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Opportunistic dietary nature of Yellowfin tuna (*Thunnus albacares*): Occurrence of polythene and plastic debris in the stomach.

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Abstract

A total number of 112 stomachs of Yellowfin tuna (*Thunnus albacares*) were analyzed. The total length range of the observed yellowfin tuna was 40-150 cm with the mean length being 107.5 cm and weight range being 10-86.5 kg. The diet of yellowfin tuna around Sri Lanka comprised of a variety of food items such as fish (51.75 %), squids (34.5%), crabs (4.5%), shrimps (7.5%) and debris (1.75%). The great diversity in the food composition was represented mainly by some families of teleost fishes, then cephalopods and crustaceans, which indicate that they are non-selective feeders and that feeding depends on prey availability rather than selectivity. The present study reports the ingestion of debris such as plastic and polythene by yellowfin tuna (*Thunnus albacares*) in the Indian Ocean.

Introduction

The fisheries sector plays an important role in the Sri Lanka economy. The offshore and high sea fish production is dominated by tuna and tuna like fish (Hasarangi et. al., 2012). Oceanic tuna resources in Sri Lanka mainly consist of yellowfin tuna (*Thunnus albacares*), big eye tuna (*T. obsesus*) and skipjack tuna (*Katsuwonus pelamis*). According to the (MFARD, 2014) the annual catch in 2012 of the two major oceanic tuna species, yellowfin and skipjack were 42, 780 Mt and 53, 410 Mt respectively. Yellowfin tuna is the second most important fish catch in Sri Lanka. The good quality yellowfin tuna mainly targets the export market. A range of fishing gears is being used in capturing tuna and tuna like fishes (Haputhantri and Maldeniya, 2011). The Yellowfin tuna (*Thunnus albacares*), considered as an apex predator, is a large pelagic fish existing in the oceanic columnar waters and vigorously hunts for its prey. They are voracious feeders and actively prey on fish species, crustaceans and molluscs. The endurance of these apex predators depend on their effectiveness of finding prey-loaded areas in the locality of their environment (Sund et al., 1981; Bertrand et al., 2002).

Numerous studies have been carried out in different parts of the world to bring together information on food and feeding habits of yellowfin tuna (*Thunnus albacares*); the world's tropical and sub-tropical oceans, specifically in the Pacific Ocean. In the Indian waters observations on the food of yellowfin tunas caught on longline gears have been reported by Sudarsan et. al., (1991), Rohit et. al., (2010). Some other studies have shown yellowfin tuna caught from gillnets and longline gears in Sri Lanka (Maldeniya, 1996; Dissanayake et. al., 2008). Moreover, feeding habits of tuna in the Indian Ocean has been described around Andaman Sea, western Indian Ocean (Bram et. al., 2012). Food is an important factor influencing the growth, migration and abundance of the fish stocks. Information on the biological characteristics of this highly migratory species is valuable for assessing stocks for conservation and management for sustainable exploitation of the resources. Therefore, present study was undertaken to obtain information on the predatory pressure of yellowfin tuna on fish and other prey species.

Methodology

Gut samples of yellow fin tuna were collected from January to June 2015 during processing at the Ceylon Fresh Sea Food private limited, Ja-ela and from Chilaw and Negombo fish landing sites. Before collecting the gut samples, total length, standard length of each individual was measured to the nearest 0.1cm using a measuring tape. Gut samples were transported to the laboratory of Marine Biology Research Division at National Aquatic Resources Research and Development Agency (NARA) and kept frozen at -20 ^{0}C. Each Gut sample was thawed before analysis. The total weight of stomach contents was determined to the nearest 0.01g using an electronic balance.

Stomach fullness was visually categorized into five groups as full (1), three-fourth full (3\4), half full (1\2), one-fourth (1\4) full and empty (0), based on the enlargement of the stomach due to the presence or absence of food.

The recognizable prey items were categorized into wide prey classes (fishes, crustaceans, squids and others), which were weighed to estimate their proportions by wet mass in the diet. The identifiable prey items were categorized to the lowest possible taxon. Prey items were measured using standard length (SL in cm) for fishes, the mantle length (in cm) for cephalopods, and carapace width for pelagic crabs.

Results and Discussion

The size distribution of the yellowfin tuna stomachs collected from the processing factory ranged from 105- 155 cm in total length with the mean length of 107.5 cm and stomach samples collected from fish landings ranged from 40- 98 cm in total length (Figure 1). Of the observed specimens in all the 112 tuna stomachs analyzed, 20 (18 %) were empty while 92 (82%) stomachs were with food. Visual inspection of the distension of tuna stomach showed that proportion of full, three fourth full, half full, one fourth full, empty was 35 %, 9 %, 11 %, 27%, 18 % respectively (Figure 2). Dominant prey species observed in the stomach contents of *T. albacares* are shown in appendix 1.

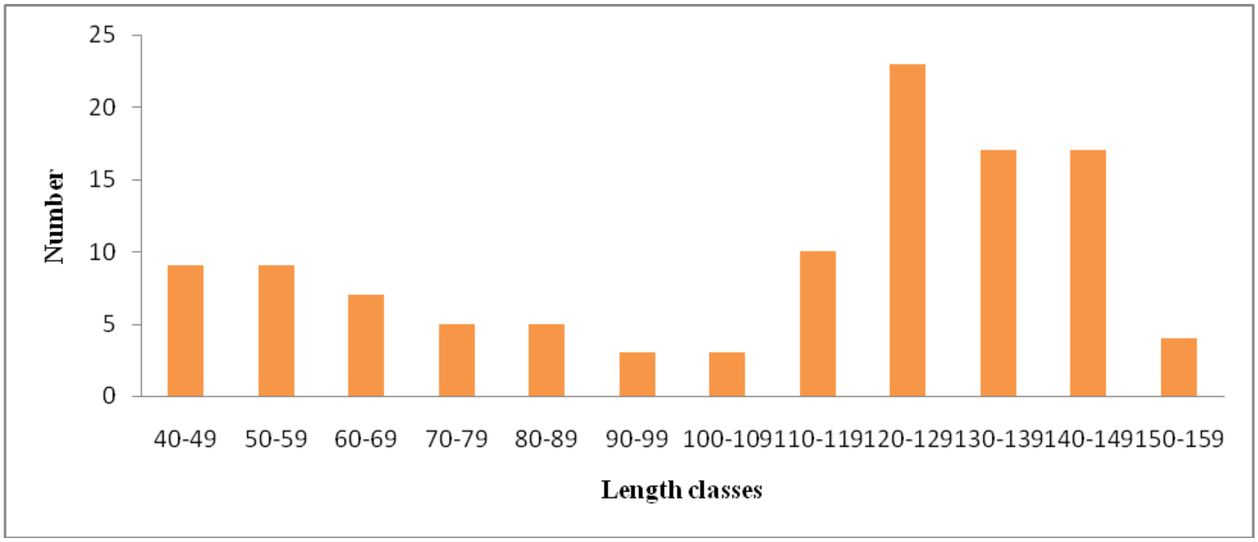

Figure 1: Number of yellowfin tuna by size classes

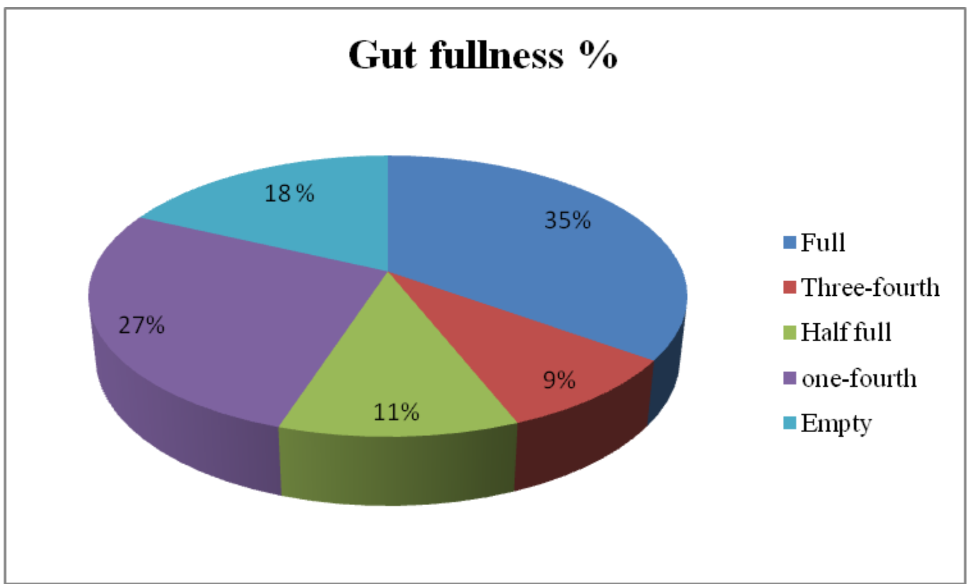

Figure 2: Gut fullness of the Yellowfin tuna

The great diversity in the food composition was represented by about 10 families of teleost fishes, crustaceans and cephalopods, which indicate that they are non-selective feeders and that feeding depends on prey availability rather than selectivity. Basically tunas are opportunistic predators and feed on a great variety of suitably sized fishes, crustaceans and squids (Bram et al., 2012). Some other studies, Kornilova (1981) also observed that fishes were the most important prey by weight for yellowfin tuna in the equatorial zone of the Indian Ocean. Moreover, Alverson (1963) also recorded that the major food items in the stomach contents of yellowfin tuna collected from the eastern tropical Pacific area was fish (46.9% of total volume), crustaceans (45.4%) and cephalopods.

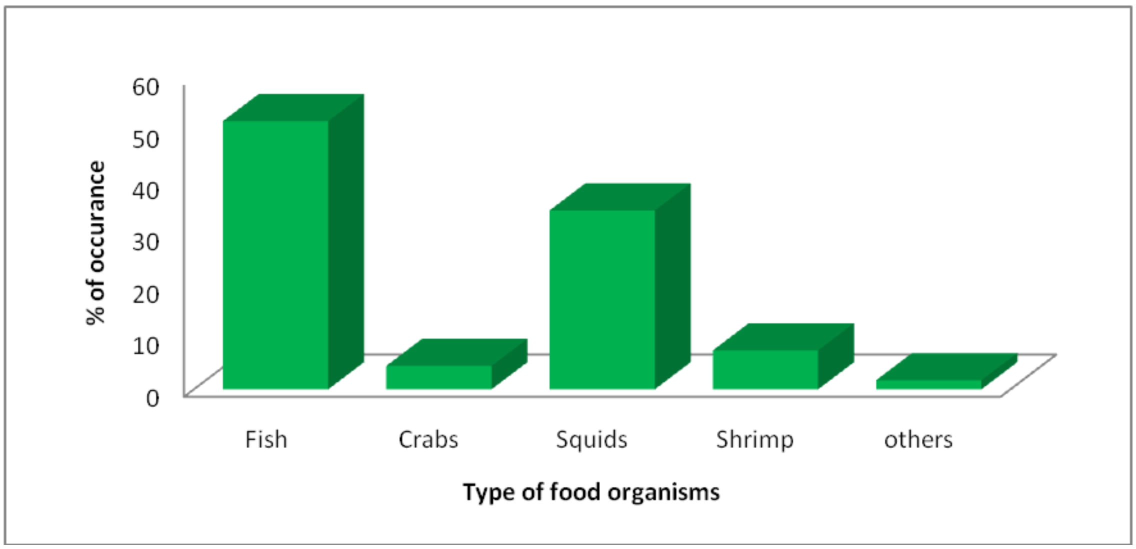

Table 1: The observed stomach content

Prey category	**Species**	**Average length of prey item (cm ±SD)**	**Average weight of prey item (g ±SD)**
Fish			
Coastal			
Clupeidae	*Amblygaster sirm* *Sardinella sp*	16.2±1.5 13.7±1.1	86.17±4.5 50±2.2
Caesionidae	*Caesio sp*	12.5±.75	40±1.1
Engraulididae	*Stolephorus sp* *Stolephorus indicus*	3.89±0.423 14±3.80	2.64±0.479 19.83±10
Leiognathidae	*Leiognathus sp*	9.25±3.89	10.27±8.51
Lutjanidae	*Lutjanus sp.*	14.75±.8	43.5±4.2
Offshore			
Carangidae	*Decapterus sp.*	17.7±5.15	81.64±62.3
Exocoetidae	*Exocoetus sp*	16.2±4.15	38.48±27.1
Scombridae	*Rastrelliger kanagurta* *Katsuwonus pelamis* *Auxis thazard*	17.72±3.70 15.7±2.2 24.58±3.75	88.54±3.8 79.3±2.5 184.5±69.7
Sphyraenidae	*Sphyraena jello*	60±3.9	164.06±3.2
Trachiuridae	*Trichurus sp.*	28.3±1.7	47.5±2.5
Cephalopods			
Teuthoidea	*Loligo duvauceli*	20.25±	81.52±
	Loligo (Dryteathis) singhalensis	8.72±4.197	14.7±13.55
Sepiidae	*Sepia pharaonis*	10±1.41	10.62±5.47
Crustaceans			
Shrimp	*Peneaus sp.*	4.8±0.316	2.54±1.281

Present study also found the accumulation of squid beaks in stomachs of *T. albacares*, which were useful in determining the food item diversity. These beaks are resistant to digestion by apex predators and continue to gather in the stomachs long after the muscle tissues have been digested (Rohit et al., 2010).

Conclusion:

Although the samples analyzed in the present study is limited; it reveals some extent of pollution in the offshore/deep sea marine environment. The gut content of the yellowfin tuna caught from offshore/deep sea showed polythene packets and plastic lids, which may be due to feeding scarcity or were mistakenly taken in to the body. Marine plastic/synthetic debris extensively affects marine wild life and biodiversity. Various studies have shown the effects of plastic/synthetic debris/waste in marine mammals, sea turtles through entanglement and ingestion. Furthermore, some researchers have shown that presence of plastics in digestive tracts of the fish can reduce the fish's feeding force and lead to ultimate starvation. The most destructive effect is degraded plastic compounds getting trapped/ blocked in the intestinal tract. Therefore, more research towards the effects of plastic/synthetic debris on the marine environment and fishes is recommended.

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Appendix 1: Major food items and plastic materials observed in the stomach contents of *T. albacares.*

Rastrelliger kanagurta

Auxis thazard

Sepia pharaonis

Penaeus sp

Cephalopode beaks

Exocoetus sp

Polythene and plastic found in Yellowfin tuna gut