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Food habits of bait-caught skipjack tuna *Katsuwonus pelamis* off the Canary Islands*

ANTONIO G. RAMOS, JOSÉ M. LORENZO and JOSÉ G. PAJUELO

Departamento de Biología, Universidad de las Palmas de Gran Canaria, Campus de Tafira, 35017 Las Palmas de Gran Canaria, España.

SUMMARY: Stomach contents of skipjack tuna 46-70 cm in total length and caught off the Canary Islands by live bait between May 1988 and January 1991 were analyzed. Of the 400 stomachs examined, 33.7% (135) were empty. In the remaining stomachs (265), 59.4% of the prey were digested while 40.6% were undigested. All the undigested prey were consumed as live bait and consisted of chub mackerel *Scomber japonicus* (76.9%), sardine *Sardina pilchardus* (10.7%), bogue *Boops boops* (7.3%) and silverside *Atherina presbyter* (5.1%). Digested food was only chub mackerel. Of this prey, a part was consumed as bait (36.1%) and the remaining as natural food (63.9%). Adult skipjack were not found to feed on their young. Chub mackerel consumed as natural food ranged between 14 and 25 cm in total length. Skipjack 46-58 cm in total length fed on chub mackerel 14-19 cm while larger skipjack preyed on chub mackerel 18-25 cm. The percentage of body mass ingested by the skipjack was enough to sustain its condition index at an optimum level.

Key words: Skipjack tuna, *Katsuwonus pelamis*, food habits, Canary Islands.

RESUMEN: ALIMENTACIÓN DEL LISTADO *KATSUWONUS PELAMIS* CAPTURADO CON CEBO VIVO EN LAS ISLAS CANARIAS. – Se analizó el contenido estomacal de 400 ejemplares de listado de tallas comprendidas entre 46 y 70 cm de longitud total capturados a cebo vivo en las islas Canarias entre mayo de 1988 y enero de 1991. Del total de estómagos analizados, el 33.7% (135) estaban vacíos. En el resto (265), el 59.4% de las presas estaban en avanzado estado de digestión, mientras que el 40.6% estaban muy poco o nada digeridas. Las presas poco o nada digeridas fueron consumidas como cebo y consistieron en caballa *Scomber japonicus* (76.9%), sardina *Sardina pilchardus* (10.7%), boga *Boops boops* (7.3%) y guelde blanco *Atherina presbyter* (5.1%). Las digeridas eran sólo caballas, de las cuales un 36.1% fueron consumidas como cebo y el resto (63.9%) fueron predadas de forma natural. En ningún caso se observaron vestigios de canibalismo del listado sobre sus juveniles. El rango de tallas de las caballas consumidas de forma natural osciló entre los 14 y 25 cm de longitud total. Los listados de tallas comprendidas entre los 46 y 58 cm de longitud total predaron sobre caballas cuyas tallas oscilaron entre los 14 y 19 cm y los mayores sobre caballas de tallas comprendidas entre los 18 y 25 cm. El porcentaje de peso ingerido por el listado fue suficiente para mantener su índice de condición en un nivel óptimo.

Palabras clave: Listado, *Katsuwonus pelamis*, alimentación, Islas Canarias.

INTRODUCTION

Skipjack tuna *Katsuwonus pelamis* (LINNAEUS, c species found at depths ranging to 300 m. This highly migratory m and warm-temperate waters in the tropical and subtropical Atlantic, Pacific and Indian Oceans and adjacent seas (COLLETTE, 1981; 1984).

In the Canary Islands, a seasonal live-bait tuna fishery has been developing since 1950 at below maximum sustainable yield. The fishery is dependent on two species, the skipjack and the yellowfin *Thunnus albacares*. Although the annual catches of

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these species have shown a fluctuating trend, the skipjack is always the most important representing aproximately the 75% of the total catches of both species (MACÍAS, 1992).

Studies to date on the biology of skipjack off the Canary Islands describe its sexuality, reproduction, age and growth (SANTOS-GUERRA *et al.*, 1983; RAMOS, 1992). Published data on the feeding habits are not, however, available.

The objective of this paper is to provide information on the feeding habits of the skipjack off the Canary Islands. This data will be useful to derive conclusions on pelagic prey-predator trophic habits in the marine ecosystem of these islands.

MATERIALS AND METHODS

Samples of skipjack, in total 400 specimens ranging from 46 to 70 cm total length, were obtained fortnightly from commercial catches of the artisanal fleet at different fishing ports on the Canary Islands (Fig.1) between May 1988 and January 1991. The fish were caught by live-bait around the islands. Bait consisted of the sardine *Sardina pilchardus*, bogue *Boops boops*, chub mackerel *Scomber japonicus* and silverside *Atherina presbyter*.

The analysis of the samples was always done inmediately after landing. The total body length of the fish was measured to the nearest cm and the stomachs were removed and preserved in 70% ethanol.

The food bolus was weigthed to the nearest 0.1 g and the contents were identified to the species level. Undigested and digested prey items were identified by comparing the external characters and by examination of the otoliths and skeletal structures, respectively. The total length of the prey was taken to the nearest cm. In the case of the digested preys, the total length was calculated following the procedure described by PAWSON (1990). Stomach contents data were arbitrarily stratified into 4-cm groups based on skipjack total length.

The average duration of the fishing activity (4 hours from fishing to landing) and the gastric evacuation function of smelt fed were considered to separate the effect of fishing gear disturbance introduced by the bait on the stomach contents.

The daily ration, expressed as a percentage, was calculated by dividing the daily meal by the body mass. To evaluate the daily ration required to sustain the condition index at an optimum level, a relationship between the total weight of the skipjack caught off the Canary Islands and the theoretical weight for the same size range given by CAYRÉ and LALOË (1986) for this species in the northeast Atlantic was calculated.

RESULTS

Of the total stomachs examined, 135 (33.7%) were empty. In the 265 remaining stomachs (66.3%), 59.4% of the prey were digested and 40.6% were undigested.

On a mass basis, undigested prey were recorded as bait due to the low level of digestion, and consis-

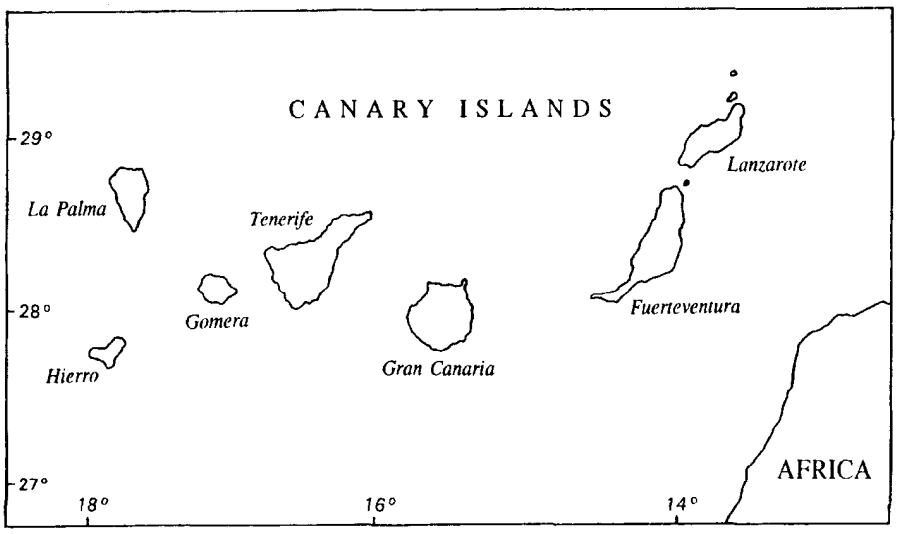

FIG. 1. – Map of the Canary Islands.

ted mainly of chub mackerel (76.9%), followed by sardine (10.7%), bogue (7.3%) and silverside (5.1%).

Digested food consisted only of chub mackerel. Of this prey, 36.1% was consumed as live bait and the remaining percentage (63.9%) was natural food (Fig.2).

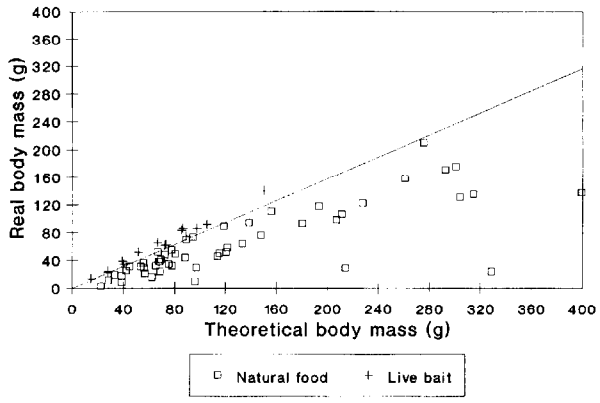

FIG. 2. – Relationship between the theoretical body mass and the real body mass of *S. japonicus* recovered from the stomachs of *K. pelamis* off the Canary Islands. A gastric evacuation period of four hours (solid line) was used to separate the prey consumed as natural food from those consumed as live bait.

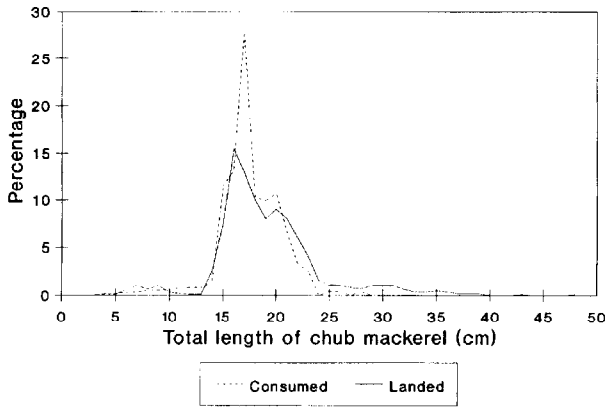

FIG. 3. – Length frequency distributions of *S. japonicus* consumed by *K. pelamis* as natural food (broken line), and landed in the Canary Islands (solid line).

Chub mackerel consumed as natural food ranged between 14 and 25 cm in total length, mainly between 16 and 19 cm (Fig.3). Significant differences (t-test, $p<0.05$) in size of the chub mackerel preyed on by the skipjack smaller and larger than 58 cm were found (Fig.4). Skipjack 46-58 cm in total length ate chub mackerel 14-19 cm while larger

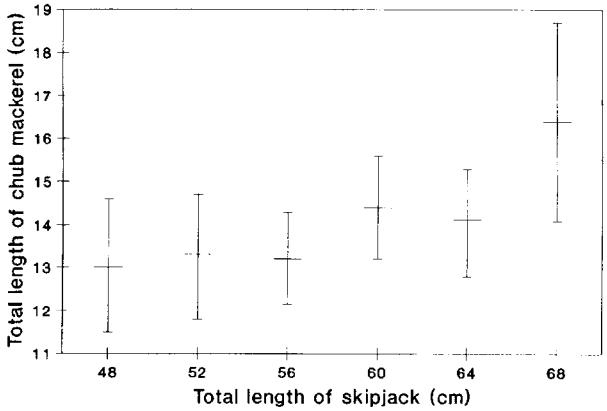

FIG. 4. – The mean (± standard error) total length of *S. japonicus* consumed as natural food by *K. pelamis* off the Canary Islands grouped into 4-cm size categories.

skipjack fed on individuals 18-25 cm. Trends reported for the biggest length group may not represent feeding habits of skipjack because the sample size was too small.

The average daily ration appeared to be 4.83% body wet mass. The relationship between the total weight of the skipjack off the Canary Islands and the theoretical weight for the same size range given by CAYRÉ and LALOË (1986) for this species in the northeast Atlantic is shown in Fig.5. The percentage of body wet mass ingested by skipjack was enough to sustain the condition index at an optimum level.

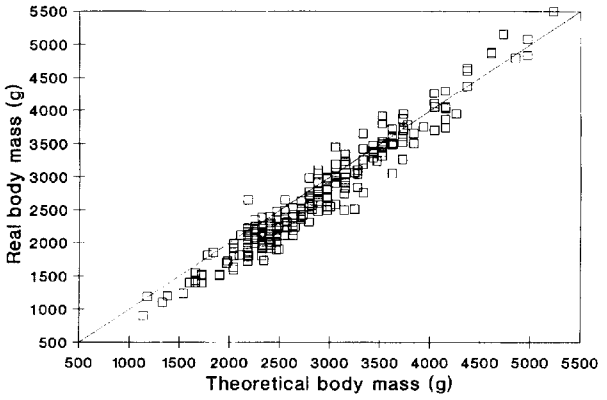

FIG. 5. – Relationship between the theoretical body mass and the real body mass of *K. pelamis* off the Canary Islands. The solid line represents the relation 1:1.

DISCUSSION

The multiplicity of prey found in different studies indicates that perhaps tunas are non-selective feeders and that stomach contents are probably

determined by prey availability (ALVERSON, 1963; BATTS, 1972; ANKEENBRANDT, 1985, 1986; AU, 1986). In the Canary Islands, the skipjack preys only on chub mackerel in natural conditions. This can be explained because of the abundance of this species in the area. On a mass basis, PASTOR and DELGADO DE MOLINA (1985) estimated using acoustic methods that the chub mackerel is the most important coastal pelagic fish in the waters off the Canary Islands, contributing 87% followed by the sardine (10%) and others (3%). In spite of the relative importance of the sardine, its absence in the diet of skipjack could be explained because it inhabits the area nearer to the coast than the chub mackerel 14-25 cm total length. The importance of fish as the main food of skipjack observed in this study has been previously reported in other areas (SUÁREZ-CAABRO and DUARTE-BELLO, 1961; DRAGOVICH, 1970; DRAGOVICH and POTTHOFF, 1972; ZAVALA-CAMÍN, 1982).

In the Canary Islands, skipjack feeds on chub mackerel 14-25 cm in total length. In this area, three groups of chub mackerel have been identified (LORENZO, 1992): small sized (4-13 cm total length); a medium sized (14-25 cm); and large sized (longer than 25 cm). Medium sized chub mackerel inhabit inshore waters, while small and large sized chub mackerel are found in shallow coastal waters and in deep offshore waters respectively (LORENZO, 1992). The occurrence of chub mackerel of 14-25 cm in the stomach contents is explained because they are available in inshore waters, where skipjacks are aggregating to feed (RAMOS, 1992; RAMOS *et al.*, 1995).

As it might be expected, a basic dietary change occurs as the skipjack grows. Skipjack 46-58 cm in total length feeds on chub mackerels 14-19 cm while larger skipjack eat individuals 18-25 cm. ALVERSON (1963), BATTS (1972), DRAGOVICH and POTTHOFF (1972) and ANKEENBRANDT (1985) also observed that a feeding change occured as the size of the skipjack increased.

The percentage of body mass ingested by the skipjack was enough to sustain the condition index at an optimum level. The feeding success suggests that more of the skipjacks had aggregated at the most favorable feeding site, where the oceanographic events provided the opportunity to quickly find a high concentration of chub mackerel (RAMOS *et al.*, 1995).

Although young skipjack have been observed in the stomach contents of the adults, no evidence of cannibalism was found in the Canary Islands area. It can be explained because the species does not spawn in the studied area and the young do not occur in these cooler northern waters (CAYRÉ and FARRUGIO, 1986). The northernmost distribution boundary for larval skipjack is the 24°C surface isotherm, located at 20°N (Cape Blanc).

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