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First record of skipjack tuna (*Katsuwonus pelamis*) from Dahab in the Gulf of Aqaba, Red Sea, Egypt

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ABSTRACT

The present study describes the first record of skipjack tuna, *Katsuwonus pelamis* (Linnaeus, 1758), from Dahab on the west coast of the Gulf of Aqaba, northern Red Sea. In the field, marine biologists photographed fish specimens and recorded the morphometric parameters for identification. Purse seines, line gear and longlines were the main fishing methods used to collect this fish. The skipjack tuna, *Katsuwonus pelamis*, is a member of Family: Scombridae and it was first observed in Dahab (Gulf of Aqaba, northern Red Sea) following its first detection in October 2021 by artisanal Bedouin fishermen at the start of the cooling trend of sea temperature in the region. The fish specimens were described, and their morphometric and meristic characteristics were investigated. This fish migrates from the Indian Ocean to the Red Sea via the narrow Strait of Bab El-Mandab. This migration is a new route for this fish species and it has been recorded for the first time in the Red Sea. The skipjack tuna is chiefly a scavenger, consuming a variety of creatures with different percentages. According to our findings, small fish (*Atherinomorus lacunosus*) is the most dominant and preferred food item consumed by *K. pelamis*, accounting for 79% of the total consumption food items. In conclusion, the first sighting of skipjack tuna, *Katsuwonus pelamis*, an epipelagic oceanic fish species in Egypt's Gulf of Aqaba, occurred in October 2021.

INTRODUCTION

The Red Sea, with a length of 2350 kilometers and a width of 350 Kilometers, is a long tube joining the Mediterranean Sea to the Indian Ocean. The width of the strait of Bab-El-Mandab is about 26 km and separates the Red Sea from the Indian Ocean via the Gulf of Aden. The northern tip of the Red Sea is separated into two gulfs, the Gulf of Suez and the Gulf of Aqaba. The adjacent land area of the Red Sea is mostly arid, having deserted or semi-desert regions with no major river inflow. Further inland, the desert regions are bordered by extensive mountain ranges **(Haddad & Douabul, 1999; Osman, 2000; Smeed, 2004; Abd El-Gaid, 2014; AL-Zahaby, 2015; Afifi, 2019** and **Abdelhak, 2021).**

Gulf of Aqaba is narrow (14 - 26 km in width) but it has steep sides that descend near its center to almost 2000 m. Even at its narrow (6 km) entrance (Strait of Tiran). Its water depth is about 250 meters. Surface water circulation is generated by tidal water influx from northern part of the Red Sea, as well as by prevailing north-east winds **(Salem, 1999)**.

The Bab El-Mandeb is among the most vital straits in the world, located at the southern end of the Red Sea and linking it to the Gulf of Aden and the Indian Ocean. Bab El-Mandeb is a narrow and shallow channel, with the shallowest point (Hanish Sill, about 160 meters deep) at the northern end and the narrowest point (Perim Narrows) at the southern end, with a width of about 25 kilometers and a depth of about 220 meters **(Johns & Sofianos, 2012)**. It is also a tidal transition zone between two distinct tidal regimes: the Red Sea, where tidal variations are mostly semidiurnal and have a range of less than 1 m; and the Gulf of Aden, where tides are mixed and have a range of over 2 m **(Jarosz *et al.*, 2005)**. Even though the evolutionary processes driving the rates of endemism are unknown, the Bab El-Mandab's short (18 km) and deep (137 m) strait, the only connection to the Indian Ocean, is believed to have had a major effect (**Klausewitz, 1989**). Hypothesis which is supported the appearance of a variety of organisms in the central/northern Red Sea and the Gulf of Aden (just beyond the Red Sea) that are missing from the southern Red Sea supports this notion **(Roberts *et al.*, 1992** and **Di Battista *et al.*, 2013).**

Skipjack tuna (*Katsuwonus pelamis*) is a top commercial fish, collected periodically in subtropical and tropical regions of the Atlantic, Indian, and Pacific oceans, as well as tropical waters between 15 and 30 degrees Celsius. The western and central Pacific Ocean (WCPO) supplied more than 70% of the skipjack tuna (*K. pelamis*) catches caught with purse seines in water **(Hermida *et al.*, 2018** and **Bintoro *et al.*, 2021).** The tuna resources in the Indian Ocean are plentiful. The Indian Ocean's tuna resources are abundant. Fishing for tuna in FMA 573 (Fisheries Management Areas in the Indian Ocean; South of Java, Bali, and Nusa Tenggara) is currently accomplished with different types of fishing gears including: longlines, lines, poles, and trolling lines. FADs (fish aggregating devices) are additional fishing equipments that are used in conjunction with trolling lines, poles, and lines to simplify fishing. Skipjack is caught using a variety of gear in the Philippines and Indonesia, where small but important artisanal fisheries for skipjack and other tuna rely mostly on trolling and traditional techniques **(Nurani *et al.*, 2018)**.

The skipjack tuna (*K. pelamis*) is a mesopredator fish with seasonal prevalence and little life-history knowledge. It is a highly migratory fish species that may be found in subtropical and tropical seas, the primary fishing area for tuna purse-seine fisheries, with skipjack making up the majority of the catch **(Chang *et al.*, 2022)**. Tunas are thought to be predators and opportunistic eaters in general. The presence of caridean prawns, *Leptochela* sp., and *Thalassocaris* sp. in guts of skipjack tuna was recorded as main types of food indicating the quantity of this prey and its ease of access **(Sivadas & Wesley, 2007)**. Skipjack tuna primarily consumed small fish, mollusks, and crustaceans **(Batts, 1972)**. Tunas, like other members of the family Scombridae, are mostly heterosexual and it doesn't change sex very often **(Schaefer, 2001)**.

As a result, the current study focused on the first record of skipjack tuna, *Katsuwonus pelamis* (Linnaeus, 1758), from Dahab on the west coast of the Gulf of Aqaba, Red Sea.

MATERIALS AND METHODS

1. Samples collection:

A total of nine specimens of skipjack tuna, *Katsuwonus pelamis* Linnaeus, 1758 **(Fig. 1)**, were collected from Dahab on the west coast of the Gulf of Aqaba (**28°26'47.67"N, 34°31'22.58"E**) during February 2022. Fish specimens were photographed in the field and marine biologists recorded the morphometric measurements for identification. Purse seines,

line gear, and longlines were the main fishing methods used to collect the fish. Wherever possible, fish were examined fresh or preserved in an icebox and transported to the Laboratory of Fishes at the Animal House, Zoology Department, Faculty of Science, Al-Azhar University, for latter examinations. In the laboratory, fish were identified according to **FAO (1983)**. Total and standard lengths were measured to the nearest millimeter and recorded. The fish were also weighed to the nearest 0.1 g and then the following measurements were conducted.

2. Morphometric and meristic characters:

To study morphometric and meristic characters of fish**,** the following measurements were recorded according to **Hubbs & Lagler (1964)** and **Holden & Raitt (1974):**

2.1. Morphometric characters: (Fig. 2)

1. Total length (**TL**): Length from the tip of snout to the end of the caudal fin.
2. Forked length (**FoL**): Length from the tip of snout to the origin of the caudal fin.
3. Head length (**HL**): length from tip of snout to the posterior margin of operculum.
4. Snout length (**SnL**): Distance from the upper jaw to the anterior margin of the eye.
5. Eye diameter (**ED**): Horizontal diameter of the eye.
6. Body depth (**BD**): The greatest depth of the body.
7. Dorsal fin length (**DFL**): The length of dorsal fin from base to tip.
8. Pectoral fin length (**PFL**): Distance between the bases of pectoral to end of free tip.
9. Pelvic fin length (**PvFL**): The length of pelvic fin from base to tip.
10. Anal fin length (**AFL**): The length of anal fin from base to tip.
11. Caudal fin length (**CFL**): Distance between the tips to the bases of caudal fin.
12. Caudal peduncle length (**CPL**): Length from the anus to origin of caudal fin.
13. Caudal peduncle depth (CPD): Width of the caudal peduncle
14. Basal dorsal fin length (**BDFL**): Width base of the dorsal fin
15. Basal spine dorsal fin length (**BsDFL**): Width spine base of the dorsal fin
16. Basal rays dorsal fin length (**BrSDFL**): Width rays base of the dorsal fin
17. Basal pectoral fin length (**BPFL**): Width base of the pectoral fin
18. Basal pelvic fin length (**BPvFL**): Width base of the pelvic fin
19. Basal anal fin length (**BAFL**): Width base of the anal fin
20. Pre-dorsal fin length (**PrDL**): Length from snout tip to anterior end of dorsal fin.
21. Pre-pectoral fin length (**PrPFL**): Length from snout tip to pectoral fin anterior end.
22. Dorsal pectoral Length (**DPL**): Distance between dorsal fin origin and pectoral fin origin.
23. Pelvic anal length (**PvAL**): Distance between pelvic fin origin and anal fin origin.

2.2. Meristic characters: (Fig. 2)

1- Number of the dorsal fin spine (**D.F.S.**).
2- Number of the dorsal finlets (**D.Fl.**).
3- Number of the pectoral fin rays (**P.F.R.**).
4- Number of the pelvic fin rays (**Pv.F.R.**).
5- Number of the anal finlets (**A.Fl.**).
6- Number of gill rakers (**G.R.**) on the first gill arch.

Fig. (1): Photograph of skipjack tuna, *Katsuwonus pelamis*, collected from the Egyptian coast of Dahab, Aqaba Gulf, Red Sea during February 2022.

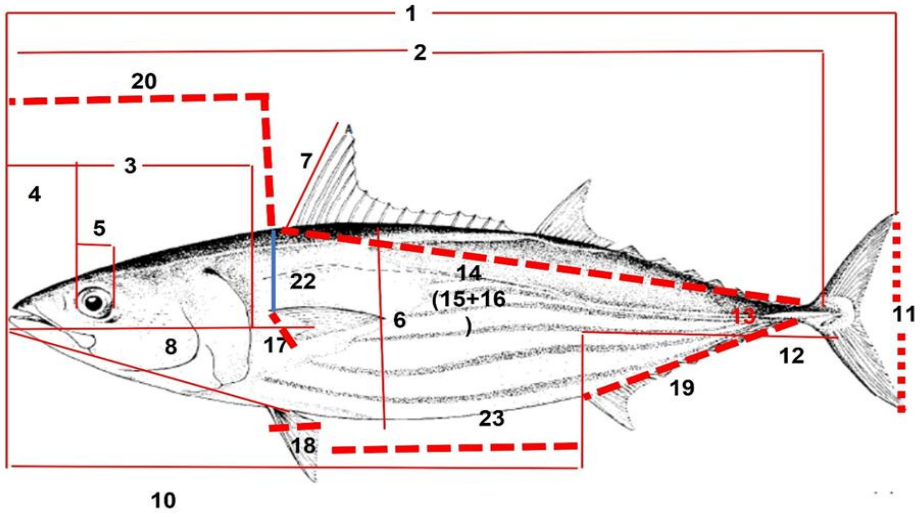

Fig. (2): Morphometric measurements of skipjack tuna (*Katsuwonus pelamis*) species used in this study. Morphometric Abbreviations: 1– **TL** (Snout–caudal fin end), 2– **FoL** (Snout–caudal fin origin), 3– **HL** (snout–operculum), 4– **SnL** (upper jaw–eye), 5– **ED** (diameter eye), 6– **BD** (body depth), 7– **DFL** (dorsal fin length), 8–**PFL** (pectoral fin length), 9– **PvFL** (pelvic fin length), 10– **AFL**(Anal fin length),11– **CFL** (Caudal fin length), 12– **CPL** (Caudal peduncle length), 13–**CPD** (Caudal peduncle depth), 14– **BDFL** (Basal dorsal fin length), 15– **BsDFL** (Basal spine dorsal fin length), 16– **BrSDFL**(Basal rays dorsal fin length), 17– **BPFL** (Basal pectoral fin length), 18– **BPvFL**(Basal pelvic fin length), 19–**BAFL** (Basal anal fin length), 20– **PrDL** (Pre-dorsal fin length), 21– **PrPFL** (Pre-pectoral fin length), 22– **DPL**(Dorsal pectoral Length) and 23– **PvAL** (Pelvic anal length).

3. Food composition:

To study the food items, the numerical, frequency, and point assessment methods **(Osman *et al.*, 2013)** were carried out. After the dissection, each stomach was removed, washed with water, opened and its contents were flushed into a Petri-dish and examined under a low-power microscope. Food items were identified to the lowest possible taxonomic level. The occurrence percentage of each category was estimated and graphically represented for the studied species. The index of relative importance (IRI) of each food item was estimated according to the following equation (**Windell, 1971**):

$$\mathbf{IRI = F\% (N\% + P\%)}$$

Where: **F**= Frequency, **N**= Numerical, **P**= Point assessment.

RESULTS

The skipjack tuna, *Katsuwonus pelamis*, belongs to the Family: Scombridae and it was firstly observed in Dahab (Gulf of Aqaba, northern Red Sea) following its first detection in October 2021 by artisanal Bedouin fishermen.

Description with meristic characters:

Fusiform, elongated, and spherical body shape. Gill rakers are numerous, ranging from 53 to 63 on the first gill arches, and teeth are tiny and pyramidal. The pectoral fins are relatively long, with 26 or 27 rays; the inter-pelvic process is tiny and bifid; the anal fin is followed by 7 or 8 finlets; the dorsal fin is divided by a little interspace (not larger than the eye), the first part with 15 spines, the second part with 8 finlets. The corselet and lateral lines are the only scales on the body. Between the two lesser keels is a robust keel on every side of the caudal fin base. Lack of a swim bladder; the back is dark purple blue; the lower sides and belly are silvery with four long black lines appear as dark blotches in live fish specimens **(Table 1** and **Fig. 1)**.

Morphometric characters:

Results in **Table (2)** showed that the total length of *K. pelamis* ranged between 64.5 - 68.3 cm and fish weight ranged between 4095 – 4444 g. The forked length attains 86.36-90.19% (average 87.99±1.14) of the total body length. Body depth attains 23.21-28.19% with an average of 25.48±1.45 of the fork length. Head length ranged between 32.79-35.73% (average 34±0.88) of the fork length. Snout length ranged between 29.14-31.19% (average 30.38±0.63) of the head length. Eye diameter fluctuated between 14.65-15.84% (average 15.35±0.36) of the head length.

Dorsal fin length ranged between 15.75-18.13% (average: 16.82±0.69) of fork length. Pectoral fins length varied from 16.56-17.09% (average: 16.90±0.17) of the fork length. Pelvic fins length ranged between 12.38-13.64% (average: 13.07±0.36) of the fork length. Anal fin length fluctuated between 10.23-11.13% (average: 10.73±0.26) of the fork length. Caudal fin length attains 27.43-31.95% with an average of 30.23±1.41 of the fork length. Caudal peduncle length ranged between 35.55-40.75% (average: 38.52±1.54) of fork length. Caudal peduncle depth fluctuated between 14.54-16.41% (average: 15.62±0.56) of fork length. Basal dorsal fin length varied from 62.82-65.35% (average 63.71±0.82) of the fork length. Basal spines dorsal fin length ranged between 25.65-27.28% (average 26.44±0.47) of the fork length. Basal rays dorsal fin length ranged between 32.14-34.34% (average 33.59±0.72) of the fork length. Basal pectoral fins length ranged between 5.02-5.19% (average 5.09±0.05) of the fork length. Basal pelvic fin fluctuated between 3.41-5.19% (average 4.45±0.53) of the fork length. Basal anal fin length varied from 26.29-29.44% with an average of 27.66±0.93 of the fork length. Pre-dorsal fin length ranged between 35.38-38.24% (average 37.29±0.95) of the fork length. Pre-pectoral fin length fluctuated between 35.71-39.13% (average 37.58±1) of the fork length. Dorsal pectoral length ranged between 22.24-27.28% (average 25.02±1.48) of the fork length. Pelvic anal length ranged between 33.44-38.42% (average 35.45±1.51) of the fork length **(Table 2)**.

Table (1): Meristic characters of skipjack tuna, *K. pelamis*, collected from the Egyptian coast of Dahab, Aqaba Gulf, Red Sea during February 2022.

DFS	DFl	PFR	PvFR	AFl	GR
15	8-9	26-27	24	7-8	53 - 63

Abbreviations according to that recorded in materials and methods

Table (2): Descriptive statistics of morphometric characters (cm) of skipjack tuna, *K. pelamis*, collected from Egyptian coast of Dahab, Aqaba Gulf, Red Sea during February 2022.

Parameters	Minimum	Maximum	Mean	Standard deviation
W (g)	4095	4444	4273	174.61
TL (cm)	64.5	68.3	66.8	2.022
FoL/TL (%)	86.357	90.190	87.99	1.978
HL/Fol (%)	32.792	35.727	34.01	1.531
SnL/HL (%)	29.146	31.188	30.38	1.086
ED/HL (%)	14.647	15.842	15.36	0.628
BD/Fol (%)	23.214	28.187	25.48	2.515
DFL/Fol (%)	15.747	18.133	16.82	1.211
PFL/Fol (%)	16.558	17.090	16.90	0.297
PvFL/Fol (%)	12.388	13.636	13.07	0.633
AFL/Fol (%)	10.227	11.131	10.73	0.460
CFL/Fol (%)	27.435	31.957	30.23	2.444
CPL/Fol (%)	35.55195	40.754	38.52	2.678
CPD/Fol (%)	14.542	16.413	15.62	0.968
BDFL/Fol (%)	62.825	65.350	63.71	1.425
BsDFL/Fol (%)	25.649	27.289	26.44	0.821
BrSDFL/Fol (%)	32.143	34.346	33.59	1.257
BPFL/Fol (%)	5.027	5.195	5.10	0.086
BPvFL/Fol (%)	3.411	5.195	4.45	0.927
BAFL/Fol (%)	26.299	29.444	27.66	1.6138
PrDL/Fol (%)	35.390	38.241	37.29	1.646
PrPFL/Fol (%)	35.714	39.13824	37.58	1.734
DPL/Fol (%)	22.240	27.28905	25.03	2.565
PvAL/Fol (%)	33.442	38.42011	35.46	2.620

Abbreviations according to that recorded in materials and methods (Fig. 2)

Habitat:

The first sighting of skipjack tuna, *K. pelamis*, an epipelagic oceanic fish species in Dahab, occurred in October 2021 by artisanal Bedouin fishermen at the start of cooling trend in Aqaba Gulf, Red Sea. Specifically, it was observed off Laguna site in the central of Dahab at depths ranging from 400 to 600 m during the day. However, at night it ascends to the near sea surface (~ 5 m) for feeding. Adults can only be found in water with a surface temperature of at least 25°C. The total temperature range where they can be found is 14.7 to 30°C.

Convergence, the boundary between both warm and cold-water masses (i.e., the polar front), hydrographical discontinuities, and other upwelling are all common places for this

species to congregate. Early in the morning and late in the afternoon are the busiest times for feeding. Cannibalism is a frequent practice. Other billfishes and tuna are the main predators of skipjack. Purse seines and pole-and-line gear are used to catch skipjack tuna at the surface and longlines are also used inadvertently.

This fish migrates from the Indian Ocean to the Red Sea via the Bab El Mandab Strait. This migration is a new route for this fish and the first time it has been recorded in the Red Sea **(Fig. 3)**.

Fig. (3): Map showing the migration road of skipjack tuna, *Katsuwonus pelamis*, from Indian Ocean to Egyptian coast of Dahab, Aqaba Gulf, Red Sea.

Food habits:

K. pelamis is moderately fed and consumes a wide range of animal foods mainly of small fishes. Point assessment method showed that the stomach contains small fish, *Atherinomorus lacunosus* (94.87%) of the total prey items. Malacostraca (1.50%), Cephalopoda (3.46%), Copepoda (0.002%) and Amphipoda (0.15%) were the minor food items consumed by the fish **(Table 3** and **Figs. 4 & 5)**.

The relative importance of the different food items in the stomach of *K. pelamis* based on the point assessment method (P%), numerical method (N%) and occurrence method (F%) is given in **Table (3)** and shows that the fish is mainly a scavenger, consuming a wide range of animals with different percentages of food items; small fish, *Atherinomorus lacunosus*, are chiefly consumed by *K. pelamis*, with 10025.6 (79%) being the most dominant and preferable food items consumed by the fish. Cephalopoda 1581.8 (12%), Malacostraca 5.14 (5%), Copepoda 220.3 (2%) and Amphipoda 298.7 (2%) were the subsequent food items consumed by the fish **(Fig. 6)**.

Table (3): Index of relative importance (IRI) of stomach contents of skipjack tuna, *K. pelamis*, collected from the Egyptian coast of Dahab, Aqaba Gulf, Red Sea during February 2022.

Prey items	N	N%	F	F%	P	P%	IRI
Fish	126	55.51	6	66.67	6300	94.87	10025.6
Malacostraca	20	8.81	5	55.56	100	1.50	573.1424
Cephalopoda	46	20.26	6	66.67	230	3.46	1581.873
Copepod	15	6.61	3	33.33	0.15	0.002	220.3396
Amphipoda	20	8.81	3	33.33	10	0.15	298.7057
Total	227	100	9	255.56	6640.15	100	

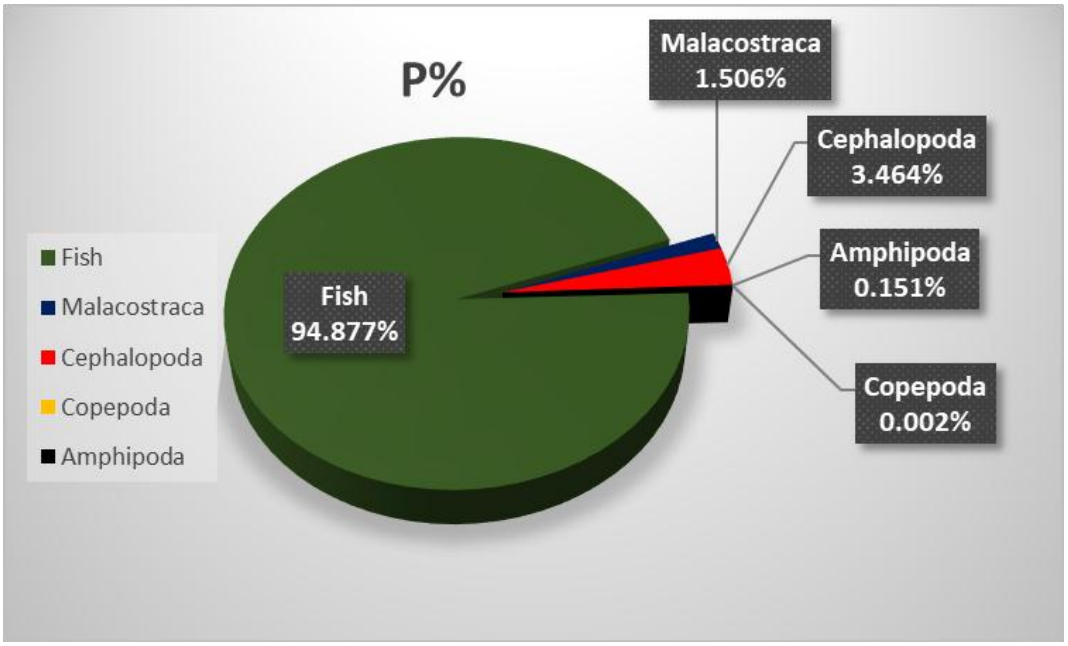

Fig. (4): Point assessment method (%) of various categories of food items of stomach content of skipjack tuna, *Katsuwonus pelamis*, collected from the Egyptian coast of Dahab, Aqaba Gulf, Red Sea during February 2022.

Fig. (5): Photograph of *Atherinomorus lacunosus* from prey items in stomach content of *K. pelamis*

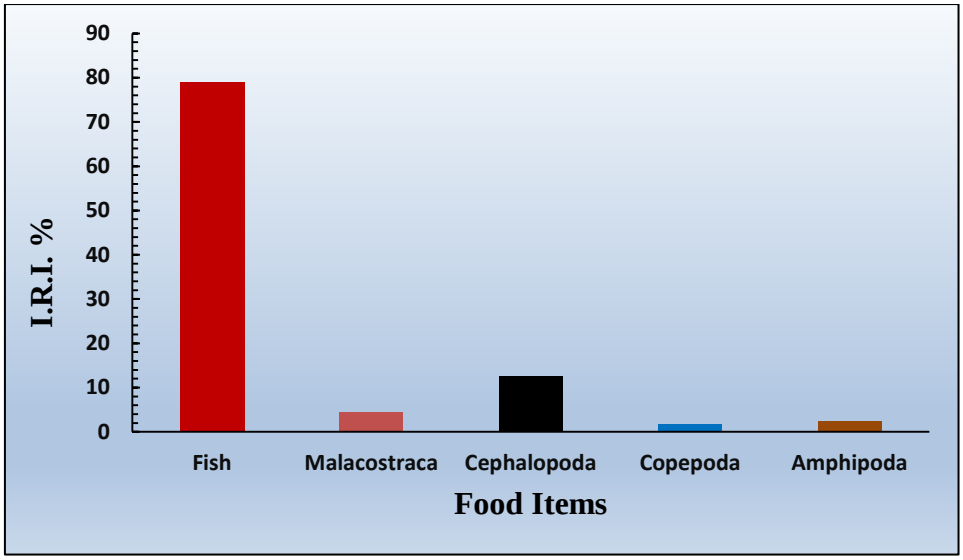

Fig. (6): Index of relative importance (I.R.I) of various categories of food items of stomach content of skipjack tuna, *Katsuwonus pelamis*, collected from the Egyptian coast of Dahab, Aqaba Gulf, Red Sea during February 2022.

DISCUSSION

The information about biology will make it easier for the fisheries managers to determine fish growth patterns, especially for skipjack tuna (*K. pelamis*). Some literature and papers explain that the biological aspects such as morphological characteristics, length-weight relationship, and the reproductive of skipjack tuna (*K. pelamis*) because of their high production and life history features, the skipjack tuna (*K. pelamis*) is considered a resilient species **(Júlia *et al*., 2019)**.

In this study, *K. pelamis* is recognized for its first record from Dahab on the west coast of the Gulf of Aqaba, northern Red Sea. **Saber *et al* (2015)** mentioned that tuna is a tropical species that inhabits warm waters worldwide. However, it is caught as bycatch of tuna fisheries in the Mediterranean Sea, whereas various fisheries target skipjack tuna in the three oceans. Many countries recognize this species as a valuable economic resource, and data on its fundamental life cycle characteristics, distribution, and captures are accessible. Nevertheless, data on this species in the Mediterranean Sea are rare.

During the day, skipjack depths extend from the sea surface to 260 m, whereas at night they are mostly restricted to the surface-mixed layer. Premature skipjack tuna deep dive throughout the day, displaying a recurrent bounce-diving activity to depths of 50–310 m, with vertical usage of the water column most likely connected to foraging. These findings are consistent with previous research by **Chang *et al* (2022)**.

In the present study, the total length of *K. pelamis* ranged between 64.5–68.3 cm and the fish weight ranged between 4095 and 4444 g. **Bintoro *et al* (2021)** found fish weight ranged between 2098 and 3012 g in the waters of Prigi, Trenggalek, East Java, Indonesia. **Chang *et al* (2022)** recorded fish weight between 800 and 3600 g in eastern and western Taiwan. Morphometric indices of traditional characteristics are used for the identification of

fish races and species **(Mekkawy, 1991** and **Soliman, 2005)**. In this study, the morphometric and meristic characteristics of *K. pelamis* were similar to those obtained by **FAO (1983)**.

In the current study, *K. pelamis* is chiefly a scavenger, consuming a variety of creatures with different percentages. The small fish (*Atherinomorus lacunosus*) was the most dominant and preferred food item consumed by *K. pelamis*, accounting for 79% of the total consumption food items. Similar results were recorded by **Batts (1972)**, who found that the major food item was fish, constituting small fish, (*Etrumeus sadina*), at more than 50%, and this is contrary to what was found by **Sivadas & Wesley (2007)** as they found that the stomachs of tuna were full of prawns as a major food item. In the Indian Ocean, **Roger (1994)** found that all guts of sampled tunas from sets under FADs before sunrise were empty.

The Bab El-Mandeb Strait is a narrow waterway with a rather small depth that is responsible for its steep shelf structure with depths of less than 50 m. This causes the tidal oscillations of the level in the Strait of Bab El Mandeb to be of a mixed character, being affected by tides of the Red Sea and appearing as co-oscillations with tides of the Gulf of Aden. It is possible that the skipjack tuna *Katsuwonus pelamis* found in the Indian Ocean doesn't cross the Bab El-Mandeb Strait to the Red Sea due to the structural characteristics of the strait and the lack of depth **(Jarosz *et al.*, 2005; Androsov & Voltzinger, 2008** and **Johns & Sofianos, 2012)**. Recently, the skipjack tuna *Katsuwonus pelamis* crossed the Bab El-Mandeb Strait and migrated to the Red Sea and the Gulf of Aqaba in small groups.

In conclusion, the first sighting of skipjack tuna, *Katsuwonus pelamis*, an epipelagic oceanic fish species in Egypt's Gulf of Aqaba, occurred in October 2021.

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