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FOOD AND FEEDING HABITS OF YELLOWFIN TUNA *THUNNUS ALBACARES* (BONNATERRE, 1788), CAUGHT BY HANDLINE AROUND PAYAO IN THE MORO GULF

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TABLE OF CONTENTS

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1. INTRODUCTION

The tuna fishery has become a major fishery of the country in the past few years in terms of production and export of marine fishery products. Production has increased significantly from around 25,000 metric tons in 1973 to about 261,000 mt in 1984 (BFAR, 1984). In 1984 the tunas contributed 17% to the total marine fishery production, of which 26% came from yellowfin tuna alone. In the same year tuna export reached 36,029 mt valued at about 1 billion pesos. This volume of tuna export consisted of 13,387 mt frozen, 22,259 mt canned, and 43 mt dried tuna valued at 259, 736, and 1 million pesos, respectively.

There are 21 species of tuna and tuna-like species recorded to have occurred in the Philippine waters (Herre, 1953). Of this number, six are exploited commercially namely: yellowfin tuna (Thunnus albacares), bigeye tuna (Thunnus obesus), skipjack tuna (Katsuwonus pelamis), frigate tuna (Auxis thazard), bullet tuna (Auxis rochei) and kawakawa (Euthynnus affinis). Of the commercial tuna species, yellowfin, skipjack and bigeye in that order are the most important because of their high export demand and value.

The major fishing grounds of the country, where more than 10,000 mt of tunas are caught annually, are the Sulu Sea, Bohol Sea, Moro Gulf, Cuyo Pass, Visayan Sea, and Guimaras Strait. The major fishing gears used in these areas are purse-seine, ringnet and handline which are operated with the use of an indigenous fish aggregating device (FAD), the payao. Almost all fishing operations in these major fishing grounds are undertaken with the use of payao. As a result of the productive tuna fishing around payao, the Philippines has become the number one tuna producer among the countries facing the South China Sea (Aprieto, 1980).

The payao is usually made of bamboo but some structures are made of steel for longer life. The use of payao proved to be a very effective tool in catching pelagic fishes. It attracts and aggregates foodfishes, thus making them also vulnerable to adult yellowfin tunas which need not pursue their prey and select their food.

Larger sizes of yellowfin tuna and bigeye tuna are caught by handline. Catches of ringnet and purse-seine using payao include juvenile tunas (20-25 cm) such as yellowfin, skipjack, bigeye, kawakawa, bullet and frigate (Ganaden et.al., 1982). Considerable amount of roundscads are also caught.

Yellowfin tunas are caught in all fishing grounds of the country (Figure 1). Table 1 presents the 1984 landings of yellowfin by statistical fishing area by gear. Moro Gulf is the most productive area, contributing 37% of the total landed catch that year. The most important gear used in capturing yellowfin tuna is the handline which accounts for 53% of the country's total yellowfin landings, 15,217 mt or 49% of which came from Moro Gulf.

Inspite of the importance of the tuna fishery, biological knowledge on the local tuna is still very inadequate.

Yesaki (1983) indicated that adult yellowfin tuna preys largely on juveniles of skipjack and yellowfin. These juvenile tunas as well as other vulnerable foodfishes could contribute a significant amount to the total fish landings if they are not preyed upon by adult yellowfin. Hence, this study is important in that it will provide the information necessary in determining the impact of predation on foodfishes by adult yellowfin tuna caught around payao as well as the effect on total fish landings as a result of predation on important juvenile fishes.

2. OBJECTIVES OF THE STUDY

This is a qualitative and quantitative study of the gut contents of yellowfin tuna caught by handline around payao in Moro Gulf to determine their food and feeding habits.

This study has the following specific objectives:

(1) To determine the composition and volume of the stomach contents of yellowfin tuna by sex and by size class;

(2) To estimate the daily consumption rate of male and female yellowfin tuna.

3. REVIEW OF LITERATURE

The study of stomach content has been an important field of activity in fisheries biology. However, almost all studies that have been done on the food intake of fishes were qualitative rather than quantitative, that is, biologists have described the occurrence of food found in the stomach only, but they have not described how much of each food species is eaten. Moreover, all previous studies on tunas have dealt on those caught without the use of an aggregating device such as the payao.

Kishinouye, as cited by Ronquillo (1953), studied the stomach contents of 141 specimens, mostly yellowfin, albacore and bigeye tuna. He found many deep-sea species of fish and some invertebrates. Nakamura as cited by Ronquillo (1953), also studied the stomachs of 57 yellowfin tuna from the Celebes Sea. He found 17 families of fishes in the stomachs of these 57 yellowfin tuna. Among the mollusks and crustaceans he found squids and stomatopods, respectively. Most of the fishes he found belong to the following genera: Engraulis, Ostracion, Balistes, Sphyraena, Stolephorus and Leiognathus. Watanabe (1958) studied the regional differences in the food consumption of tunas and marlins from several oceanic areas and found that the food consumption varies from region to region. Chi and Yang (1971) studied the stomach contents of tunas in the waters southwest of Taiwan and revealed that the variety of food items was great from planktonic crustaceans to large fish and squids. They also found the stomatopods of the family Squillidae and squid as the major food items.

Magnusson (1969) worked on the digestion and food consumption of skipjack tuna and found that the fish eats an equivalent of about 8.6 percent of the body weight. He also found that the capacity of the stomach is about seven percent of the fish weight. Olson's (1982) work on the feeding and energetics of yellowfin tuna presented an estimate of the daily food consumption by yellowfin tuna in nature based on two independent methods 1) predicting the energy requirement of the fish based on an energy budget, and 2) estimating the daily meal utilizing stomach samples and measurements of the rates of food passage through the gut. He estimated that a yellowfin tuna in the 4+ age-class may eat on the average at least 730g of frigate tuna, 440g of rudderfish and about 233g of other prey per day.

Ronquillo (1953, 1962) studied the food habits of tunas and dolphins based on the examination of their stomach contents.

4. FISHING AREA AND FISHING GEAR

Moro Gulf (Figure 2) is one of the largest fishing grounds of the country and the most productive in terms of yellowfin tuna. It is situated in Southern Mindanao, bounded by Basilan Island on the west and Saranggani Island on the east, or approximately between 5° 45' "N, 121° 40' "E and 5°20' "N, 125°20' "E. The depth of the Gulf ranges from 1,600 m to 5,800 m. The bottom is generally muddy.

Handline is generally used to capture deep-swimming tunas, particularly yellowfin and bigeye tunas. In Moro Gulf, handlining is usually practiced while the banca is tied onto a payao. This gear is used throughout the Philippines, especially in Moro Gulf. From General Santos City alone, there are around 6,000 units of handline boats which operate in Moro Gulf. These handline boats are larger and higher powered than those used in other parts of the country. They are fitted with insulated boxes capable of holding 0.8 to 1.5 tonnes of iced fish (de Jesus, 1982). About five blocks of ice are used for each fishing operation/trip. This ice lasts a maximum of 6 days so these boats make 4 to 6 day trips depending upon the catch. A boat usually has a crew of 5 to 6 men.

Fishing operation is usually done by lowering the lines to varying depths ranging from 80 to 180 fathoms. Each fisherman lowers his line to various depths, one at 80 fm another at 100 fm, the others, at 120, 140, 160 and 180 fm. Once the depth of the highest concentration of fish has been located, all the lines are lowered or adjusted to that depth. Only one hook is used per line (Figure 3).

Payao is an anchored fish aggregating device made up of either bamboo or boxed steel plate with strings of coconut leaves suspended underneath (de Jesus, 1982) Payao is used to attract or aggregate small and large pelagic fishes which are caught by various fishing gears. Fishermen usually tie their boat onto the payao where handline fishing is usually done.

5. MATERIALS AND METHODS

In mid-February 1982, biological studies of yellowfin tuna were initiated at the facilities of the Dole Philippines, Inc. in General Santos City by the Japan Trust Fund Project "Investigation on the Indian Ocean and West Pacific Small Tuna Resources", in collaboration with the Bureau of Fisheries and Aquatic Resources (BFAR). Funds were provided by the project to hire two local persons to conduct sampling through March 1983. BFAR has continued the biological sampling program, with this thesis proponent as Study Leader of the programme.

This study, authorized by Atty. Reuben A. Ganaden, Project Leader, was a part of the Tuna Stock Assessment Research Project of the BFAR Fisheries Research Division.

5.1 Data Collection

Sampling was conducted at the receiving section of the Seafoods Department of Dole Philippines, Inc. at General Santos City. This company purchases large tunas, principally yellowfin, skipjack and bigeye, captured by handline fishermen who fish around payao. Collection of samples was done regularly every five days or a total of 6 to 7 sampling days per month, regardless of Saturdays, Sundays and holidays. Sampling was carried out for one year, from November 1983 to October 1984. Ten samples were taken randomly from the landed catch of the fishermen, regardless of the state of the stomach, and were preserved in 10% formalin solution. The two samplers of the BFAR Tuna Stock Assessment Research Project based at General Santos City were utilized in collecting the samples. Monthly monitoring of the samplers activities was done, during which time the samples were also analyzed.

Each sampling day the following information was recorded:

a) Fork length of the fish. This was measured from the snout to the cartilaginous tip of the shortest or median caudal fin ray.

b) Weight of the fish. This was taken to the nearest kilogram using the weighing scale of Dole Philippines, Inc.

c) Sex. This was determined visually.

d) Weight of the stomach. Stomachs were removed with incisions at the esophagus and intestine. They were individually wrapped in cheesecloth, labelled and preserved with 10% formalin in a bucket

Other relevant data/information was obtained through interviews with fishermen.

5.2 Samples Collected and Analyzed

Detailed examination of the stomachs was done in the laboratory. The weight of the preserved intact stomachs were taken before examination of the contents. Prey organisms were separated into species and/or species categories and identified to the lowest possible level. The number of each species and/or species category was recorded and total weight to the nearest gram was taken with an O-Haus, Dial-O-Gram balance. Organisms which could not be identified because of advanced stage of digestion were grouped and weighed as "digested".

A total of 620 stomachs of yellowfin tuna caught by handline were collected and analyzed; 403 of which were from males and 217 from females.

5.3 Analyses

The stomachs analyzed were summarized by sex and by size class to determine sexual and size differences in feeding habits. The stomach contents were categorized into prey, digested and chum. Prey consists of organisms found in the stomach which were indentifiable. Digested consists of food items which, through the process of digestion had been converted into a state which was beyond recognition. Chum consists of fleshy parts of small tuna or roundscad cut into small pieces which was thrown into the water by fishermen to lure the fish.

The contribution of the various categories in the diet of yellowfin tuna was determined using the formula:

IRI = (% N + % W) % F (Olson, 1982)
where: IRI = Index of Relative Importance
% N = Number percentage
% W = Weight percentage
% F = Frequency of occurrence percentage

In the computation of IRI, only the data on food items considered as "prey" were included. Chum and digested food were excluded in the analysis as they are considered artificial food items and unquantifiable, respectively (Shomura, pers. comm. 1/).

The difference in feeding between sexes was obtained by summarizing the stomach contents of the males and the females separately. To derive the food consumption per kilogram of predator, the average weight of the stomach contents was divided by the average weight of the fish in order to obtain comparable values.

The length measurements of sampled yellowfin were divided into four size classes: 100-115 cm, 116-131 cm, 132-147 cm, and 148-163cm to determine differences in feeding by size class. Likewise, the average weight of each length class was taken to get the food consumption rate per kilogram of predator within the size class to get comparable values.

The feeding rate (r) was determined using the equation:

r = W/A (Olson, 1982)
where r = rate of feeding
W = observed weight of stomach contents
A = area under evacuation curve, which is the average proportion of food remaining in the stomach over the evacuation time period

The value 4.69 which Olson (1982) determined from the feeding experiments he conducted with mackerel (Scomber japonicus) was used as the parameter A in calculating the hourly feeding rate. The feeding rate obtained using the A value derived from mackerel could be an underestimation as the mackerels are digested slower than most prey organisms (Yesaki, 1983).

Although tunas are generally considered to feed only during daylight hours (Reintjes and King, 1953), the daily meal was computed by multiplying "r" by 24 hours, as yellowfin under payao are assumed to feed at night as well as during the day (Yesaki, 1983).

An IBM PC micro-computer was used in the computation for the Index of Relative Importance (IRI) using programs of LOTUS 123, and for other statistical tests using the Microstat program.

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6. RESULTS AND DISCUSSION

6.1 Composition of stomach contents

Analysis of 620 stomachs taken from yellowfin tuna caught in Moro Gulf suggests a very high incidence of food considering that there were only four stomachs that were found empty.

The prey organisms consumed by yellowfin tuna consisted of fishes and invertebrates. The fishes belong to six orders, 24 families, 18 genera; only 12 were identified to species level. Of the invertebrates, four classess, four orders, six families and three genera were identified.

The fishes commonly encountered in the stomachs of yellowfin tuna were *Thunnus albacares*, *Katsuwonus pelamis*, unidentified species belonging to the families Balistidae, Tetraodontidae and Gempylidae, *Pseudobalistes fuscus*, *Decapterus* sp., *Auxis* sp., *Brama dussumieri*, and *Kyphosus* sp. The invertebrates were *Loligo* sp., *Argonauta* sp., and unidentified species belonging to the families Squillidae, Penaeidae and Brachyura. The taxonomic classification of the food items is presented in Appendix 1.

The contributions of the various categories in the diet of yellowfin, as determined by the values of Index of Relative Importance (IRI), are presented in Tables 2, 3 and 4 and Figure 4, 5 and 6 for sexes combined, females and males, respectively.

The ten most important food items, in the order of their IRI values for both sexes combined are *Katsuwonus pelamis*, *Thunnus albacares*, *Loligo* sp., unidentified species of the family Balistidae, cephalopod beaks, brachyurans, stomatopods of the family Squillidae, *Decapterus* sp., *Pseudobalistes fuscus*, and *Auxis* sp. For females, *K. pelamis* is the most important, followed by *T. albacares*, some species of the family Balistidae, *Loligo* sp., etc. For the males, the preferred food item is also *K. pelamis*, followed by *T. albacares*, *Loligo* sp., brachyurans, cephalopod beaks, etc.

6.2 Weight of stomach contents

The average weight of the males examined was 52.48 kg; that of the females was 40.33 kg. The meam length of the males was 136.9 cm and that of the females was 126.8 cm.

The average total weight of the contents per stomach was 419 grams for both sexes of yellowfin tuna. The monthly average total weight of stomach contents ranged from 244 g to 545 g; these values were recorded in June and September, respectively (Table 5). For male yellowfin tuna, the average total weight of contents per stomach was 427 g while that of females was 405 g. The highest average total weight of stomach contents for males was 634 g in September, and the lowest was 250 g in June (Table 6). The observed highest average total weight of stomach contents for females was 635 g in May and the lowest was 227 g in June (Table 7).

The food items found in the stomachs of both sexes are composed of 47% chum, 41% prey, and 12% digested food. The monthly average of chum ranged from 29% in November to 58% in January, while prey ranged from 25% in May to 55% in October. Digested food ranged from 7% in January, June and July to 22% in May (Figure 7).

The food items of female yellowfin comprised 37% prey organisms, 52% chum and 11% digested food. Prey organisms ranged from 13% in May to 58% in December and October; chum ranged from 32% in December to 67% in May and August; and digested food ranged from 5% in January to 20% in May (Figure 8).

The food consumption of male yellowfin comprised 43% prey organisms 44% chum and 13% digested food. The prey organisms ranged from 29% in March to 57% in September; chum ranged from 28% in November to 59% in January; and digested food ranged from 7% in June to 25% in March (Figure 9).

The monthly consumption of prey organisms shows that there is a variation in the intake of a particular prey by month in terms of weight (Table 8 and 9, Figure 10 to 12). For both sexes, juvenile yellowfin tuna was the main item in the diet, with values of 132 g and 158 g in September and October, respectively; and juvenile skipjack with values of 118 g and 112 g in November and December, respectively. Juvenile skipjack seems to be the preferred prey as it comprised the main item during most months, except in June and August, which may indicate the prevalence of the species in the area.

The high incidence of food organisms observed in the stomachs of yellowfin tuna may be attributed to the process by which handline catch was handled. The yellowfin captured by handline in Moro Gulf were placed in iced boxes in less than 15 minutes of hooking and kept there for 3 to 6 days, depending on the volume of the catch before landing. The fish are beheaded and gutted upon landing. Yesaki (1983) stated that the high volumes and fresh state of food organisms in the stomach indicated that regurgitation is minimal and that digestion is more or less arrested after death.

The daily meal of yellowfin tuna captured by purse-seine in the Eastern Pacific was found to be 642 g for a 12-hour feeding period (Olson, 1982). If feeding is assumed to occur throughout 24 hours or one entire day, then the quantity will be doubled to 1,284 g per day. The fish are usually enclosed in the purse-seine for a number of hours, frozen aboard the vessel and partially or completely thawed prior to unloading and butchering (Olson, 1982). Eggers (1977) stated that the tuna probably cease feeding once they are enclosed in a net and digestion continues at a reduced rate until the stomach is completely frozen.

It appears that the food consumption values for yellowfin vary. Yesaki (1983) partly attributed these varying values to the difference in the method of capture and the processing of stomach contents.

The average weight of contents in the stomachs of yellowfin tuna caught around payaos in Moro Gulf was 419 g. This is considerably higher than the amount found in stomachs of yellowfin captured by longline and troll line. The stomach contents of 118 yellowfins captured by both troll line and longline in the waters southwest of Taiwan averaged 94 g per stomach (Chi and Yang, 1971), while in the Central Pacific the average stomach contents of 101 yellowfin was 87 cc per stomach caught by longline (Hayashi and Mori, 1967).

The high food consumption of yellowfin tuna in Moro Gulf is probably influenced by the presence of the fish aggregating device, the payao. Prey organisms are attracted to and concentrated under the payao, thereby exposing them to large yellowfin tuna which prey on small fish. Adult yellowfin tunas feed continuously throughout the day, and possibly throughout the night, because of the unlimited food supply. Yellowfins are voracious eaters and are seemingly non-selective, that is, they eat any living organisms available (Ronquillo, 1951). This situation may partly explain the difference in food volumes between those captured under payaos and those from the open ocean. Other factors are regurgitation and digestion of food organisms (Yesaki, 1983).

The high incidence of food in the stomach of yellowfin during certain months of the year may be attributed to the tendency of the animal to take more food during spawning (Yamanaka, 1987). The tunas eat additional food even after their stomach is half-filled rather than empty (Magnusson, 1969). The presence of readily available food under the payao accounts for almost the same volume of stomach contents of both male and female yellowfin.

The variety of food items in the diet of the yellowfin is accounted for by the effectiveness of the payao to lure and aggregate fishes belonging to various groups which in turn attract larger animals, particularly tunas which are known to be predatory.

6.3 Differences in Feeding by Sex

The average weight of stomach contents was 8.1 g/kg for males, comprising of 3.5 g/kg of prey organisms, 3.6 g/kg of chum and 1 g/kg of digested food. For females, the average weight was 10 g/kg, comprising of 3.7 g/kg of prey organisms, 5.2 g/kg of chum and 1.1 g/kg of digested food (Figure 13). The highest average weight of stomach contents for males was 10.5 g/kg in July, while that of females was 15.8 g/kg in May. The lowest was observed in June for both male and female at 5.2 g/kg and 5.6 g/kg, respectively.

Inspite of these differences in the average weight of contents and consumption rate, this study revealed no significant difference in feeding of both sexes of yellowfin at 5% level of significance.

Yesaki (1983) and Chi and Yang (1971) also found no significant difference in consumption rates of male and female yellowfin tuna.

6.4 Difference in Feeding by Size Class

The weight of the stomach contents averaged 290 g for the 100-115 cm class, 327 g for the 116-131 cm class, 459 g for the 132-147 cm class, and 427 g for the 148-163 cm class for male yellowfin tuna. For female yellowfin, the average weights of stomach contents were 324 g for the 100-115 cm class, 406 g for the 116-131 cm class, 432 g for the 132-147 cm class, and 640 g for the 148-163 cm class (one fish only).

The average weights of stomach contents in grams for each kilogram of fish at length classes 100-115 cm, 116-131 cm, 132-147 cm and 148-163 cm were 10.67 g/kg, 8.56 g/kg, 8.17 g/kg and 6.28 g/kg, respectively, for the males; and for the females, 12.14 g/kg, 10.67 g/kg, 8.49 g/kg and 10.0 g/kg respectively.

The monthly consumptions in grams/kilograms of prey organisms, chum and digested food items by length class of male and female yellowfin are presented in Figure 14 and 15. The mean values for each food category by length class are likewise indicated.

Since most of the studies conducted on the feeding habits of yellowfin only differentiated feeding by sex, this study attempted to differentiate feeding by size class within the same sex. Previous studies showed no significant difference in feeding behaviour between male and female yellowfins caught in the open sea.

Most of the stomach samples analyzed were taken from yellowfins of 116-147 cm length class; only few from the length classes 100-115 cm and 148-163 cm which accounted for the variability in the food consumption values obtained. These values when subjected to statistical tests showed no significant difference between size classes in the males; however, for the females, the difference in food consumption was found significant at the 5% level between the 116-131 cm and 132-147 length classes.

6.5 Estimates of Prey Organisms Consumed

The average weight of food in all stomachs sampled was 419 g, consisting of 172 g prey organisms, 196 g chum and 51 g digested food. This gives a daily meal of 2,145 g comprising of 1,004 g chum, 878 g prey and 263 g digested food. It is estimated that an adult yellowfin tuna consumes 783 kg of food per year, of which 321 kg are prey, 366 kg chum and 96 kg digested food (Table 10).

One female yellowfin tuna consumes 756 kg of food per year, comprising of 280 kg prey, 392 kg chum and 84 kg digested food (Table 11), while one male yellowfin tuna consumes 798 kg of food per year, 342 kg of which are prey, 353 kg chum and 103 kg digested food (Table 12).

The volume of juvenile skipjack and yellowfin tuna consumed by an adult yellowfin in Moro Gulf is higher than those reported in other areas. This high consumption rate on juvenile skipjack and yellowfin may be attributed to the presence of payaos or fish aggregating devices deployed by fishing operators in areas where handlining is usually done. Juvenile skipjack, yellowfin and other small tunas and pelagic fishes are attracted and concentrated under the payao. The presence of an aggregate of these small pelagic fish in turn attracts large predators, particularly large yellowfin.

The principal prey organism consumed by female yellowfin were skipjack, followed by yellowfin and roundscad. A female yellowfin in the Moro Gulf consumes about 847 g of skipjack, 764 g of yellowfin, 298 g of roundscad, 80 g of frigate tuna, 57 g of other fish, 22 g of mollusk and 5 g of crustacea per day.

Skipjack was also the principal prey of male yellowfin. A total of 2,185 g of food, consisting of 980 g of skipjack, 763 g of yellowfin, 239 g of roundscad, 88 g of frigate/bullet tuna, 66 g of other fish, 46 g of mollusk and 3 g of crustacea, is consumed by a male yellowfin in one day.

Yesaki (1983) reported that the principal prey organism in the North Celebes Sea was yellowfin and that an adult yellowfin can consume, 1,060 g of juvenile yellowfin in one day. In the Eastern Pacific, frigate tuna (Auxis sp.) comprises 52% by weight of the food organisms of yellowfin (Olson, 1982).

Juvenile skipjack comprised 42% by weight of the tuna prey and 40% of the chum, while juvenile yellowfin comprised 38% by weight of the tuna prey and 36% of the chum.

Catches of juvenile skipjack, yellowfin and other small tunas by ringnets and purse-seines that operate around payao during the study period were also high (unpublished Progress Report of the Tuna Stock Assessment Research Project, 1984). Another small pelagic fish reported to be abundantly caught around payao are roundscads.

Yesaki (1983) found that the daily meal of yellowfin captured in the North Celebes Sea was 2,374 g for a 24-hour feeding period, slightly higher than the value of 2,145 g for an adult yellowfin tuna obtained in this study. This difference in weight may be a result of the different methods used to analyze stomach contents. That is, he analyzed the stomach contents in fresh condition, whereas in this study the stomach contents were preserved in 10% formalin solution.

7. SUMMARY

1. A total of 620 stomachs of yellowfin tuna taken from 403 males and 217 females were analyzed. Six orders, 24 families, 20 genera and 12 species of fish were identified. For the invertebrates, 4 classes, 4 orders, 6 families and 3 genera were identified.

2. Yellowfin females are smaller than the males. The largest female examined was 148 cm, whereas the largest male was 155 cm. The maximum length of Western Pacific yellowfin is about 155 cm for the female and 185 cm for the male.

3. The average total weight of stomach contents of male yellowfin was 427 g and that of the female, 405 g. The average total stomach contents of male yellowfin was 8.1 g/kg and that of the female, 10.0 g/kg. However, there is no significant difference in stomach content weights between sexes. The average weight of female yellowfin was 40.33 kg and the male, 52.48 kg.

4. The food items were separated into 3 categories namely: prey organisms, chum and digested food. The food items of females was comprised of 37% prey organisms, 52% chum and 11% digested food, while those of males was comprised of 43% prey organisms, 44% chum and 13% digested food.

5. Four size groups, namely: 100-115 cm, 116-131 cm, 132-147 cm and 148-163 cm, were used to determine differences in feeding by size and sex. There is no significant difference between size classes of male yellowfin although the females showed a difference between the 116-131 cm and 132-147 cm classes at 5% level of significance.

6. Juvenile skipjack accounted for the highest volume of prey for females during the whole study period except in August, September and October when juvenile yellowfin was the dominant food. The male has skipjack as the main food during the months of November, December, January, February, March and July and for the rest of the months, juvenile yellowfin was observed to be the highest.

7. Based on the Index of Relative Importance (IRI), the most important food item of female yellowfin were skipjack (993), unidentified species belonging to the family Balistidae (302), yellowfin (771), and squid (208). The male yellowfin tuna prefers to prey on skipjack (1,605), yellowfin (913), squid (343) and crab (154).

8. Female yellowfin in Moro Gulf consumes about 847 g of skipjack, 764 g of yellowfin, 298 g of roundscad, 80 g of frigate/bullet tuna, 57 g of other fish, 22 g of mollusk, and 5 g of crustacea per day. Male yellowfin consumes 980 g of skipjack, 763 g of yellowfin, 239 g of roundscad, 88 g of frigate/bullet tuna, 66 g of other fish, 46 g of mollusk and 3 g of crustacea in one day.

9. Predation by adult yellowfin caught under payao is higher on juvenile skipjack and yellowfin than on other foodfishes. This indicates that there is a high prevalence of juvenile tunas year-round in Philippine waters, particularly in the Moro Gulf.

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Appendix 1. Taxonomic classification of the food items found in the stomach of yellowfin tuna

FISH

Order: Myctophiformes
- Family: Myctophidae
- Harpadontidae
- Omosudidae
- Paralipididae

Order: Antheriniformes
- Family: Exocoetidae
  - Genus: _Cypselurus_

Order: Syngnathiformes
- Family: Syngnathidae
  - Genus: _Hippocampus_

Order: Dactylopteriformes
- Family: Dactylopteridae

Order: Perciformes
- Family: Scombridae
  - Genus: _Thunnus_
    - Species: _T. albacares_
  - Genus: _Katsuwonus_
    - Species: _K. pelamis_
  - Genus: _Auxis_
- Family: Carangidae
  - Genus: _Decapterus_
  - Genus: _Selar_
  - Genus: _Elagatis_
    - Species: _E. bipinnulatus_
- Family: Gempylidae
- Family: Trichiuridae
  - Genus: _Trichiurus_
    - Species: _T. lepturus_
- Family: Bramidae
  - Genus: _Pteraclis_
    - Species: _P. carolinus_
  - Genus: _Brama_
    - Species: _B. dussumieri_
- Family: Acanthuridae
- Family: Kyphosidae
  - Genus: _Kyphosus_
- Family: Owstoniidae
- Family: Rachycentridae
  - Genus: _Rachycentron_
    - Species: _R. canadum_
- Family: Coryphaenidae
  - Genus: _Coryphaena_
    - Species: _C. hippurus_
- Family: Chaetodontidae

Order: Tetraodontiformes
Family: Diodontidae
Family: Ostraciontidae
Family: Tetraodontidae
Genus: Arothron
Species: A. immaculatus
Family: Balistidae
Genus: Pseudobalistis
Species: P. flavimarginatus
P. fuscus
Family: Monacanthidae
Genus: Monacanthus
Family: Triacanthidae
Genus: Pseudotriacanthus
Species: P. strilifer

ARTHROPOD

Class: Crustacea
Order: Stomatopoda
Family: Squillidae
Order: Decapoda
Family: Brachyura
Family: Penaeidae

MOLLUSK

Class: Cephalopoda
Order: Teuthoidea
Family: Loligonidae
Genus: Loligo
Order: Octopoda
Family: Octopodidae
Genus: Octopus
Family: Argonautidae
Genus: Argonauta
Species: A. argo
Class: Gastropoda

COELENTERATE
Class: Scyphozoa

Table 1. 1984 yellowfin tuna production (in metric ton) by statistical fishing area and gear.

STATISTICAL FISHING AREA	HANDLINE	PURSE SEINE	RINGNET	OTHER GEARS	TOTAL
BABUYAN CHANNEL	7			13	20
BATANGAS COAST	399			289	688
BOHOL SEA	602	57	585	360	1604
CAMOTES SEA	39		32	88	159
CASIGURAN SOUND	508				508
CUYO PASS	1922	1809		81	3812
DAVAO GULF	1849		132	859	2840
EAST SULU SEA	1274	495	31	683	2483
GUIMARAS STRAIT	22	[illegible]	[illegible]	580	2006
LAGONOY GULF	440			[illegible]	[illegible]
LAMON BAY	127	135	[illegible]	[illegible]	[illegible]
LEYTE GULF	[illegible]		[illegible]	[illegible]	[illegible]
LINGAYEN GULF	1425	1488		94	[illegible]
MANILA BAY	2622	355	150	115	[illegible]
MORO GULF	15217	[illegible]	1682	243	21742
RAGAY GULF	79		9	66	154
SAMAR SEA	471		59	[illegible]	849
SIBUYAN SEA	141	[illegible]	[illegible]	[illegible]	[illegible]
SOUTH SULU SEA	2501	1476	230	172	[illegible]
TAYABAS BAY	20	99	[illegible]	[illegible]	[illegible]
VISAYAN SEA	20	1464		[illegible]	1660
WEST PALAWAN WATER	106			47	153
WEST SULU SEA	431	519		36	986
TOTAL	31005	18728	4261	4930	58924

Table 2. Number of individuals, aggregate weight, frequency of occurrence and values of index of relative importance (IRI) of foodfish organisms found in the stomach of 620 adult yellowfin tuna.

FOOD ITEM	NUMBER OF ORGANISMS	AGGREGATE WEIGHT	OCCURRENCE NUMBER	IRI
MYCTOPHIDAE	11	54.80	6	0.42
HARPADONTIDAE	25	45.90	10	1.47
OMOSUDIDAE		93.30	16	3.45
PARALIPIDIDAE	3	27.50	3	0.06
EXOCOETIDAE				
Cypselurus sp.	21	311.20	8	1.32
SYNGNATHIDAE				
Hippocampus sp.	9	33.40	9	0.50
Others	10	21.60	8	0.47
DACTYLOPTERIDAE	9	11.90	8	0.42
SCOMBRIDAE				
Thunnus albacares	200	38409.80	124	861.09
Katsuwonus pelamis	200	47211.70	126	1036.85
Auxis sp.	34	4301.10	26	21.91
CARANGIDAE				
Decapterus sp.	80	6752.70	36	52.98
Selar sp.	2	73.90	2	0.04
Elagatis bipinnulatus	3	195.20	3	0.14
GEMPYLIDAE	75	763.50	29	15.52
TRICHIURIDAE				
Trichiurus lepturus	54	750.80	17	7.07
BRAMIDAE				
Pteraclis carolinus	9	43.20	9	0.51
Brama dussumieri	35	731.80	23	7.05
ACANTHURIDAE	18	57.40	16	1.75
KYPHOSIDAE				
Kyphosus sp.	37	820.00	21	6.95
OWSTONIIDAE	13	26.30	7	0.69
RACHYCENTRIDAE				
Rachycentron canadum	1	160.00	1	0.03
CORYPHAENIDAE				
Coryphaena hippurus	1	61.10	1	0.01
CHAETODONTIDAE	30	41.40	19	3.31
DIODONTIDAE	14	22.60	12	0.98
OSTRACIONTIDAE	17	14.30	12	0.81
TETRAODONTIDAE				
Arothron immaculatus	8	30.40	6	0.31
Others	50	189.50	27	3.33
BALISTIDAE				
Pseudobalistes fuscus	135	213.70	44	24.55
P. flavamarginatus	14	56.50	8	[illegible]
Others	287	913.50	78	136.[illegible]
MONACANTHIDAE				
Monacanthus sp.	27	50.10	16	2.54
TRIACANTHIDAE				
Pseudotriacanthus strigilifer	6	8.30	1	[illegible]
SQUILLIDAE	167	148.00	66	61.[illegible]
PENAEIDAE	69	58.90	45	17.77
BRACHYURA	516	104.50	26	[illegible]
LOLIGONIDAE				
Loligo sp.	327	3302.40	126	293.54
OCTOPODIDAE				
Octopus sp.	20	94.90	17	2.15
ARGONAUTIDAE				
Argonauta argo	15	17.00	11	[illegible].95
CEPHALOPODA (unidentified)	37	19.60	31	6.31
CEPHALOPODA (beak only)	257	56.60	87	125.79
GASTROPODA	4	3.90	2	0.05
SCYPHOZOA	17	15.40	9	[illegible]

Table 3. Number of individuals, aggregate weight, frequency of occurrence and values of index of relative importance (IRI) of foodfish organisms found in the stomach of 217 adult female yellowfin tuna.

FOOD ITEM	NUMBER OF ORGANISMS	AGGREGATE WEIGHT	OCCURRENCE NUMBER	IRI
MYCTOPHIDAE	2	8.90	2	0.25
HARPADONTIDAE	11	25.56	5	3.28
OMOSUDIDAE	12	36.40	6	4.37
PARALIPIDIDAE	2	13.50	2	0.26
EXOCOETIDAE				
Cypselurus sp.	7	122.70	2	1.14
SYNGNATHIDAE				
Hippocampus sp.	2	4.60	2	0.24
Others	1	1.70	1	0.06
DACTYLOPTERIDAE	1	1.60	1	0.06
SCOMBRIDAE				
Thunnus albacares	62	12245.80	37	771.23
Katsuwonus pelamis	69	13561.60	43	993.42
Auxis sp.	11	1279.60	7	17.03
CARANGIDAE				
Decapterus sp.	31	2759.50	14	79.19
Selar sp.	1	33.90	1	0.10
Elagatis bipinnulatus	0	0.00	0	0.00
GEMPYLIDAE	18	210.40	11	14.29
TRICHIURIDAE				
Trichiurus lepturus	16	242.20	6	7.47
BRAMIDAE				
Pteraclis carolinus	3	8.70	3	0.54
Brama dussumieri	8	188.80	6	4.31
ACANTHURIDAE	3	9.10	11	2.00
KYPHOSIDAE				
Kyphosus sp.	13	270.00	9	10.[illegible]
OWSTONIIDAE	3	7.50	3	0.54
RACHYCENTRIDAE				
Rachycentron canadum	0	0.00	0	0.00
CORYPHAENIDAE		0.00		
Coryphaena hippurus	0	0.00	0	0.00
CHAETODONTIDAE	8	10.80	5	2.3[illegible]
DIODONTIDAE	5	11.70	5	1.49
OSTRACIONTIDAE	3	4.20	3	0.52
TETRAODONTIDAE				
Arothron immaculatus	1	7.20	1	0.07
Others	6	27.40	5	1.88
BALISTIDAE				
Pseudobalistes fuscus	28	50.80	16	26.39
P. flavamarginatus	6	21.90	3	1.10
Others	186	487.20	27	301.56
MONACANTHIDAE				
Monacanthus sp.	15	23.00	6	5.27
TRIACANTHIDAE				
Pseudotriacanthus striliter	0	0.00	0	0.00
SQUILLIDAE	39	92.70	22	51.[illegible]
PENAEIDAE	18	12.10	12	12.3[illegible]
BRACHYURA	61	13.60	10	34.[illegible]
LOLIGONIDAE				
Loligo sp.	88	686.30	35	207.55
OCTOPODIDAE				
Octopus sp.	4	22.60	4	1.03
ARGONAUTIDAE				
Argonauta argo	6	10.10	4	1.41
CEPHALOPODA (unidentified)	6	2.60	5	1.71
CEPHALOPODA (beak only)	58	12.70	26	85.42
GASTROPODA	3	2.60	1	0.17
SCYPHOZOA	1	0.90	1	0.0[illegible]

Table 4. Number of individuals, aggregate weight, frequency of occurrence and values of index of relative importance (IRI) of foodfish organisms found in the stomach of 403 adult male yellowfin tuna.

FOOD ITEM	NUMBER OF ORGANISMS	AGGREGATE WEIGHT	OCCURRENCE NUMBER	IRI
MYCTOPHIDAE	9	45.90	4	0.50
HARPADONTIDAE	14	20.30	5	0.89
OMOSUDIDAE	24	56.90	10	3.09
PARALIPIDIDAE	1	14.00	1	0.02
EXOCOETIDAE				
Cypselurus sp.	14	188.50	6	1.39
SYNGNATHIDAE				
Hippocampus sp.	7	28.80	7	0.66
Others	9	19.90	7	0.81
DACTYLOPTERIDAE	8	10.30	7	0.70
SCOMBRIDAE				
Thunnus albacares	138	26163.90	87	913.36
Katsuwonus pelamis	122	33649.50	83	1065.15
Auxis sp.	23	3021.50	19	24.65
CARANGIDAE				
Decapterus sp.	49	3785.60	22	41.12
Selar sp.	1	40.00	1	0.03
Elagatis bipinnulatus	3	195.20	3	0.31
GEMPYLIDAE	57	562.10	18	15.79
TRICHIURIDAE				
Trichiurus lepturus	38	508.60	11	6.93
BRAMIDAE				
Pteraclis carolinus	6	34.50	6	[illegible]
Brama dussumieri	15	423.10	12	4.32
ACANTHURIDAE	15	49.30	14	2.76
KYPHOSIDAE				
Kyphosus sp.	24	550.00	12	5.70
OWSTONIIDAE	10	18.80	6	0.76
RACHYCENTRIDAE				
Rachycentron canadum	1	160.00	1	0.07
CORYPHAENIDAE				
Coryphaena hippurus	2	64.20	2	0.09
CHAETODONTIDAE	22	27.40	14	3.84
DIODONTIDAE	9	10.90	7	0.79
OSTRACIONTIDAE	9	10.10	9	1.01
TETRAODONTIDAE				
Arothron immaculatus	7	43.20	5	0.49
Others	44	162.20	22	12.88
BALISTIDAE				
Pseudobalistes fuscus	107	162.90	28	37.66
P. flavamarginatus	8	34.60	5	0.54
Others	101	426.30	51	69.45
MONACANTHIDAE				
Monacanthus sp.	12	27.10	10	1.54
TRIACANTHIDAE				
Pseudotriacanthus strigilifer	6	8.30	1	0.08
SQUILLIDAE	123	55.30	44	66.08
PENAEIDAE	51	46.80	33	20.81
BRACHYURA	455	90.90	28	154.47
LOLIGONIDAE				
Loligo sp.	239	2616.10	91	34.62
OCTOPODIDAE				
Octopus sp.	16	22.30	13	2.87
ARGONAUTIDAE				
Argonauta argo	9	6.90	7	0.78
CEPHALOPODA (unidentified)	31	16.80	26	9.87
CEPHALOPODA (beak only)	199	43.90	61	147.27
GASTROPODA	1	1.30	1	0.01
SCYPHOZOA	16	14.50	8	1.58

Table 5. Monthly average weight of stomach contents (in grams) of one adult yellowfin tuna

MONTH	NO. OF STOMACH	PREY ORGANISMS	CHUM	DIGESTED	TOTAL
NOV	60	221	120	77	418
DEC	60	178	228	62	468
JAN	60	112	183	23	318
FEB	60	164	181	38	383
MAR	60	109	235	86	430
APR					
MAY	40	108	227	92	427
JUN	60	93	133	18	224
JUL	60	194	252	42	488
AUG	60	167	214	37	418
SEP	60	280	209	56	545
OCT	40	274	180	45	499
TOTAL	620	172	196	51	419

Table 6. Monthly average weight of stomach contents (in grams) of male yellowfin tuna.

MONTH	NO. OF STOMACH	PREY ORGANISMS	CHUM	DIGESTED	TOTAL
NOV	44	259	135	91	485
DEC	41	144	270	71	485
JAN	42	114	203	27	344
FEB	38	178	181	37	396
MAR	34	101	158	87	346
APR					
MAY	32	116	178	82	376
JUN	45	100	132	18	250
JUL	30	235	284	50	569
AUG	40	190	157	42	389
SEP	35	364	210	60	634
OCT	22	269	199	47	515
TOTAL	403	183	189	55	427

Table 7. Monthly average weight of stomach contents (in grams) of female yellowfin tuna

MONTH	NO. OF STOMACH	PREY ORGANISMS	CHUM	DIGESTED	TOTAL
NOV	16	116	77	41	234
DEC	19	253	137	43	433
JAN	18	107	136	14	257
FEB	22	139	181	42	362
MAR	26	119	336	84	539
APR					
MAY	8	80	425	130	635
JUN	15	71	137	19	227
JUL	30	153	219	34	406
AUG	20	122	326	27	475
SEP	25	162	208	50	420
OCT	18	280	158	42	480
TOTAL	217	150	210	45	405

Table 8. Monthly average weight of prey organisms (in grams) consumed by an adult yellowfin tuna by sex.

		MONTH										
SEX	FOOD ITEMS	NOV	DEC	JAN	FEB	MAR	MAY	JUN	JUL	AUG	SEP	OCT
MALE		86.00	24.00	32.00	57.00	18.00	34.00	35.00	92.00	78.00	161.00	139.00
FEMALE	Yellowfin	41.00	77.00	9.00	53.00	3.00	9.00	30.00	39.00	75.00	92.00	182.00
BOTH		74.00	41.00	25.00	56.00	12.00	29.00	34.00	65.00	77.00	132.00	158.00
MALE		134.00	96.00	65.00	89.00	32.00	32.00	33.00	104.00	95.00	156.00	74.00
FEMALE	Skipjack	73.00	105.00	37.00	62.00	62.00	70.00	24.00	67.00	35.00	40.00	81.00
BOTH		118.00	112.00	56.00	80.00	45.00	40.00	31.00	86.00	75.00	108.00	77.00
MALE		23.00	5.00	6.00		24.00	5.00					27.00
FEMALE	Frigate/bullet		8.00	26.00		25.00						
BOTH		17.00	6.00	12.00		24.00	4.00					15.00
MALE		12.00	6.00	1.00	11.00	11.00	15.00	5.00	15.00		25.00	16.00
FEMALE	Roundscad		10.00	30.00	17.00	14.00		4.00	31.00		9.00	7.00
BOTH		9.00	7.00	10.00	13.00	12.00	12.00	4.00	23.00		18.00	12.00
MALE		2.10	4.80	4.80	12.30	9.70	11.20	18.00	14.70	13.00	11.00	9.00
FEMALE	Other fish	0.86	8.00	3.00	13.00	8.50	0.15	8.00	11.00	10.00	15.00	8.00
BOTH		1.74	5.91	3.66	11.17	9.17	8.99	15.84	12.61	11.99	12.37	8.56
MALE		1.50	7.50	3.80	3.10		18.00	13.00	9.00	5.00	11.20	4.00
FEMALE	Mollusk	0.12	0.90	2.00	2.80	6.00	2.00	4.50	6.00	2.00	6.00	2.00
BOTH		1.13	5.41	3.10	3.01	6.00	14.46	1.90	7.61	3.97	9.12	2.96
MALE		0.53	0.03	1.25	9.30	6.00	0.40	0.87	0.05	0.14	0.02	0.04
FEMALE	Crustacean	0.19	4.00	0.36	0.65		0.06	0.99	0.11	0.09		
BOTH		0.44	1.30	0.98	1.15		0.33	0.88	0.08	0.12	0.01	0.02

Table 9. Monthly average number of prey organisms consumed by an adult yellowfin tuna by sex.

		MONTH										
SEX	FOOD ITEMS	NOV	DEC	JAN	FEB	MAR	MAY	JUN	JUL	AUG	SEP	OCT
MALE		0.64	0.12	0.19	0.21	0.09	0.19	0.16	0.53	0.40	0.83	0.55
FEMALE	Yellowfin	0.31	0.37	0.06	0.14	0.04	0.13	0.13	0.20	0.45	0.40	0.94
BOTH		0.55	0.20	0.15	0.18	0.07	0.18	0.15	0.37	0.42	0.65	0.73
MALE		0.36	0.41	0.26	0.31	0.12	0.25	0.27	0.33	0.40	0.26	0.32
FEMALE	Skipjack	0.56	0.89	0.33	0.29	0.23	0.63	0.27	0.23	0.15	0.08	0.22
BOTH		0.42	0.57	0.28	0.30	0.17	0.33	0.27	0.28	0.32	0.18	0.28
MALE		0.14	0.12	0.07		0.12	0.06					0.14
FEMALE	Frigate/bullet		0.21	0.22		0.12						
BOTH		0.10	0.15	0.12		0.12	0.50					0.08
MALE		0.05	0.07	0.02	0.10	0.12	0.31	0.02	0.30		0.34	0.14
FEMALE	Roundscad		0.11	0.50	0.14	0.08		0.13	0.30		0.12	0.06
BOTH		0.03	0.08	0.17	0.12	0.10	0.25	0.05	0.30		0.25	0.10
MALE		0.45	1.66	1.14	0.76	0.41	0.62	3.89	1.53	1.22	1.26	0.27
FEMALE	Other fish	0.38	4.05	0.44	1.81	0.35	0.12	7.87	1.07	1.90	1.00	0.28
BOTH		0.52	2.42	0.93	1.17	0.43	0.50	4.77	1.30	2.70	1.15	0.28
MALE		0.30	1.60	1.45	1.05		1.43	2.71	0.93	1.53	1.09	0.23
FEMALE	Mollusk	0.19	0.68	0.83	0.81	0.58	0.75	1.87	0.93	0.90	0.72	0.17
BOTH		0.27	1.30	0.35	0.97	0.47	1.30	2.50	0.93	1.32	0.93	0.20
MALE		0.95	0.09	1.33	10.07	0.38	0.94	1.93	0.10	0.25	0.03	0.05
FEMALE	Crustacean	0.31	0.32	1.33	2.43		0.12	1.40	0.23	0.15		
BOTH		0.78	0.15	1.33	7.40		0.83	1.80	0.17	0.22	0.02	0.03

Table 10. Estimated weight of food organisms consumed per day and per year by an adult yellowfin tuna.

FOOD ITEM	PREY /DAY (g)	/YR (kg)	CHUM /DAY (g)	/YR (kg)	DIGESTED /DAY (g)	/YR (kg)	TOTAL /DAY (g)	/YR (kg)
Yellowfin	317	116	349	127	95	35	761	278
Skipjack	390	142	429	157	117	43	936	324
Frigate/Bullet	36	13	39	14	11	4	86	31
Roundscad	54	20	187	68	16	6	257	94
Other Fish	48	18			14	5	62	23
Mollusk	30	11			9	3	39	14
Crustacean	3	1			1		4	1
Total	878	321	1004	366	263	96	2145	783

Table 11. Estimated weight of food organisms consumed per day and per year by an adult female yellowfin [illegible]

FOOD ITEM	PREY /DAY (g)	/YR (kg)	CHUM /DAY (g)	/YR (kg)	DIGESTED /DAY (g)	/YR (kg)	TOTAL /DAY (g)	/YR (kg)
Yellowfin	289	105	389	142	86	31	764	[illegible]
Skipjack	[illegible]	[illegible]	[illegible]	157	96	35	[illegible]	[illegible]
Frigate/Bullet	[illegible]	13	41	15	[illegible]	[illegible]	[illegible]	[illegible]
Roundscad	[illegible]	[illegible]	214	78	13	[illegible]	[illegible]	[illegible]
Other Fish	39	[illegible]			13	5	[illegible]	
Mollusk	17	[illegible]			[illegible]	[illegible]	[illegible]	
Crustacean	3	1			2	1	[illegible]	[illegible]
Total	[illegible]	[illegible]	[illegible]	[illegible]	230	84	[illegible]	[illegible]

Table 12. Estimated weight of food organisms consumed per day and per year by an adult male yellowfin [illegible]

FOOD ITEM	PREY /DAY (g)	/YR (kg)	CHUM /DAY (g)	/YR (kg)	DIGESTED /DAY (g)	/YR (kg)	TOTAL /DAY (g)	/YR (kg)
Yellowfin	[illegible]	[illegible]	350	[illegible]	100	37	[illegible]	278
Skipjack	[illegible]	[illegible]	425	155	128	47	[illegible]	[illegible]
Frigate/Bullet	[illegible]	[illegible]	36	[illegible]	12	4	[illegible]	[illegible]
Roundscad	[illegible]	[illegible]	[illegible]	64	14	[illegible]	[illegible]	[illegible]
Other Fish	[illegible]	[illegible]			15	[illegible]	[illegible]	[illegible]
Mollusk	35	13			11	4	[illegible]	[illegible]
Crustacean	[illegible]				1		[illegible]	
Total	[illegible]	[illegible]	967	[illegible]	281	[illegible]	[illegible]	[illegible]

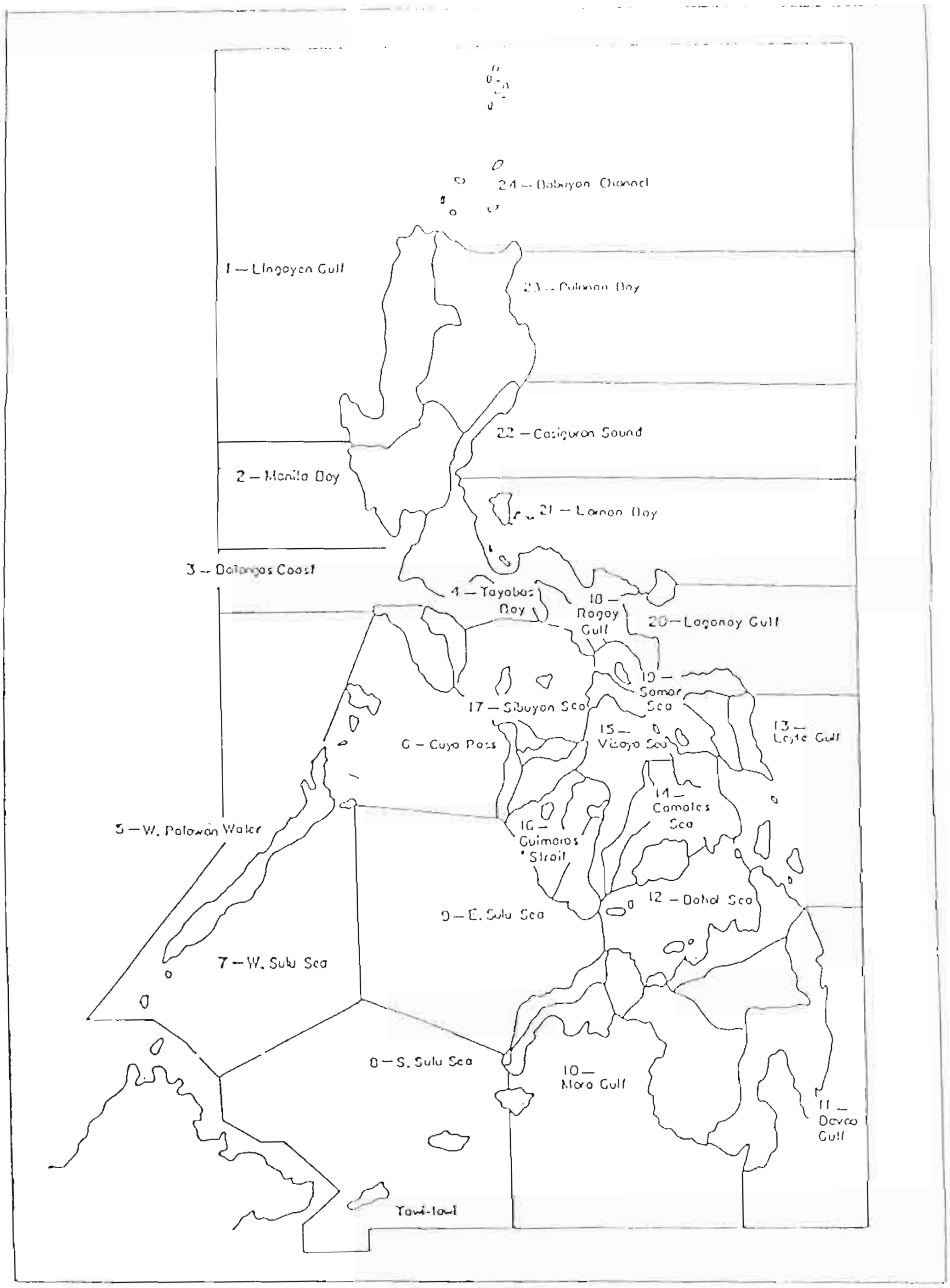


Figure 1. Map of the Philippines showing the different statistical fishing areas (Source: BFAR Statistics, 1984).

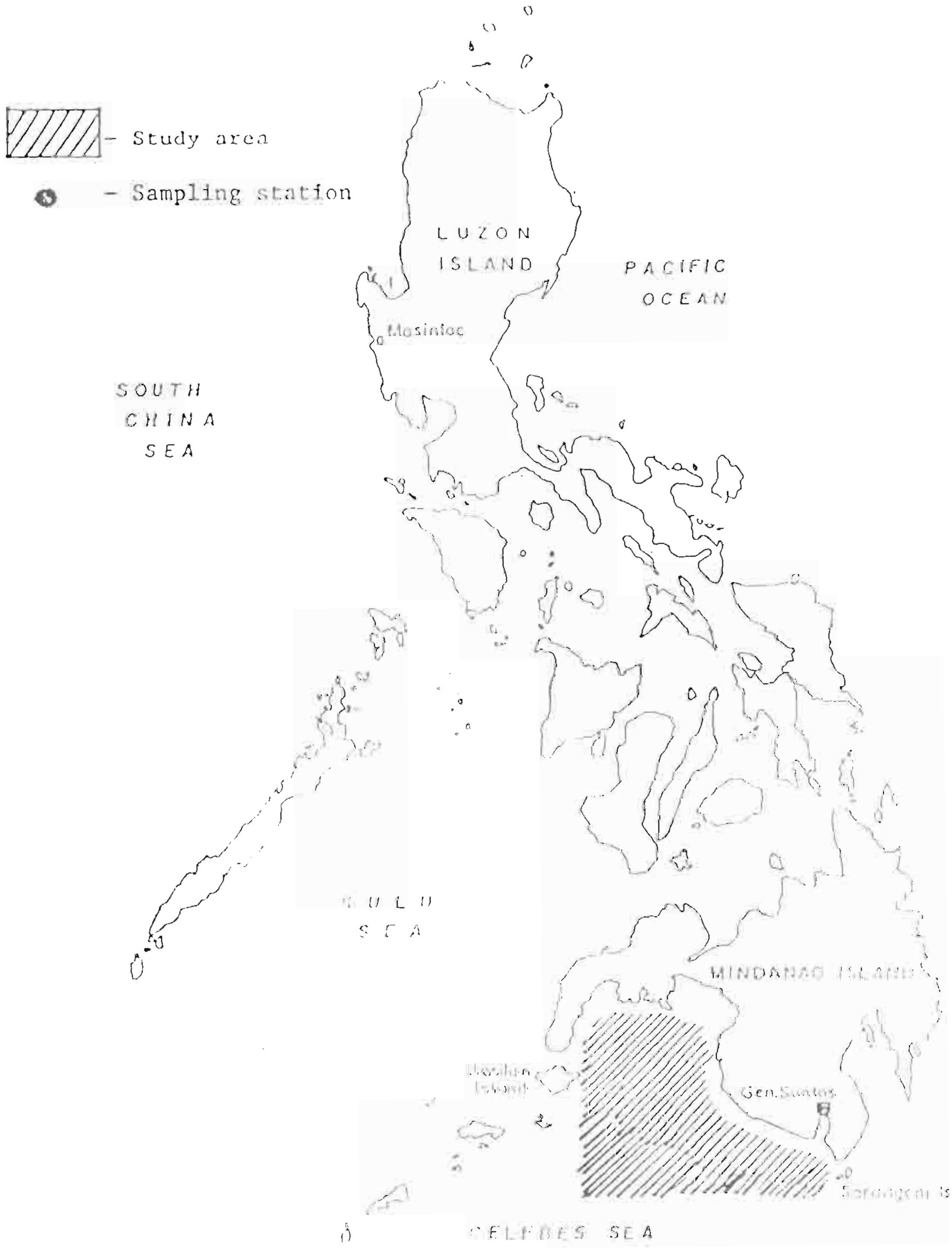


Figure 2. Map of the Philippines showing the study area and the sampling station.

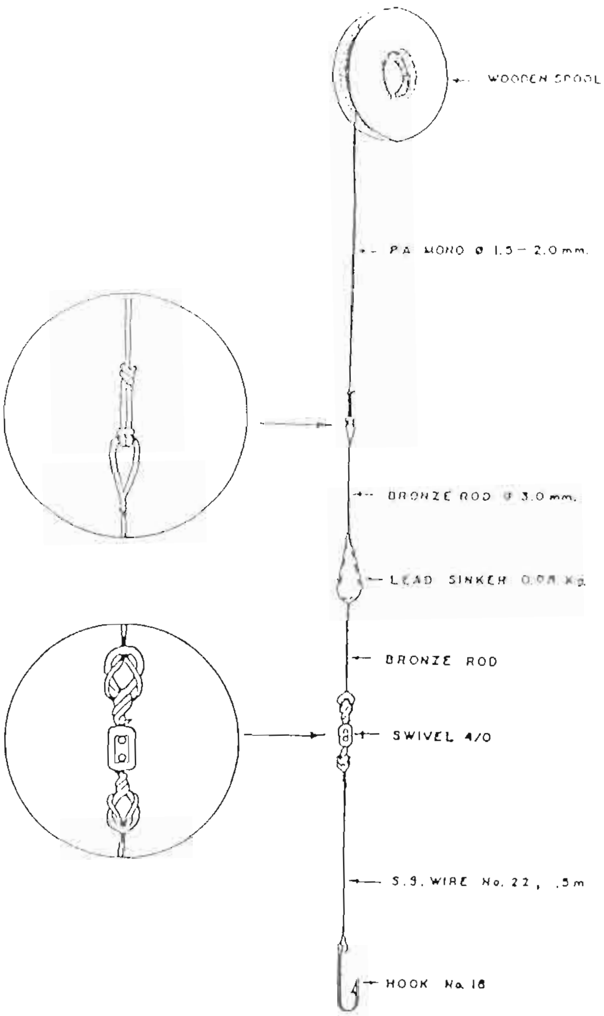


Figure 3, Schematic illustration of a handline gear (Source: de Jesus, 1982).

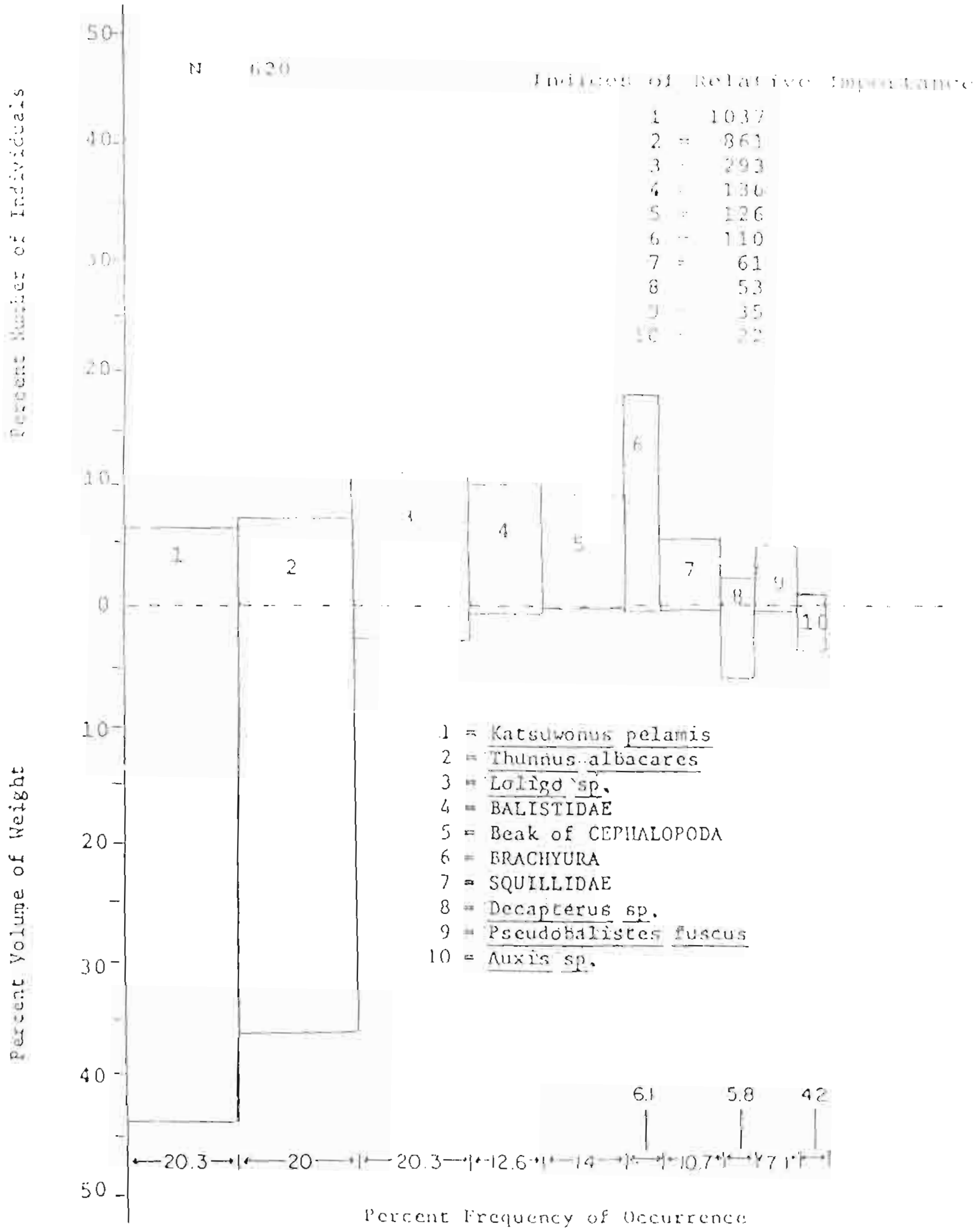


Figure 4. The principal prey organisms found in the stomachs of combined female and male yellowfin as determined by the Index of Relative Importance (IRI)

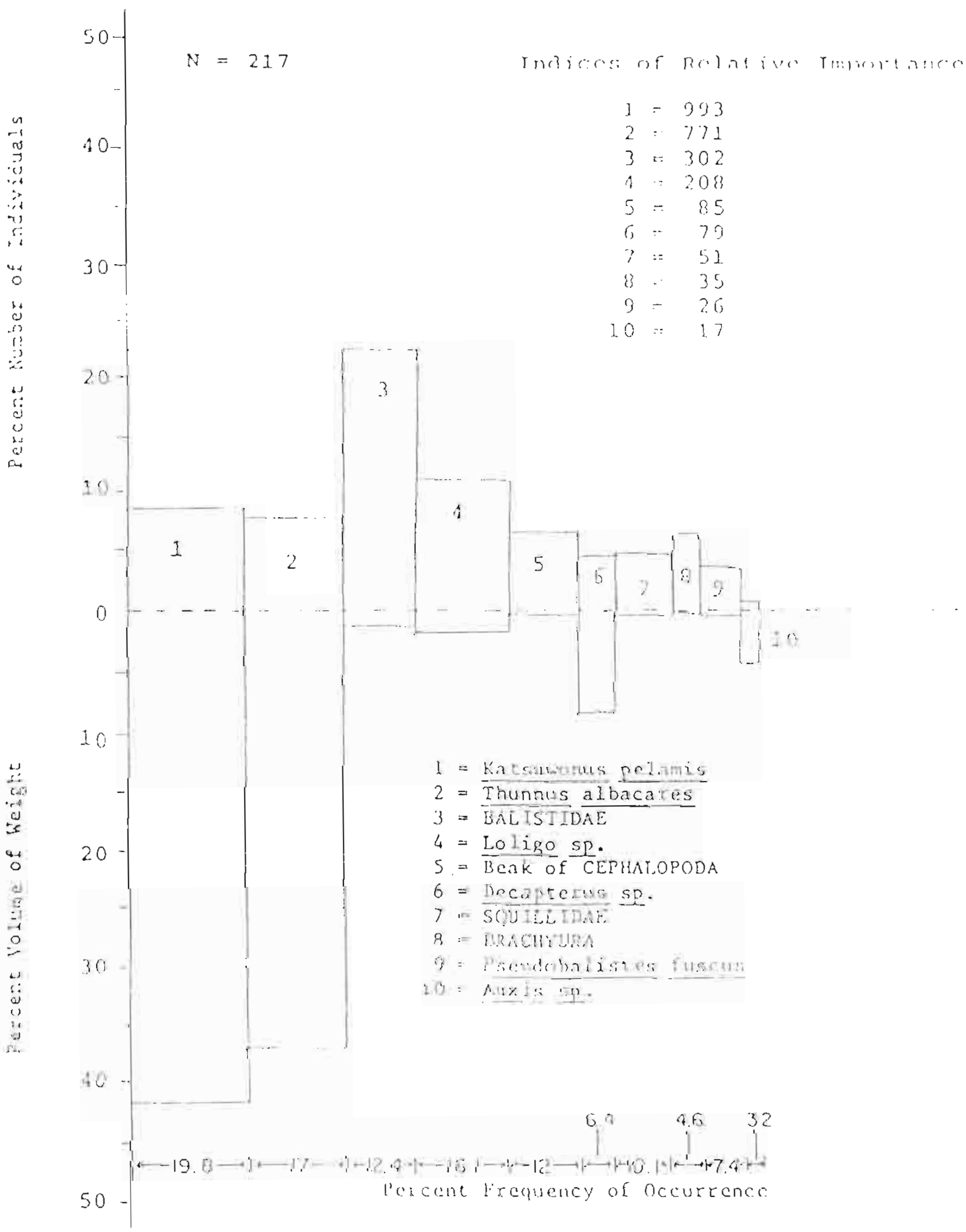


Figure 5. The principal prey organisms found in the stomach of female yellowfin as determined by the Index of Relative Importance (IRI)

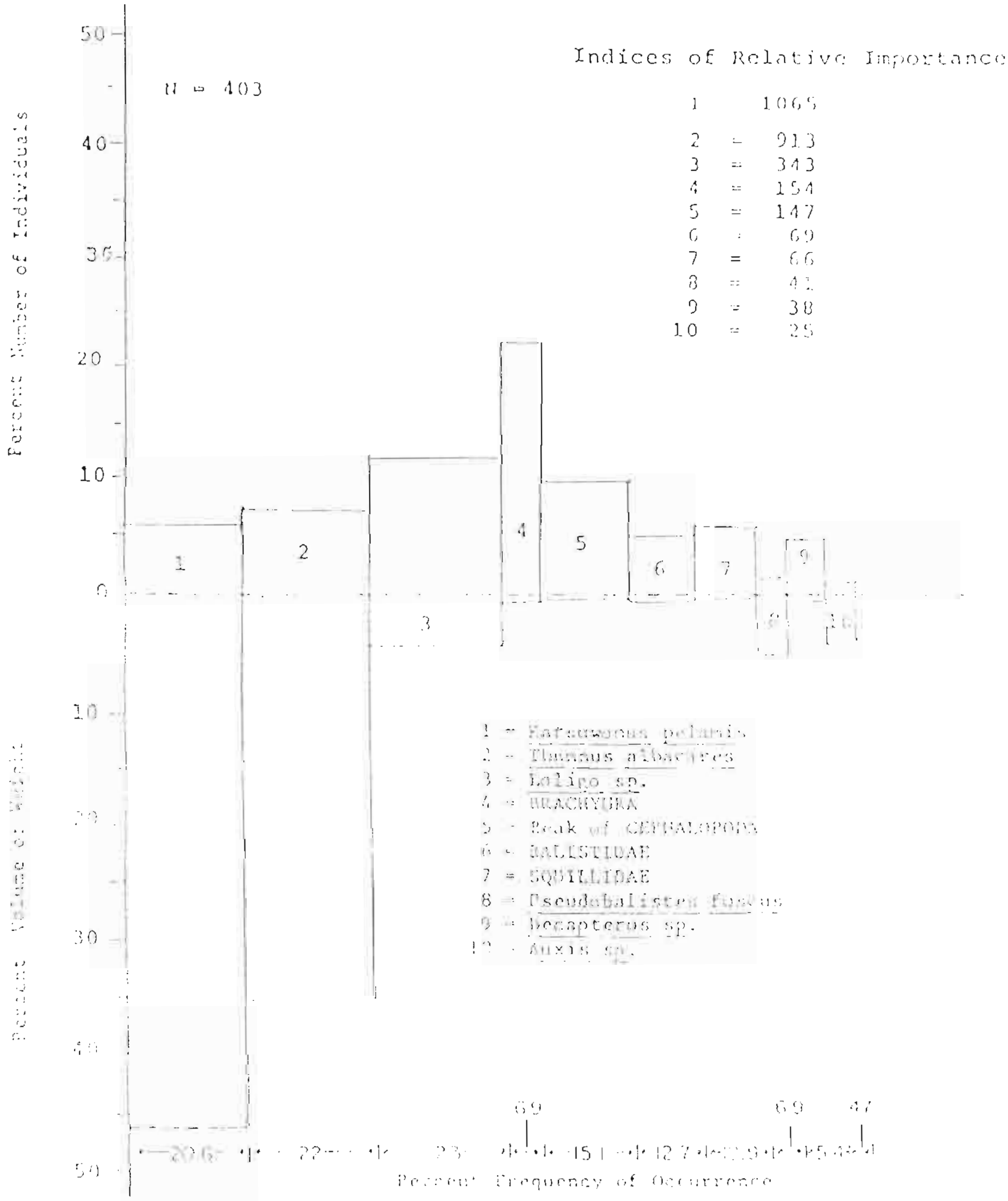


Figure 6. The principal prey organisms found in the stomach of male yellowfin as determined by the Index of Relative Importance (IRI)

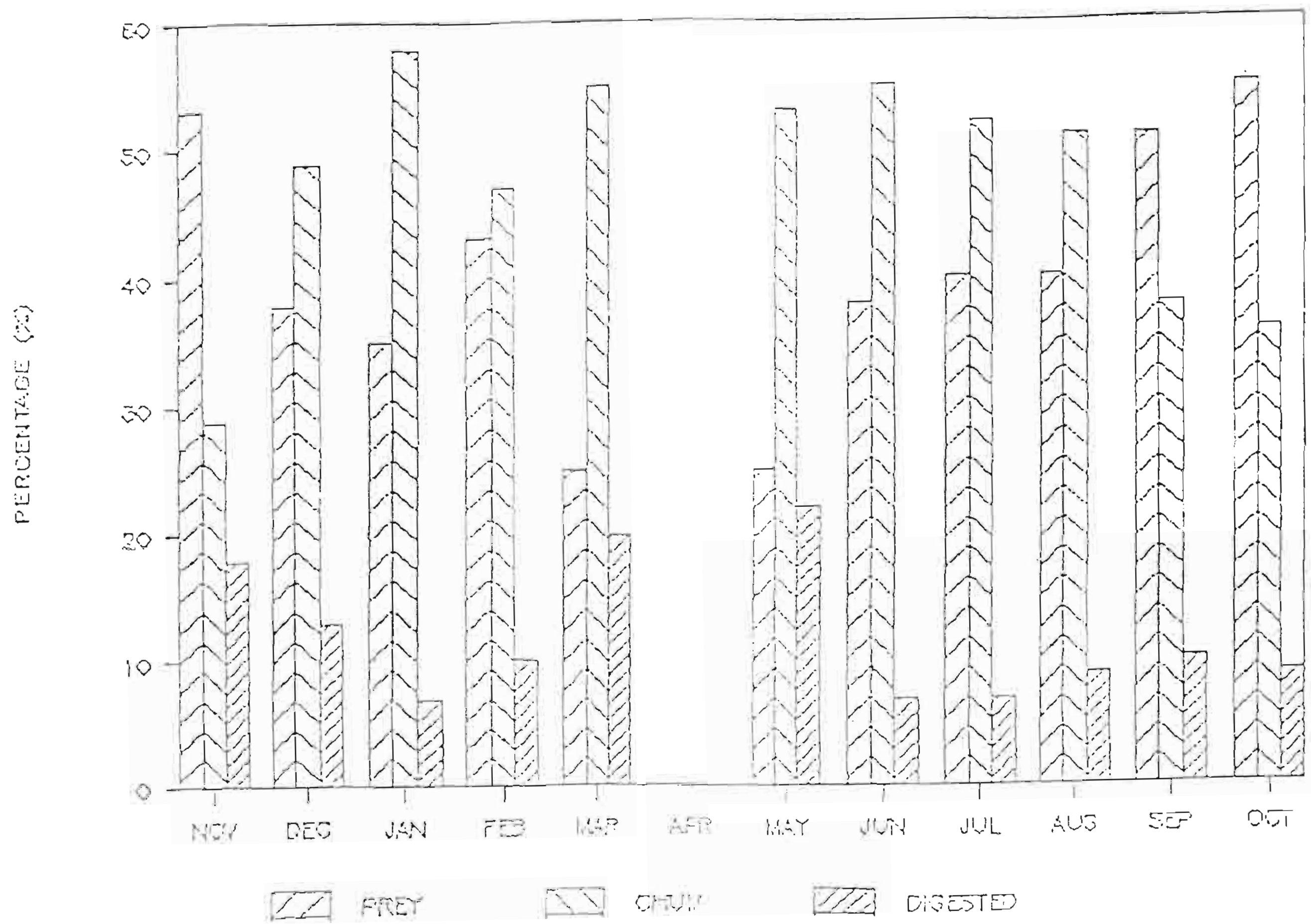


Figure 7. Percentage composition of food categories: prey, chum and "digested" of adult yellowfin tuna caught by handline.

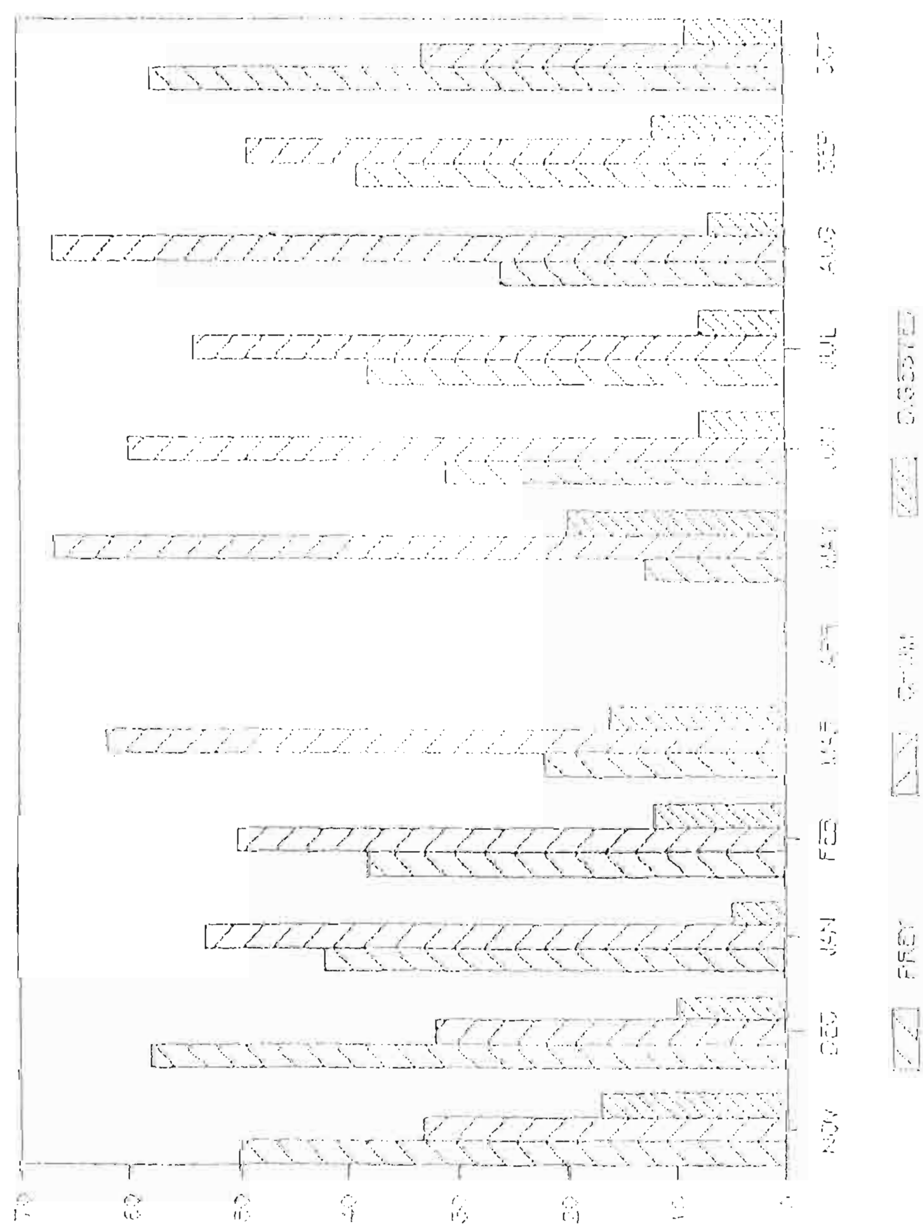


Figure 8. Percentage composition of food categories: prey, chum and digested of female yellowfin.

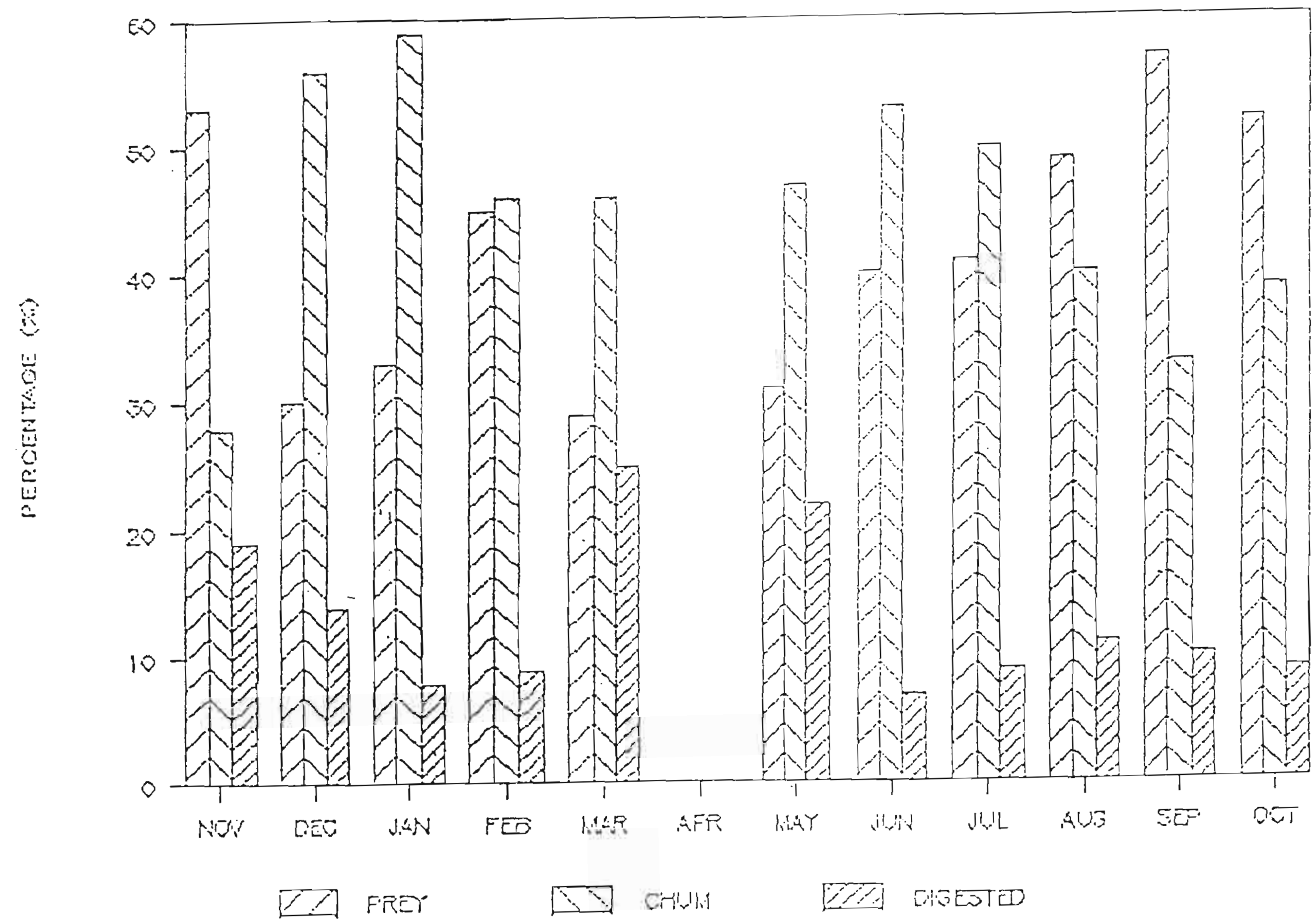


Figure 9. Percentage composition of food categories: prey, chum and "digested" of a male yellowfin tuna caught by handline.

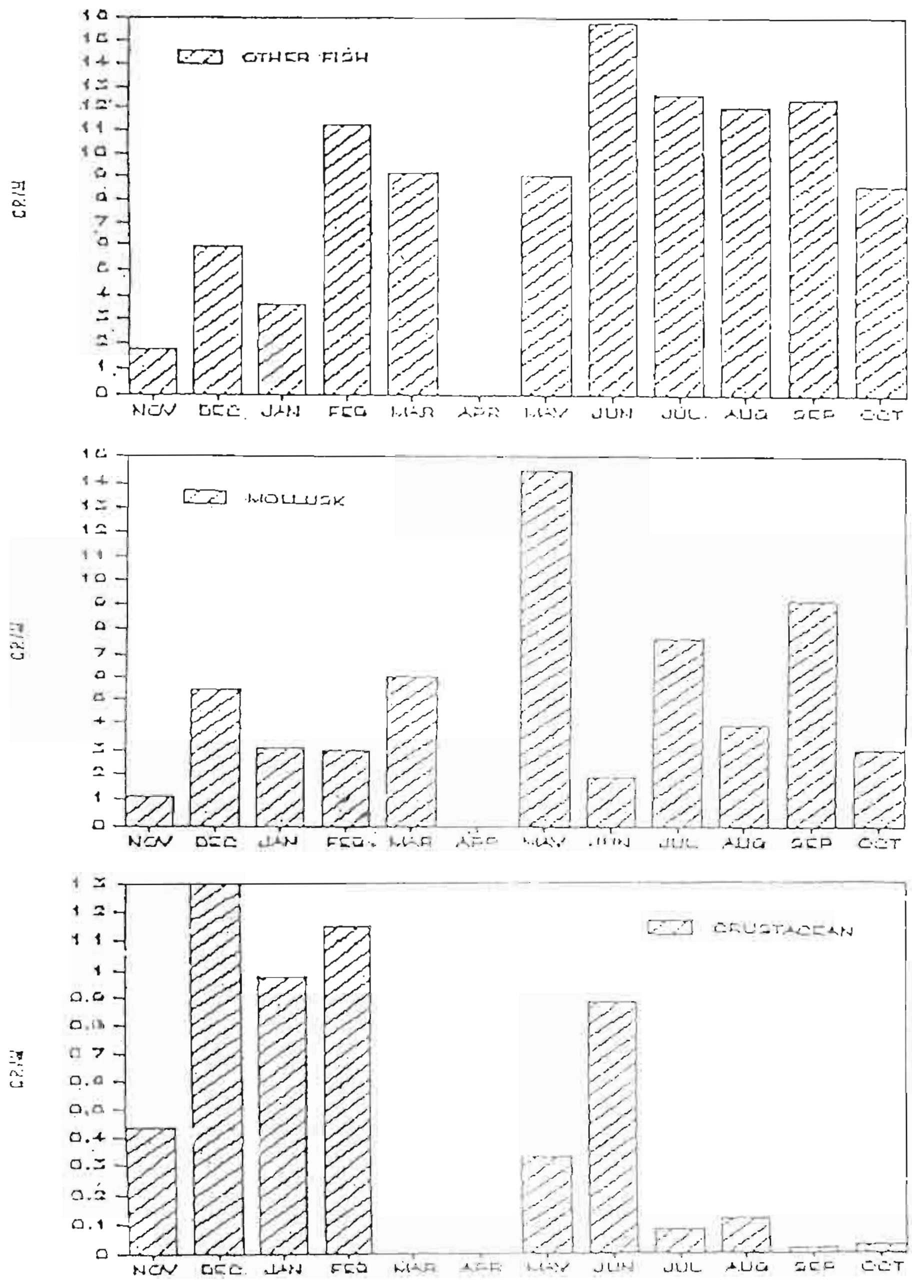
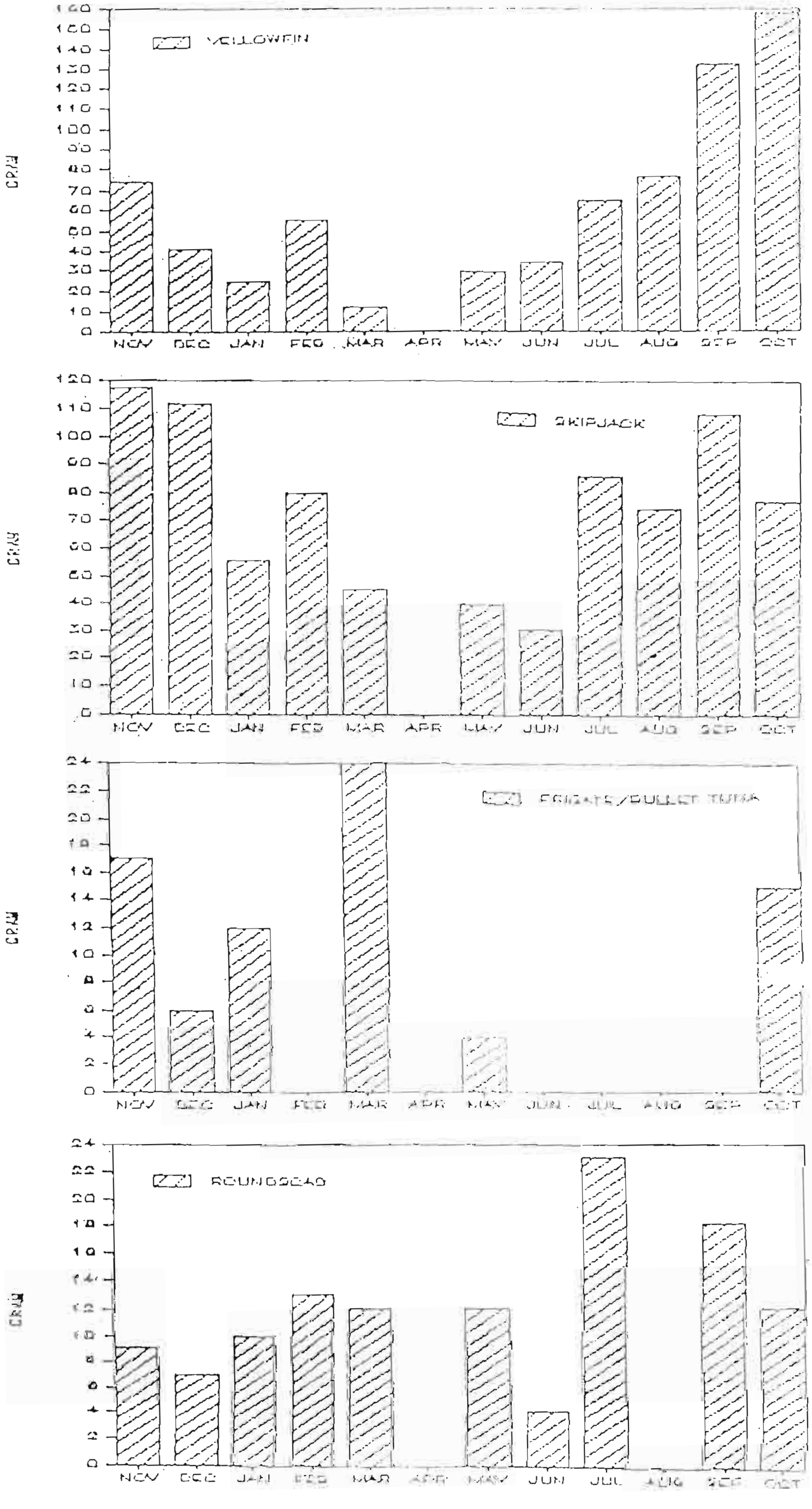


Figure 10. Monthly average weight of prey organisms consumed by one yellowfin (both sexes combined).


YELLOWFIN
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FRIGATE/BULLET TUNA
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Figure 10

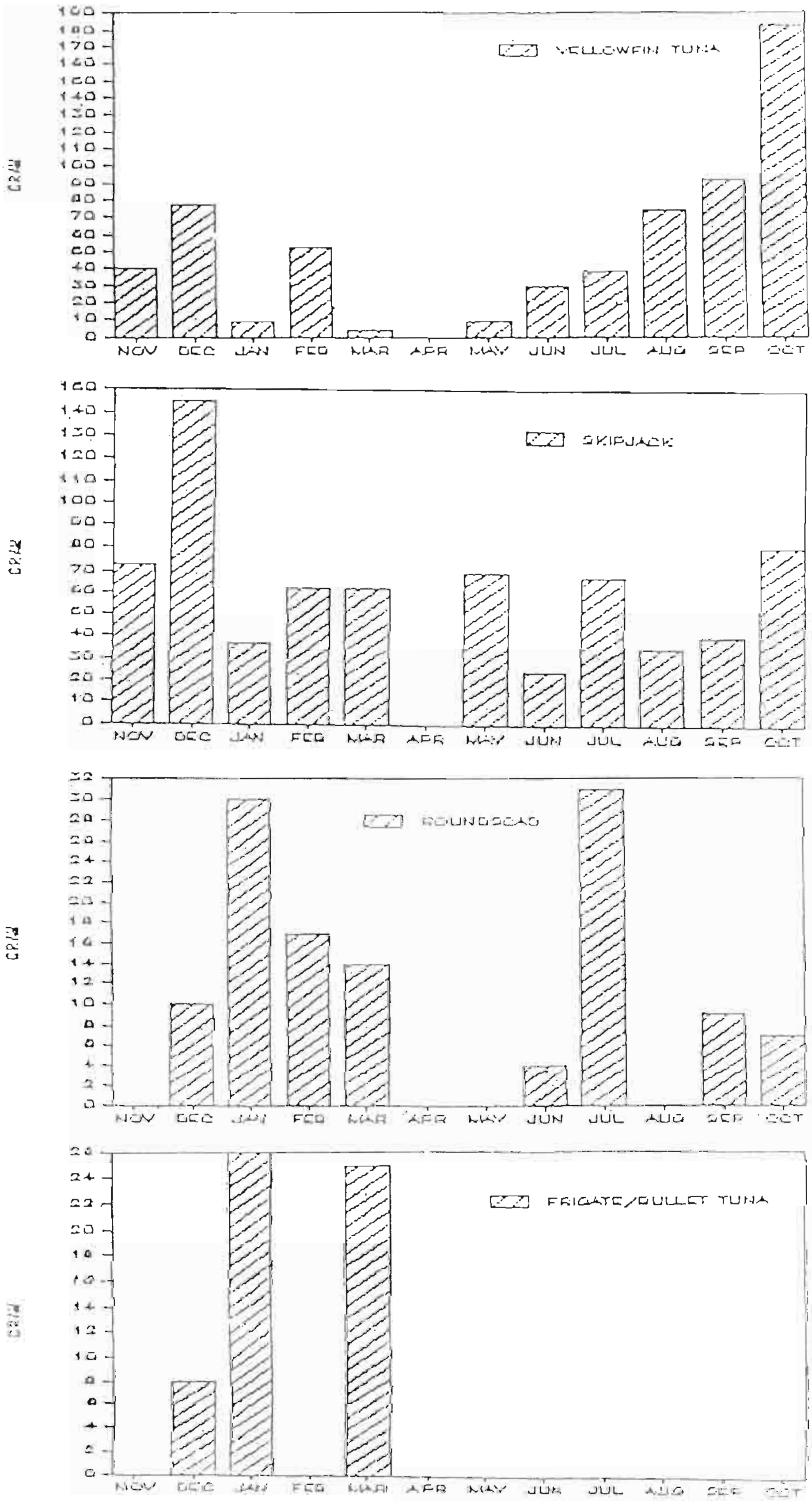
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Figure 11

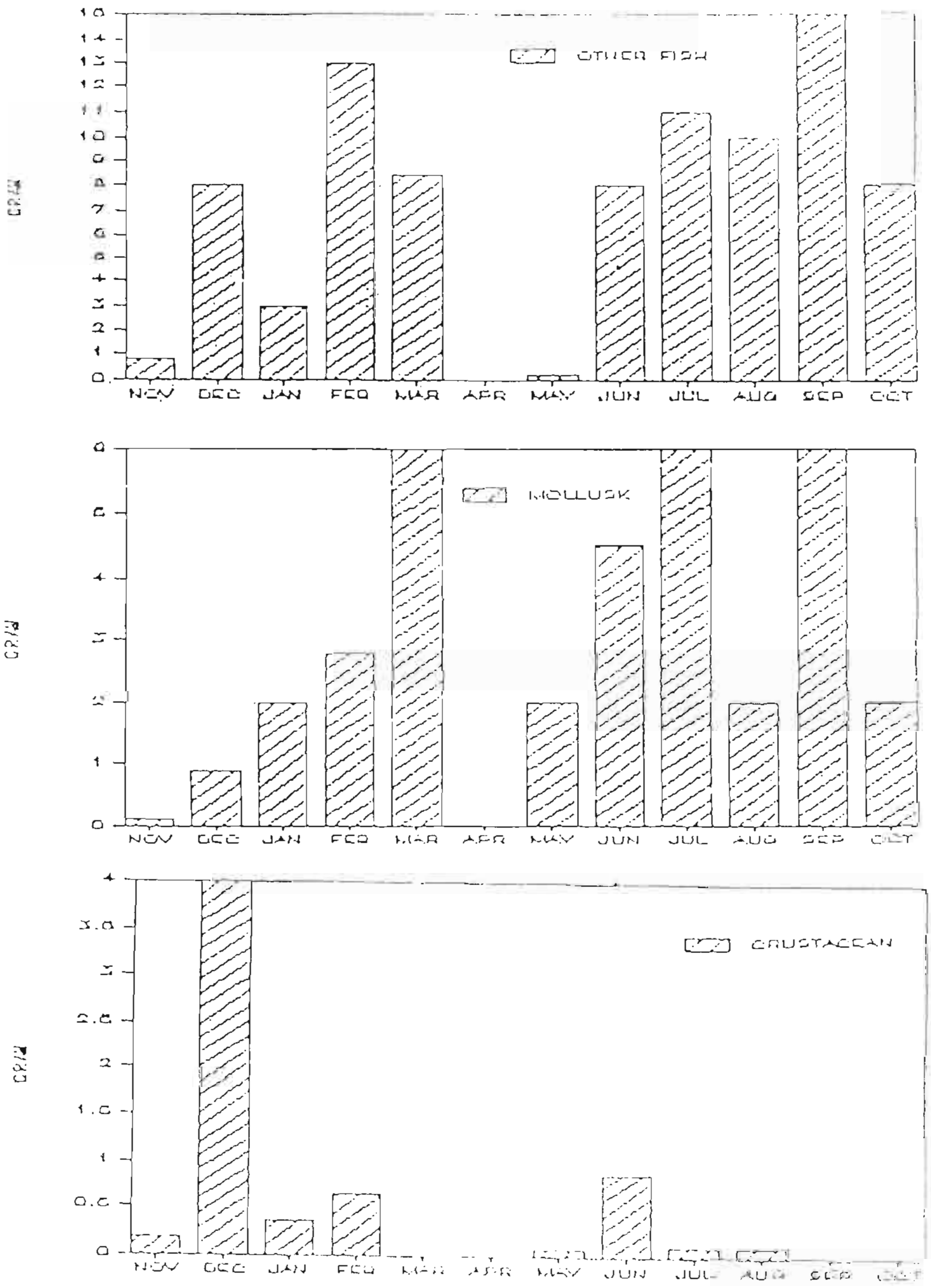

Figure 11. Monthly average weight of prey organisms consumed by one female yellowfin.

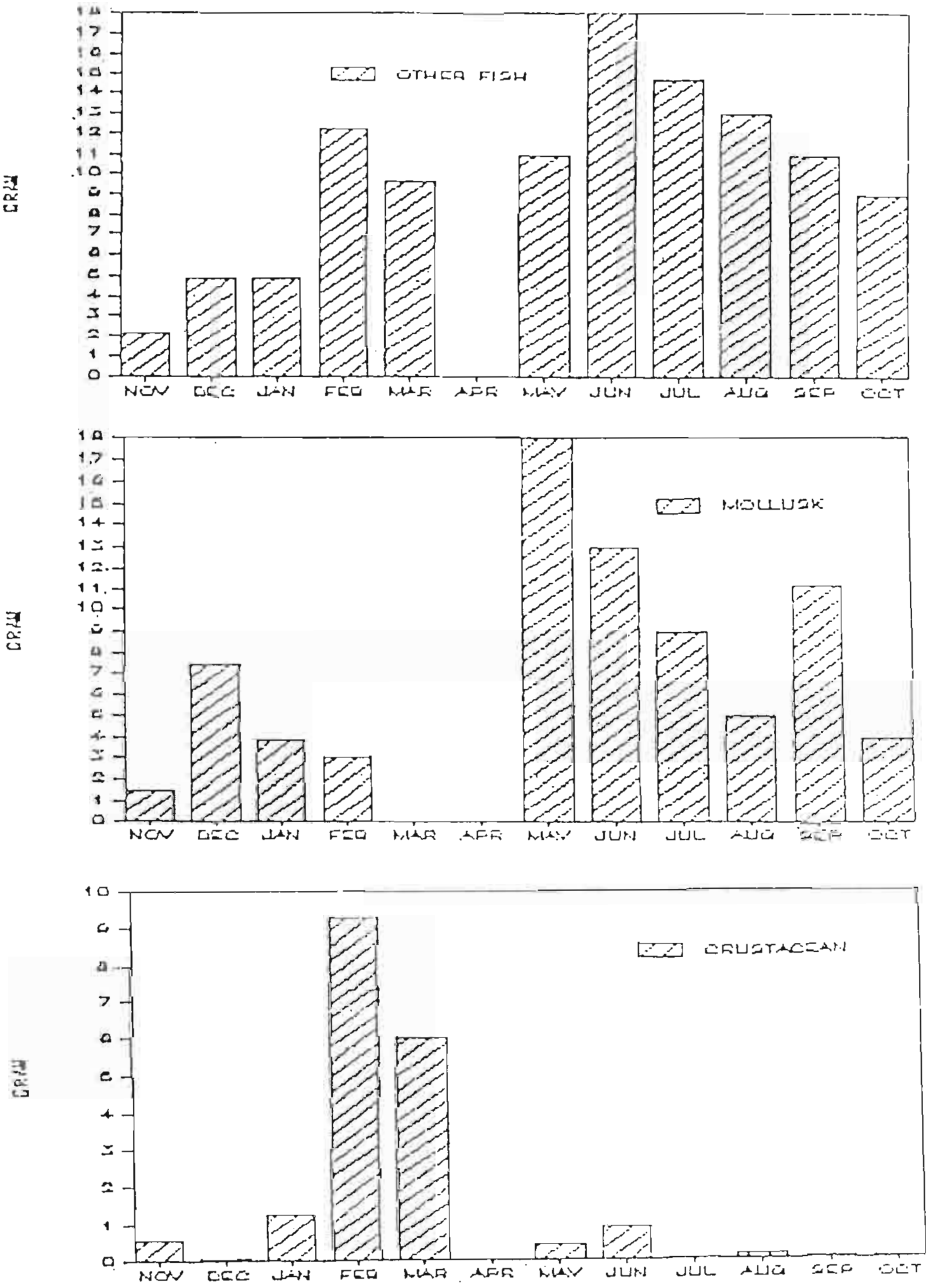

Figure 12. Monthly average weight of prey organisms consumed by one male yellowfin.

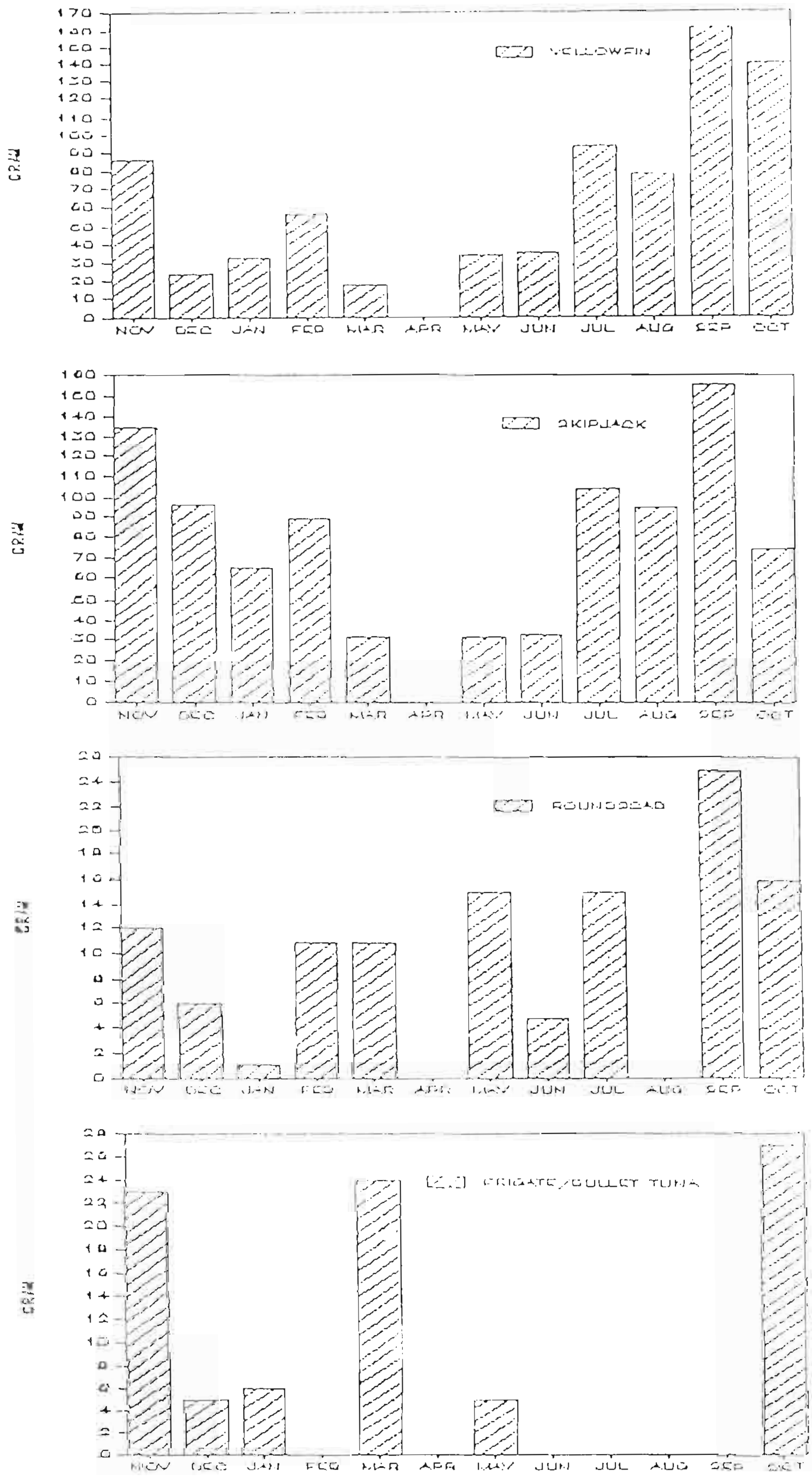
YELLOWFIN
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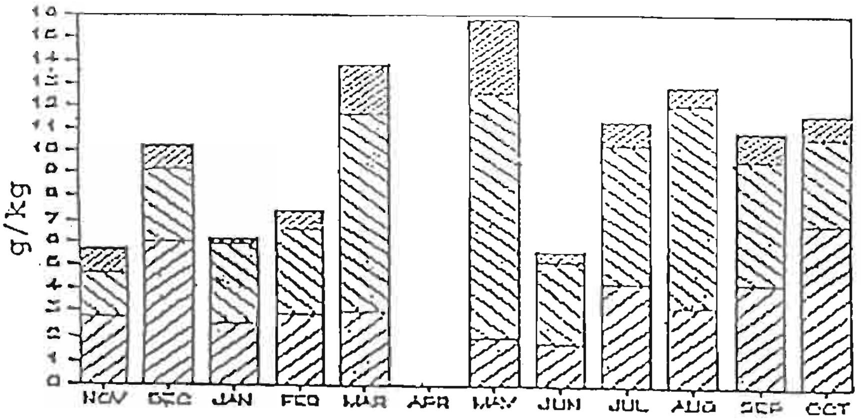
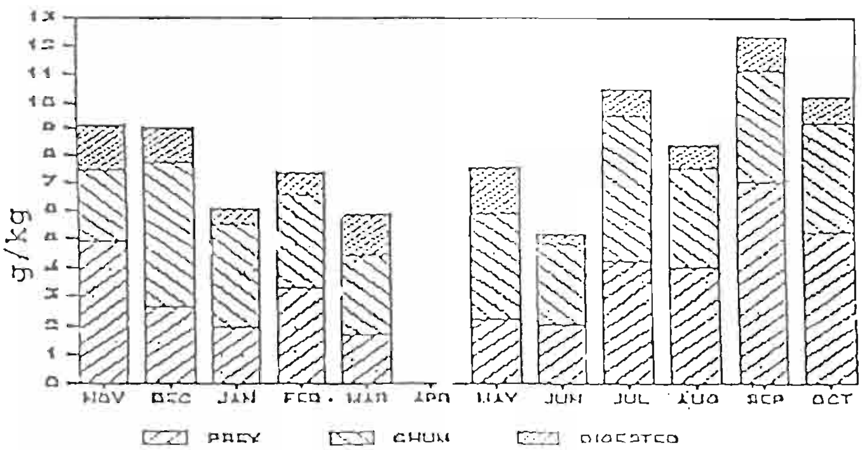
Figure 12



$\bar{x}$ prey - 3.7 g/kg
$\bar{x}$ chum - 5.2 g/kg
$\bar{x}$ digested- 1.1 g/kg
n = 217

(a) Female



$\bar{x}$ prey - 3.5 g/kg
$\bar{x}$ chum - 3.6 g/kg
$\bar{x}$ digested- 1.0 g/kg
n = 403

(b) Male

Figure 13. Monthly average weight of stomach content of a yellowfin (a) female and (b) male.

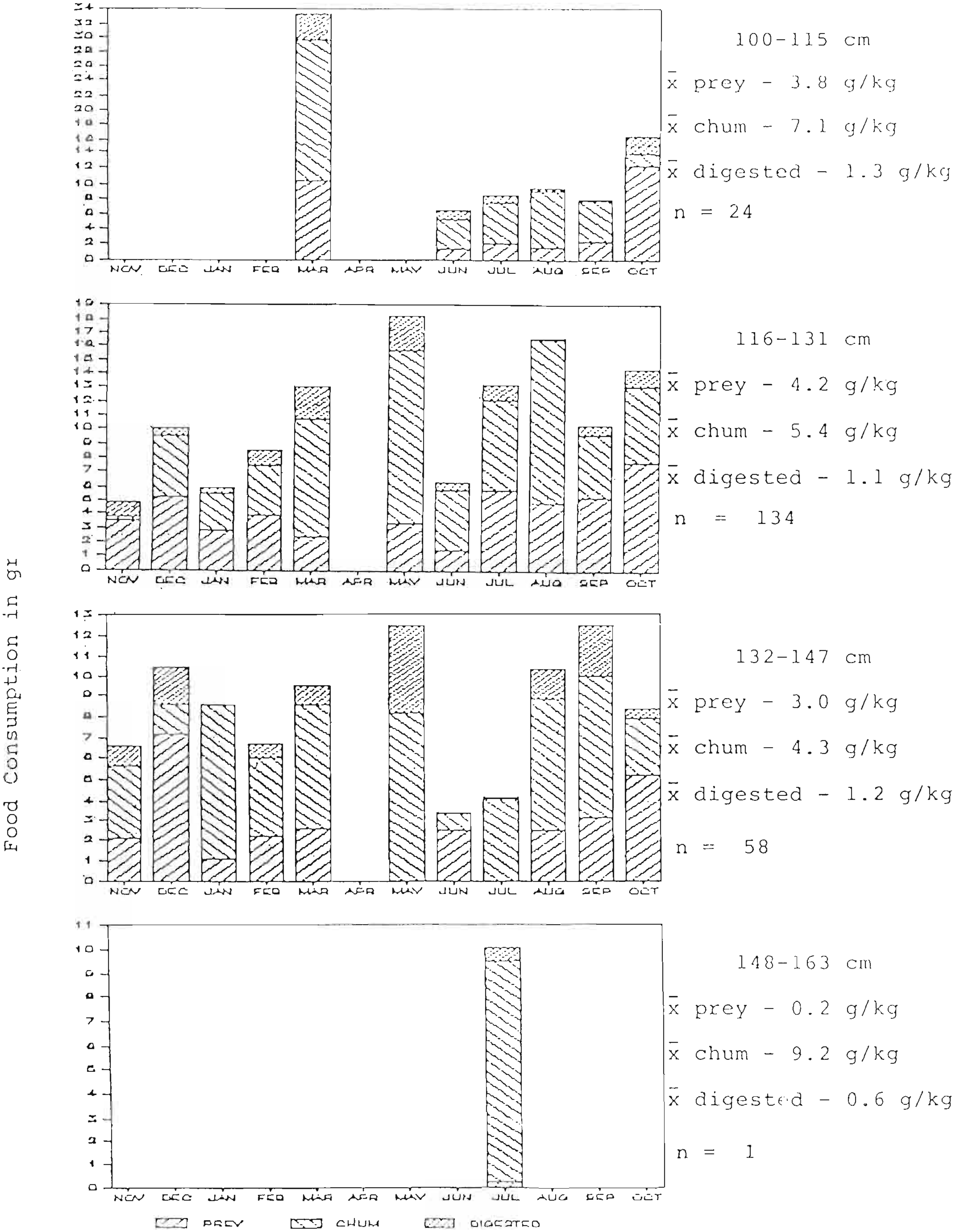


Figure 14. Monthly average consumption in grams/kilogram of prey organisms, chum and digested by length class of female yellowfin.

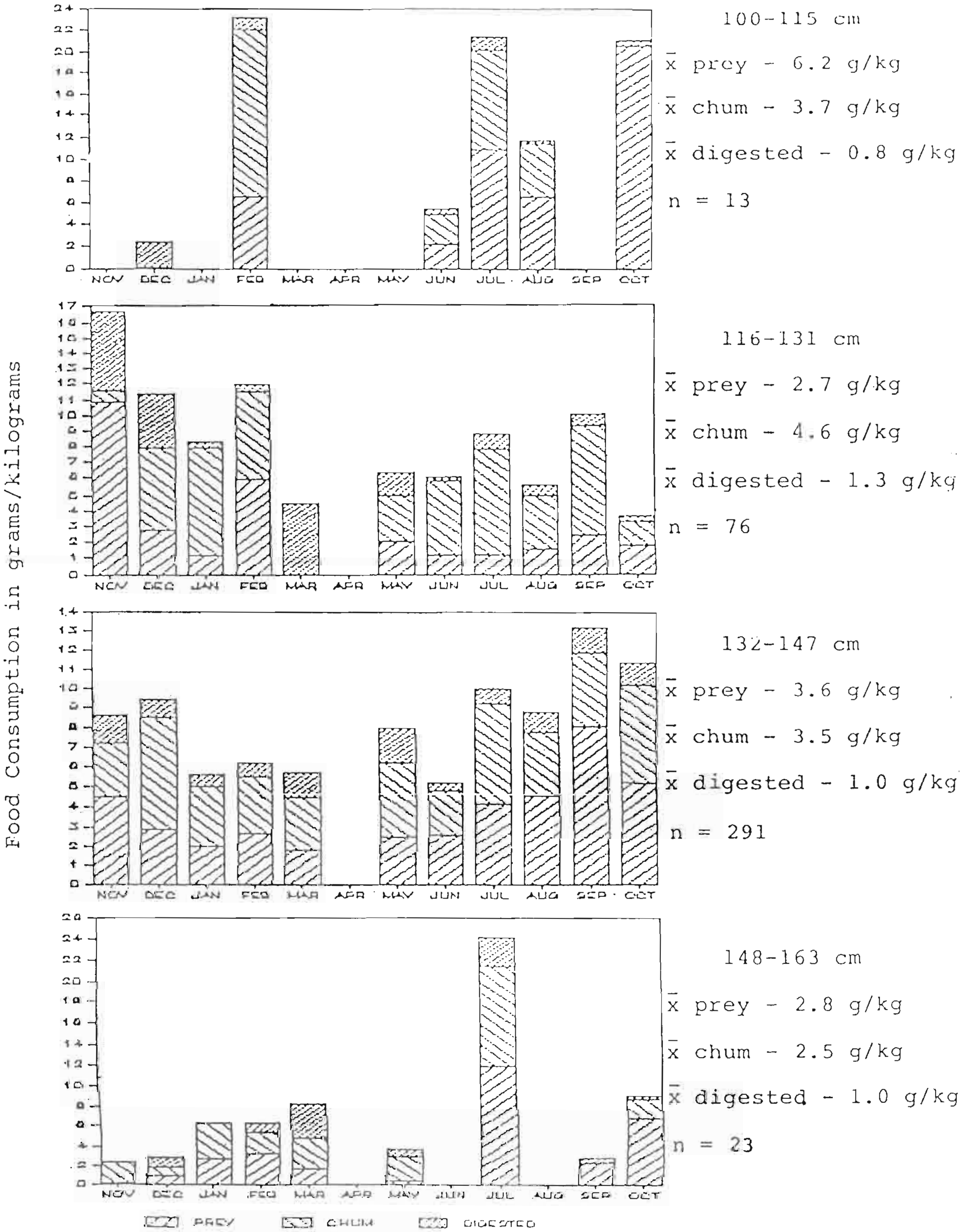


Figure 15. Monthly average consumption in grams/kilogram of prey organisms, chum and digested by length class of male yellowfin.

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IPTP Manual No.1 SCS Manual No. 2	Manual for the collection of historical statistical data on tuna and tuna-like species in the Indo-Pacific region. January, 1983.
IPTP Manual No.2	Manual for collecting statistics and sampling on tuna and tuna-like species in the Indian Ocean and Southeast Asian Region. May, 1987. 157p.

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DATA RECORD

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COLLECTIVE VOLUMES

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