	153°27' E	13 July 1950	1	216	S (BKM)	Yabe et al. (1958)
10°07' S	121°26' E	21 Feb. 1953	1	173	S (D)	Yabe et al. (1958)

^{1/} Collections are reported from one area, the "Western Pacific" (long. 120° E to 180°). Collections are listed according to latitude, from the northernmost to the southernmost record. Each collection for which I estimated a position(s) for the distributional map (fig. 2) is denoted by an asterisk(s) (*).

^{2/} S = stomach, YF = yellowfin tuna, BKM = black marlin, D = dolphin.

The only reference that I find to juvenile bigeye tuna collected in the central Pacific is in Yabe et al. (1963), who indicated (their Fig. 2) that this species has been found near long. 135° W. Lacking other information, however, I did not include this record in Table IV or Fig. 2. But the occurrence of small bigeye tuna in the central Pacific is not unexpected. Dung and Royce (1953) reported that bigeye tuna 36-50 cm long were taken by pole and line or trolling near the Hawaiian Islands.

There seems to be no record of collection of juvenile bigeye tuna in the eastern Pacific.

REFERENCES

- Alverson, F.G. (1963). The Food of Yellowfin and Skipjack Tunas in the Eastern Tropical Pacific Ocean. Bull. Inter-Amer. Trop. Tuna Comm., 7(5): 295-396.
- Asano, M. (1964). Young Albacore Taken from the Northeastern Sea Area of Japan in August and September 1963. Bull. Tohoku Fish. Res. Lab., 24: 20-27. [In Japanese with English summary; English Translation by Tamio Otsu on File at Bur. Comm. Fish. Biol. Lab., Honolulu.]
- Dung, D.I.Y. and W.F. Royce (1953). Morphometric Measurements of Pacific Scombrids. Spec. Sci. Rep. U.S. Fish Wildl. Serv.--Fish., 95, 170 pp.
- Eckles, H.H. (1949). Observations on Juvenile Oceanic Skipjack (*Katsuwonus pelamis*) from Hawaiian Waters and Sierra Mackerel (*Scomberomorus sierra*) from the Eastern Pacific. Fish. Bull., U.S., 51(48): 245-250.
- Greenhood, E.C. (1952). Results of the Examination of Four Small Yellowfin Tuna, *Neothunnus macropterus*. Calif. Fish Game, 38(2): 157-163.
- Hatai, S. et al. (1941). A Symposium on the Investigation of Tuna and Skipjack Spawning Grounds. Kagaku Nanyo (South Sea Sci.), 4(1): 64-75. English Translation by B.M. Shimada and W.G. Van Campen in Spec. Sci. Rep. U.S. Fish Wildl. Serv.--Fish., 18: 1-11, (1950).
- Hotta, H. (1953). On the Distribution of Young of Skipjack, *Katsuwonus pelamis* in the Southern Seas of Kyushu. Bull. Tohoku Fish. Res. Lab., 2: 19-21. [In Japanese with English Summary.]
- _____ and T. Ogawa (1955). On the Stomach Contents of the Skipjack *Katsuwonus pelamis*. Bull. Tohoku Fish. Res. Lab., 4: 62-82. [In Japanese with English Summary; Translation on File at Bur. Comm. Fish. Biol. Lab., Honolulu.]

- Inanami, Y. (1942). Small Skipjack Caught at Truk. Nanyo Suisan Joho (South Sea Fish. News), 6(1): 7. [Cited by Shimada, 1951b; Original Not Seen.]
- King, J.E. and R.T.B. Iversen (1962). Midwater Trawling for Forage Organisms in the Central Pacific, 1951-1956. Fish. Bull., U.S., 62(210): 271-321.
- Kishinouye, K. (1923). Contributions to the Comparative Study of the So-called Scombroid Fishes. J. Coll. Agric. Tokyo, 8(3): 293-475.
- _____ (1924). Observations on the Skipjack Fishing Grounds. Suisan Gakkai Ho, 4(2): 87-92. English Translation by W.G. Van Campen in Spec. Sci. Rep. U.S. Fish Wildl. Serv.--Fish., 19: 12-14, (1950).
- _____ (1926). An Outline of Studies of the Plecostei (Tunas and Skipjack) in 1925. Suisan Gakkai Ho, 4(3): 125-137. English Translation by W.G. Van Campen in Spec. Sci. Rep. U.S. Fish Wildl. Serv.--Fish., 19: 108, (1950).
- Klawe, W.L. (1959). Nuevo Examen de Atunes Jovenes Capturados Frente a la Costa Occidental de Mexico Durante la Quinta Expedicion George Vanderbilt (1941). Ciencia, Mex., 18(11-12): 245-247. [English Translation on File at Bur. Comm. Fish. Biol. Lab., Honolulu.]
- _____ (1963). Observations on the Spawning of Four Species of Tuna (*Neothunnus macropterus*, *Katsuwonus pelamis*, *Auxis thazard* and *Euthynnus lineatus*) in the Eastern Pacific Ocean, Based on the Distribution of Their Larvae and Juveniles. Bull. Inter-Amer. Trop. Tuna Comm., 6(9): 447-540.
- Koga, S. (1958). On the Difference of the Stomach Contents of Tuna and Black Marlin in the South Equatorial Pacific Ocean. Bull. Fac. Fish. Nagasaki, 7: 31-40. [In Japanese with English Summary.]
- Marr, J.C. (1948). Observations on the Spawning of Oceanic Skipjack (*Katsuwonus pelamis*) and Yellowfin Tuna (*Neothunnus macropterus*) in the Northern Marshall Islands. In: M.B. Schaefer and J.C. Marr, Contributions to the Biology of the Pacific Tunas. Fish. Bull., U.S., 51(44): 201-206.
- Matsumoto, W.M. (1958). Description and Distribution of Larvae of Four Species of Tuna in Central Pacific Waters. Fish. Bull., U.S., 58(128): 31-72.
- _____ (1961). Collection and Descriptions of Juvenile Tunas from the Central Pacific. Deep-Sea Res., 8(3/4): 279-285.
- _____ (1962). Identification of Larvae of Four Species of Tuna from the Indo-Pacific Region I. Carlsberg Foundation, Dana Rep. No. 55, 16 pp.

- Matsumoto, W.M. (1963). Unique Shape of the First Elongate Haemal Spine of Albacore, *Thunnus alalunga* (Bonnaterra). Copeia 1963(2): 460-462.
- _____. (In press). Distribution and Abundance of Tuna Larvae in the Pacific Ocean. In: Thomas A. Manar, Proceedings of the Governor's Conference on Central Pacific Fishery Resources, State of Hawaii.
- Mead, G.W. (1951). Postlarval *Neothunnus macropterus*, *Auxis thazard*, and *Euthynnus lineatus* from the Pacific Coast of Central America. Fish. Bull., U.S., 52(63): 121-127.
- Nakamura, E.L. (1965). Food and Feeding Habits of Skipjack Tuna (*Katsuwonus pelamis*) from the Marquesas and Tuamotu Islands. Trans. Amer. Fish. Soc., 94(3): 236-242.
- Otsu, T. and R.N. Uchida (1963). Model of the Migration of Albacore in the North Pacific Ocean. Fish. Bull., U.S., 63(1): 33-44.
- Schaefer, M.B. and J.C. Marr (1948). Spawning of Yellowfin Tuna (*Neothunnus macropterus*) and Skipjack (*Katsuwonus pelamis*) in the Pacific Ocean off Central America, with Descriptions of Juveniles. In: M.B. Schaefer and J.C. Marr, Contributions to the Biology of the Pacific Tunas. Fish. Bull., U.S., 51(44): 187-196.
- Shimada, B.M. (1951a). Contributions to the Biology of Tunas from the Western Equatorial Pacific. Fish. Bull., U.S., 52(62): 111-119.
- _____. (1951b). Juvenile Oceanic Skipjack from the Phoenix Islands. Fish. Bull., U.S., 52(64): 129-131.
- Suda, A. (1953). Juvenile Skipjack from the Stomach Contents of Tunas and Marlins. Bull. Jap. Soc. Sci. Fish., 19(4): 319-340. [In Japanese with English Summary.]
- Sun, T.G. (1960). Larvae and Juveniles of Tunas, Sailfishes, and Swordfish (Thunnidae, Istiophoridae, Xiphiidae) from the Central and Western Part of the Pacific Ocean. Trud. Inst. Oceanol., 41: 175-191. [English Translation by W.L. Klawe, Inter-Amer. Trop. Tuna Comm., La Jolla, Calif.]
- Ueyanagi, S. and E. Ahlstrom (1963). Species Identification and Distribution: Larvae and Eggs. Proceedings of the World Scientific Meeting on the Biology of Tunas and Related Species, FAO Fish. Rep., (6): 1: 33-35.
- _____. and H. Watanabe (1964). Methods of Identification for the Young Stages of Tunas and Spearfishes. Nankai Reg. Fish. Res. Lab., Materials for the Tuna Fisheries Research Council, February 1964, 16 pp. [English Translation by W.G. Van Campen on File at Bur. Comm. Fish. Biol. Lab., Honolulu.]

- Wade, C.B. (1950). Juvenile Forms of *Neothunnus macropterus*, *Katsuwonus pelamis* and *Euthynnus yaito* from Philippine Seas. Fish. Bull., U.S., 51(53): 395-404.
- Watanabe, H. (1958). On the Difference of the Stomach Contents of the Yellowfin and Bigeye Tunas from the Western Equatorial Pacific. Rep. Nankai Fish. Res. Lab., 7: 72-81. [In Japanese with English Summary; English Translation on File on Bur. Comm. Fish. Biol. Lab., Honolulu.]
- Yabe, H. and S. Ueyanagi (1962). Contributions to the Study of the Early Life History of the Tunas. Occ. Pap. Nankai Reg. Fish. Res. Lab., 1: 57-72. [Paper Presented to the Pacific Tuna Biology Conference, August 1961, Honolulu.]
- _____, S. Ueyanagi, S. Kikawa and H. Watanabe (1958). Young Tunas Found in the Stomach Contents. Rep. Nankai Fish. Res. Lab., 8: 31-48. [In Japanese with English Summary; English Translation on File at Bur. Comm. Fish. Biol. Lab., Honolulu.]
- _____, Y. Yabuta and S. Ueyanagi (1963). Comparative Distribution of Eggs, Larvae and Adults in Relation to Biotic and Abiotic Environmental Factors. Proceedings of the World Scientific Meeting on the Biology of Tunas and Related Species, FAO Fish. Rep., (6), 3: 979-1009.
- Yoshida, H.O. (1965). New Pacific Records of Juvenile Albacore *Thunnus alalunga* (Bonnaterre) from Stomach Contents. Pacif. Sci., 19(4): 442-450.

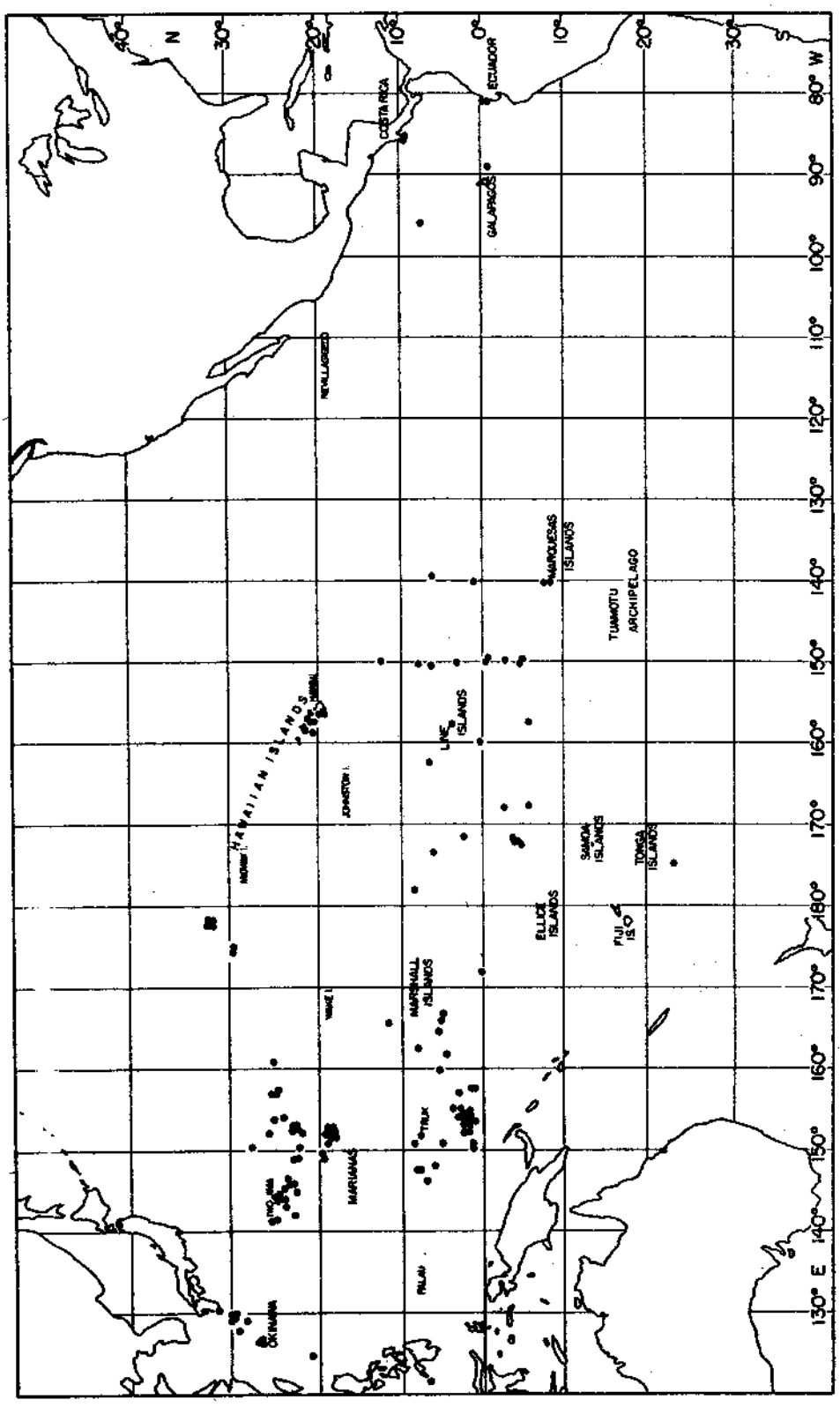


Fig. 1. Locations of Collection of Juvenile Skipjack Tuna (Katsuwonus pelamis) in the Pacific Ocean, 1916-66

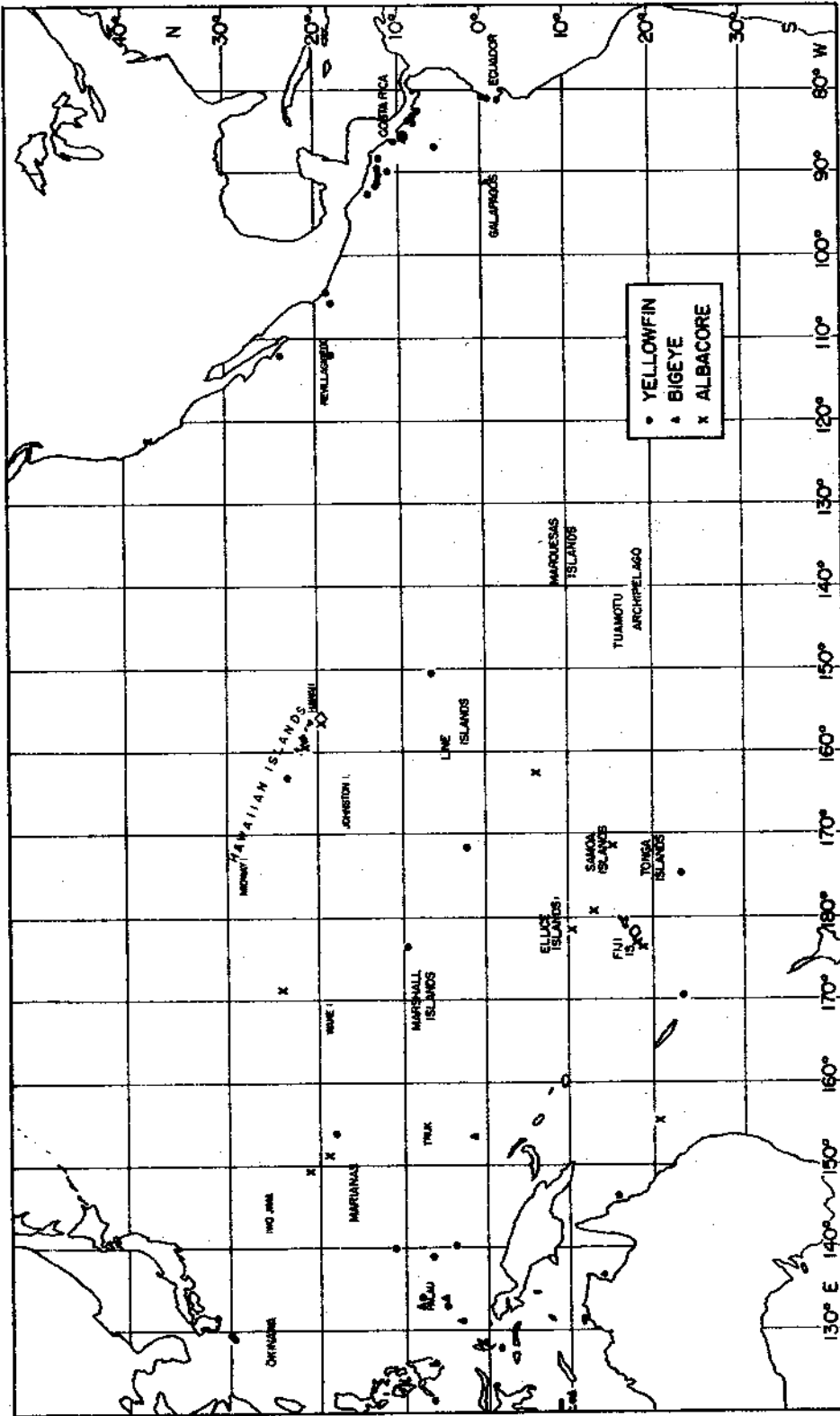


Fig. 2. Locations of Collection of Juvenile Yellowfin Tuna (*Thunnus albacares*), Bigeye Tuna (*T. obesus*), and Albacore (*T. alalunga*) in the Pacific Ocean, 1916-66