

## Predators of Skipjack, *Katsuwonus pelamis*, in the Atlantic Ocean and a Preliminary Indication of Skipjack Distribution

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Data from stomachs of 187 billfishes and tunas indicate that yellowfin tuna, blue and white marlins and spearfish are predators of skipjack while bigeye tuna are not. Skipjack in the stomachs of these predators indicate that young skipjack occur in the northwest Atlantic in an area between 60° and 70° W, and 36° and 40° N, but not in specified areas to the northeast or southwest of this.

Les données concernant le contenu stomacal de 187 poissons porte-épée et thonidés indiquent que l'albacore, le makaire bleu, le makaire blanc et le "spearfish" effectuent la prédation de listao, ce que ne fait pas le thon obèse. Les listaos détectés dans les estomacs de ces prédateurs signalent la présence de juvéniles de l'espèce dans l'Atlantique nord-ouest dans un secteur allant de 60° à 70°W et de 36° à 40°N, mais dans aucune zone précise au nord-est ou au sud-ouest du secteur en question.

Los datos obtenidos de estómagos de 187 malines y tunidos indican que el rabil, la aguja blanca, la aguja azul y el *Tetrapturus pfluegeri* son predadores del listado, mientras que el patudo no lo es. El listado encontrado en los estómagos de estos predadores indica que hay listado joven en el Atlántico Noroeste en una zona entre 60° y 70°W y 36° y 40°N, pero no en zonas detalladas al Nordeste o Sudoeste de las mencionadas.

### 1. Introduction

As a part of the International Skipjack Year Program, several countries undertook to examine stomachs of tunas and billfishes for the presence of skipjack (*Katsuwonus pelamis*). Japan was one of these countries. Preliminary results primarily from the northwest Atlantic Ocean have been reported by Nishikawa and Kikawa (1983). The objective of this work was to better describe the distribution of skipjack, particularly juvenile stages. Although the total number of predator stomachs examined was small (187), some information was gathered on which species of predators ate skipjack, and which of several areas around the Atlantic Ocean contained relatively more juvenile skipjack than others.

### 2. Materials and Methods

Tunas and billfishes were caught by the longline fishery mostly from four restricted areas of the northwest Atlantic Ocean (areas 1-4). A few were also collected from the east tropical to northeast temperate Atlantic (area 5), and one small area of the central south tropical Atlantic (area 6) (Fig. 1).

Stomachs were removed from predators aboard ship and stored at about -60°C for several months to over 1 year. The frozen stomachs were then thawed at the Far Seas Fisheries Research Laboratory and the contents were fixed in 10% formalin. Data requested with individual stomachs included vessel name, sampling date and position, predator species, sex, length and weight, and surface water temperature. Often some of these data were lacking. A total of 187 predator stomachs were available for analysis. (Table 1).

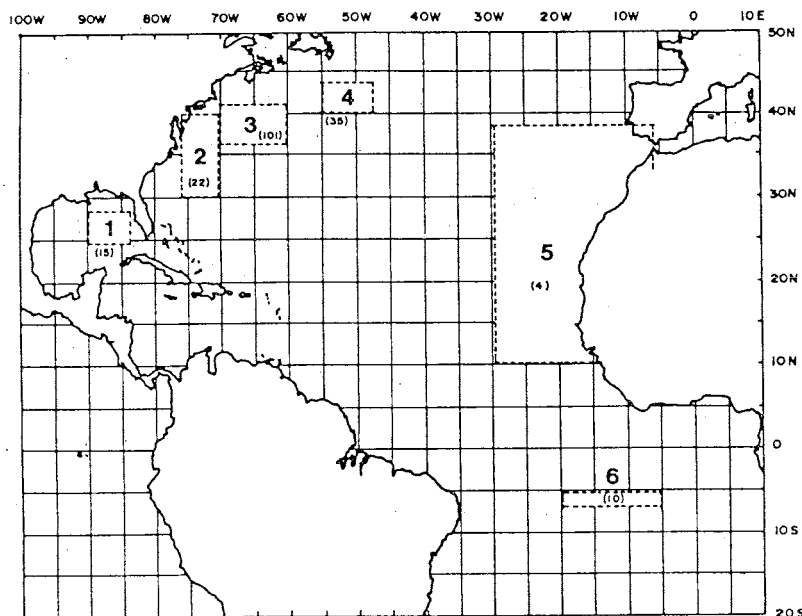


Figure 1. Areas 1-6 from which predator stomachs were collected, and the number of stomachs examined (in parenthesis) in each.

Table 1. Number of predators examined and number of skipjack, *Katsuwonus pelamis*, obtained (in parenthesis) by area and annual quarter.

Predator species:	Bluefin Tuna	Bigeeye Tuna	Yellowfin Tuna	White Marlin	Blue Marlin	Spearfish	Sailfish	Total	
Mean length:*	207	134	133	137	207	132	130		
Range:	90-237	100-168	72-170	107-160	185-235	120-160			
Area 1	March-May	15	0	0	0	0	0	15	
Area 2	June-Aug	0	3	6	1	0	0	10	
	Sep-Nov	1	8	2	0	0	0	11	
	Dec-Feb	0	1	0	0	0	0	1	
Area 3	June-Aug	1	21	13(3)	41(5)	3(3)	8(2)	1	88(13)
	Sept-Nov	0	0	5(2)	0	1(2)	1	0	7(4)
	Dec-Feb	0	5	1	0	0	0	0	6
Area 4	June-Aug	3	4	11	0	0	0	0	18
	Sep-Nov	1	14	1	0	1	0	0	17
Area 5	Dec-Feb	0	1	0	0	0	0	0	1
	March-May	2	0	0	0	0	1	0	3
Area 6	Dec-Feb	0	1	1	0	2(2)	0	0	4(2)
	March-May	0	0	0	0	6	0	0	6
Total		23	58	40(5)	42(5)	13(7)	10(2)	1	187(19)

\* Length of billfishes is eye-fork length (cm).

Juvenile skipjack (125 to 202 mm range in standard length) and adults (430 to 570 mm) from stomach contents were identified according to Kishinouye (1923), Godsil and Byers (1944), Yabe et al. (1958), Iwai et al. (1965) and Nakamura (1965). For identified specimens, the standard length was measured to the nearest millimeter unless it was heavily digested, in which case its length was estimated from the head, or occasionally, from the length of vertebral centra (Mori 1972a).

Numbers of skipjack observed in stomachs of different predators, or in predators caught in different areas or months, were compared with those expected on the basis of the total number of skipjack observed divided in proportion to the number of predators examined (i.e., total number skipjack/total number of predators  $\times$  number of predators of the species or in the area or months under comparison).

### 3. Results

Only 19 skipjack were recovered from the 187 predator stomachs. Seventeen were obtained from the northwest Atlantic Ocean (areas 1-4), of which 13 were juveniles. The remaining two, both adults, were taken from the south tropical Atlantic Ocean (area 6).

The various predator species were not caught in equal proportions from each of the different areas of the Atlantic Ocean. Therefore, before the geographical distribution of young skipjack could be examined, the question whether all the predator species were equally likely to eat the prey where it was available

needed investigation. Examination of predator stomachs from area 3 in the northwest Atlantic suggested that blue marlin (*Makaira nigricans*), yellowfin tuna (*Thunnus albacares*), white marlin (*Tetrapturus albidus*) and perhaps spearfish (*Tetrapturus pfluegeri*) frequently preyed on skipjack, whereas bigeye tuna (*Thunnus obesus*) apparently did not (Table 2). Nothing could be said about predatory habits of bluefin tuna (*Thunnus thynnus*) or sailfish (*Istiophorus albicans*), because only one individual of each species was sampled in this area.

Table 2. Skipjack occurrence from different predatory species for Area 3.

	Blue- fin	Big- eye	Yel- low- fin	White Marlin	Blue Marlin	Spear- fish	Sail- fish	Total
Number of predators	1	26	19	41	4	9	1	101
Number of skipjack:								
Observed	0	0	5	5	5	2	0	17
Expected	0.2	4.4	3.2	6.9	0.7	1.5	0.2	17.1

The four species which preyed on skipjack were caught in areas 2, 3 and 4 of the northwest Atlantic Ocean, and area 6 in the central south tropical ocean (Table 1). Therefore these areas could be compared for abundance of skipjack in stomach contents. Whereas areas 3 and 6 clearly were inhabited by young skipjack, there were none recovered in the stomachs of predators from areas 2 and 4, whereas about four would have been expected in total, based

on the number of skipjack predators examined from these areas (Table 3).

Table 3. Skipjack occurrence in different areas.

Areas	2	3	4	6	Total
Numbers of skipjack predators*	9	73	13	9	104
Skipjack prey:					
Observed	0	17	0	2	19
Expected	1.6	13.3	2.4	1.6	18.9

\* Skipjack predators include yellowfin tuna, blue and white marlins, and spearfish (see Table 2).

A possible reason for the absence of juvenile skipjack from stomachs of predators in areas 2 and 4 may have been that predators were captured in seasons when young skipjack were absent. An examination of the season records of skipjack predation in area 3 suggested that they were present at least from June to November (Table 4). In areas 2 and 4 predators were taken in the same seasons (Table 1). Therefore their absence in stomachs of predators in areas 2 and 4 likely reflects their absence in the environment of these areas.

Table 4. Skipjack occurrence in different seasons for Area 3.

	June/Aug	Sep/Nov	Dec/Feb	Total
Numbers of yellowfin, white marlin, blue marlin, and spearfish	55	7	1	63 <sup>a</sup>
Number of skipjack:				
Observed	13	4	0	17
Expected	14.8	1.9	0.3	17.0

#### 4. Discussion

The conclusion that skipjack appear to be eaten most frequently by blue marlin and seldom by bigeye tuna is the same as that reached by Mori (1972b) in his more comprehensive analysis of skipjack in stomachs of predators caught in the Pacific and Indian Oceans. Mori also concluded that skipjack were seldom eaten by bluefin tuna. In the present study, bluefin tuna were the only predator taken in area 1 and the chief predator in area 5 (only 2 specimens). The absence of skipjack in our samples from these areas therefore cannot be construed to suggest that young skipjack do not occur here, but simply that further data from other predator species are needed.

Indeed, further data are needed for all seasons from these areas. However, the recording of juvenile skipjack in the stomachs of predators during summer and fall months from the area extending as far north as 40°N, suggests that a further search for skipjack in commercial abundance during their seasonal migrations in the northwest Atlantic might well prove fruitful.

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