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Relationship between the Composition of Food Organisms of Skipjack Tuna *Katsuwonus pelamis* and Plankton in the Waters Adjacent to Cronulla, New South Wales, Australia

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濠洲 Cronulla 近海에 있어서 가다랭이의 먹이生物과 浮游生物의 組成과의 關係研究

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Abstract : An analysis of stomach contents of skipjack tuna *Katsuwonus pelamis* and plankton samples collected during troll fishing operations showed that the abundance of some dominant organisms in tuna stomachs was related to their abundance in the plankton.

Fish larvae mainly pilchards, *Nyctiphanes australis*, brachyuran and other decapod larvae and calanoid copepods are important food items for skipjack. The copepods *Undinula vulgaris* and *Nannocalanus minor* occurred consistently throughout the survey period in both stomach contents and plankton samples. *U. vulgaris* appeared to be a preferred food considering its high percentage composition in tuna stomachs compared with its low percentage composition in the plankton. *Temora turbinata* and *N. minor* may also serve as important food items for skipjack.

The largest catches of the fish were made in January and February when plankton organisms were composed dominantly of *N. australis*, copepods and brachyuran larvae. The main stomach contents during this period were *N. australis* and brachyuran larvae.

要約 : 1975넌 12월에서 1976年 5月사이에 濠洲 Cronulla近海에서 實施한 가다랭이 漁業試驗時 採集한 浮游生物과 가다랭이 胃內容物의 組成 및 量的 相互關聯性을 分析研究하였다.

가다랭이의 먹이생물의 組成과 豐度는 浮游生物의 그것들과 잘 一致하였으며 그 主要먹이 생물로서는 *Nyctiphanes australis*, brachyura幼生, 정어리稚魚 및 Copepoda等임을 밝혔다.

가장 많은 가다랭이 漁獲은 浮游生物組成上 *N. australis*와 brachyura幼生이 가장 豐富했던 1月과 2月에 있었다.

特히 Copepoda中의 *Undinula vulgaris*는 가다랭이의 먹이생들中 선택적 기호성먹이로서 가치가 큰 것으로 나타났다.

INTRODUCTION

The skipjack tuna, *Katsuwonus pelamis*, is potentially a very important commercial species in Australia, ranking second in importance behind the southern bluefin tuna *Thunnus maccoyii* in the tuna canning industry. Recently, renewed interest brought about by some poor southern bluefin tuna seasons has emphasized the need to maximize the skipjack catch.

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The distribution of skipjack tuna in Australian waters has been investigated by several workers (Serventy 1941, 1947, Thompson 1943, Robins 1952, Hynd and Robins 1967). However, the food and feeding habits have not been studied in detail in Australia and the only information to date consists of some isolated gross observations made during other studies (e.g. Robins 1952). The food preferences for this species have been extensively studied in other parts of the world (Alverson 1963, Dragovich 1970, Nakamura 1965). A knowledge of these habits is essential to an understanding of the biology, abundance and distribution of the fish.

The present paper examines the relationships between skipjack tuna food items determined by examinations of stomach contents, and the species composition and abundance of the plankton in the waters where the fish were caught.

MATERIALS AND METHODS

The material for this study is based on the contents of 51 stomachs of skipjack tuna captured by trolling and 18 zooplankton samples collected during the skipjack tuna fishing experiments. Collection took place between 0730 and 1300 hours in the areas between Cape Solander and Garie Beach, New South Wales from December 1975 to May 1976 (Fig. 1). The plankton samples were collected by vertical hauls from various depths to the surface (For actual depths see Table 2). A modified WP2 plankton net, mesh aperture 350μm with a mouth area of 0.25m^2(57.5cm diameter) was hauled at about 1m sec^{-1}. Each plankton sample was fixed in 3% formaldehyde in seawater.

At the laboratory the samples were subdivided by Folsom splitter for identification and counting of each species. Sub-samples of $\frac{1}{2}$ or $\frac{1}{4}$ portions were usually examined. The abundance of organisms was expressed as numbers per cubic metre of water, based on the apparent volume of water sampled. Stomachs were fixed in 4% formaldehyde in seawater following dissection immediately after the fish were caught. Food organisms were identified to species level where possible and the numbers of individuals for each species or group in the stomachs were counted. When food organisms were at an advanced stage of digestion and were difficult to identify, identification was restricted to more general levels i.e. class or order.

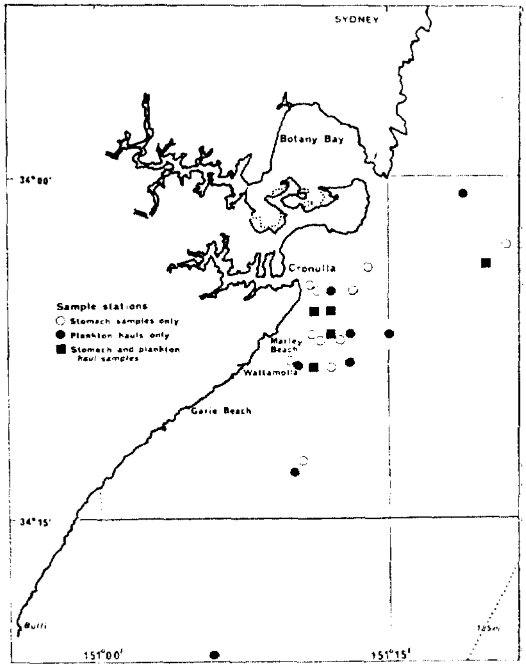

Fig. 1. Location of sampling stations for plankton and skipjack tuna stomachs in the waters adjacent to Cronulla, New South Wales, December 1975 to May 1976.

To see if certain species were being actively selected from the plankton, Ivlev's (1961) electivity index was used to calculate the degree of 'electivity' or active selections by the fish for certain prey organisms. Ivlev defined the electivity index $E=(V_i-P_i)/(V_i+P_i)$ where V_i is the relative content of one ingredient in the ration (as a percentage of the whole) and P_i is the relative value of the same ingredient in the complex of the environment. The V_i value used here is the relative value of one species as a ratio of the class of organisms represented e.g. the copepods.

RESULTS

I. Composition and abundance of food organisms of skipjack

The food organisms are listed in Table 1. The food of the tuna consisted of a wide vari-

Table 1. Composition of stomach contents of skipjack tuna in the coastal waters between Garie and Cronulla, December 1975 to May 1976.

Month	January				February		April	May
Date	15	23	30		19		15	6
Location	*M&J	Jibbon	Jibbon	Cronulla	Marley	*Watt.	Watt.	Garie
No. of samples	3	18	2	4	17	5	1	1
Nannocalanus minor		4				2	4	42
Undinula vulgaris	4				14	2	6	96
Eucalanus crassus		2						12
Paracalanus sp.	4	2						40
Clausocalanus sp.								12
Temora turbinata	8	2			10	6		
Temora sp.		4						
Candacia sp.		2					4	4
Acartia danae		5			2		4	
Corycaeus sp.		2						
Pleuromamma sp.							2	
Oncaea sp.		6			2		4	
Sapphirina sp.		2						
Copepoda sp.		6			8			
Nyctiphanes australis	28	1			59	244	3	23
Stylocheiron abreviatum	1	1						
Euphausiacea sp.				1	2			
Penaeid larvae		3					1	
Penaeid				2	1		4	5
Brachyura larvae	7	78	13	40	43	25	3	8
Decapoda larvae	10	2	6	8	10	4		
Decapoda remains								
carapace	+	C		C	C		C	C
telson	+	C		+	+		+	+
leg	C	C		C	C		C	C
other particle	+	+		+	+			
Alima larvae of squilla	2	4			3	1	1	
Brachyscelus crusculum		1				1		
Amphipoda		1	1	2	1			
Siphonophora		1			1			
Polychaeta	1		6					
Sagitta serratodenata							2	
Cavolina sp.	1	1	9	1				
Squid		3	1	1	2			
Pteropoda		1						2
Janthinidae sp.								
Doliolum sp.	1							
Oilkopleura sp.	3							
Pilchard larvae			13	1	1			
Apogonidae					1	1		

Fish larvae	7	10	5	7	2		1	3
Fish remains								
skeleton	C	C	C		+	+	C	
scale	+				+			
muscle	C				+	+	+	

*M&J=Between Marley & Jibbon, Watt.=Wattamolla, + : common C : abundant

ety of species but were mainly fish (pilchards and their larvae) and crustaceans. Large amounts of fish and crustacean remains (muscle, skeleton and scales etc.) were found in the stomachs. The pteropods and shelled heteropods were identified from their shell remains. Cephalopods were identified from their remains. The compositions varied from month to month.

Various crustacea formed the bulk of the food items. *Nyctiphanes australis* was found in large numbers in the stomachs especially in February and was the most important food organism in the skipjack diet. Brachyura larvae (megalopa stage) was the next important of the crustaceans and appeared in large numbers in stomach samples from January to May.

Other decapods such as penaeid and alima larvae of stomatopods were present in quite large numbers during January and February but not seen at all in the two samples during April and May. Amphipods were present on a low level during January and February but not during April and May.

About 13 species of copepods were identified in the fish stomachs. *Undinula vulgaris*, *Nannocalanus minor*, *Temora turbinata* and *Paracalanus* sp. were the most abundant. *T. turbinata* was present in large numders during January and February but absent thereafter. *N. minor* was present in small quantities in January, February and April but in large quantities in the May sample. *U. vulgaris* was present in all months but in a large quantity (96 individuals) in one sample in May. *Paracalanus* sp. was present in small quantities in January, absent during February and April but abundant in the May sample.

The forage fish consisted primarily of larval and juvenile forms of pelagic fish and their highest frequency of occurrence was in January with a few in February and none thereafter. Of the fish found in the stomachs, the pilchard *Sardinops neopilchardus* occurred in the largest numbers.

II. Abundance and species composition of the plankton

The species found and their abundance are given in Table 2. Maximum zooplankton abundance occurred in February when copepods dominated the samples.

The dominant copepod species was *T. turbinata*, particularly abundant during January and February showing more than 50 specimens m^{-3} in all but one haul. Its numbers decreased after that but it was still quite common in April and May. *U. vulgaris*, *P. parvus*, *N. minor* and *Acartia danae* occurred in large numbers throughout the survey period. *Clausocalanus arcuicornis*, *Paracalanus aculeatus*, *Eucalanus crassus*, *Euchaeta marina*, *Corycaeus speciosus*, *Temora discaudata*, *Calanus finmarchicus*, *C. tenuicornis* and *Candacia lipinnata* were common throughout the entire survey period. (The remaining species were either quite rare or did not occur in very many samples).

Chaetognaths occurred in large numbers throughout the survey period. *Sagitta enflata*, *S. serratodentata and S. minima* were the dominant species. *S. neglecta* was common particularly in May. *S. regularis and Krohnitta pacifica* were also quite common with a maximum in February. *S. decipiens and Eukrohnia hamata*, both

Table 2: Occurrence and abundance of plankton in the coastal waters between Cronulla and Garie Beach, December 1975 to May 1976.

Month	December		January				February				April				May			
Date	11		15		30		19				15				6			
Time	10:15	13:50	08:55	09:00	09:15	11:15	09:00	10:30	11:50	13:15	09:05	09:10	10:50	13:00	11:33	13:15	13:25	14:35
Location	*Watt.	*Marl.	Watt.		*Cron.	*Sola	Jibb	Watt	Jibb	J&M	*Marl.		Jibb.		Bulli	Garie		Jibb.
Collection depth(m)	50-0	50-0(m)	50-0	100-0	50-0	100-0	35-0	70-0	35-0	35-0	100-0	50-0	100-0	50-0	50-0	50-0	95-0	50-0
Species																		
Calanus finmarchicus?	○	○	▲	▲	▲	▲	▲	○	▲	○	▲	▲	▲	▲		○	○	○
C. tenuicornis		○	▲	▼	▲	▼	○	▲	▲	○	○	○	○	○	○	○	○	▲
Neocalanus gracilis			○	○		▲					○		○	○				
Nannocalanus minor	▲	▲	◆	◆	▼	▼	▲	▲	▼	▲	▲	◆	▲	▲	◆	◆	▼	◆
Undinula vulgaris		▲	▼	◆	▲	▼	▼	▲	●	▲	▲	◆	▲	▲	◆	◆	▼	◆
Calanoides carinatus	▲	▲	▲						▲									
Eucalanus elongatus	▲	▲	▲	▲	▲	○		○						○			○	
E. crassus	▲	▲	★	★	▼	▲	▲	▲	▼		▲	▲	○	▼	○	▲	▲	▲
E. attenuatus			▲	▲	○	▲	○		▲	○	○	○		▲	○	▲	▲	▲
E. sp.			▲	○		○	○				○							
Rhincalanus nasutus	○	○	▲	▲	▲	○		○			○		○	○				
R. cornutus			○	○														
Mecynocera clausi			▲	○			○		○		○	○	○			○	○	
Paracalanus parvus	○	○	●	●	▲	◆	▲	▲	▼	▲	▲	▲	▲	▲	▲	▼	▼	▼
P. aculeatus		○	▼	◆	▲	▲	○	▲	▲	○	○	▲	○	○	○	▲	▲	▲
Calocalanus pavo		○	○	○	○	○						○			○	○	○	
Pleuromamma abdominalis					○	○	○	○	○		○		○	▲		○	○	
Pl. gracilis				○			○						○					
Clausocalanus arcuicornis		○	▲	▼	▲	▲	▲	▲	▲	○	○	▲	○	○	▲	▼	▲	▼
Cl. furcatus				▲		○	▲	○		○				○	○	▲	○	▲
Ctenocalanus vanus				○			○	▲							○	○	○	
Canthocalanus pauper			○													○	○	
Acrocalanus gracilis				○		○		○			○	○	○					
Centropages bradyi	○	○			○	○	○	○	○	○	○	○	○	○			○	
C. gracilis						○								○				
C. furcatus			○		○	○		○	○	○	○	○			○	○	○	○
C. orsinii			○	○											○	○		
C. calaninus						○												
C. sp.	○			○									○				○	
Scolecithrix danae			○		○	○	○	○		○			○	○	○	○	○	
Scolecithricella sp.														○			○	
Lucicutia flavicornis					○	○	○	○	○	○						○	○	
Temora discaudata		○	▲	▲	▲	▲	▲	▲	▲	○	○	○			▲	▲	▲	▲
T. turbinata	○	○	●	★	●	●	●	●	●	●	▲	★	▲	◆	▲	▼	▼	★

Haloptilus acutifrons													○	◀				
Euchaeta marina	◀	○	○	◀	○	○		○	○	◀	◀	◀	○	○	◀	◀		
E. sp.	◀		○	○	○	○					○					○		
Calanopia elliptica	○	○	○	○	○				○						○			
Euaetideus giesbrechti							○		○		○		○	○				
Arietellus setosus						○												
Labidocera acutifrons	○	○	○	○														
L. *acutum*		○		○	○		○		○	○	○	○		○				
L. *cervi*									○									
L. sp.					○				○									
Candacia bipinnata	○	○	○	○	◀	○	○		○	◀	◀	○	○	○	○	○	○	○
C. *pectinata*	○	○	○		○				○		○	○	○	○		○		
C. *truncata*		○		○	○						○	○				○		
C. *catula*											○							
C. sp.												○						
Acartia clausii		○	○							◀		○	○	◀	○		○	○
A. *danae*	▶	◀	◀	◆	◀	◆	●	●	○	▶	○	○	◀	◀	▶	◆		
A. sp.	◀	○	○	◀														
Tortanus barbatus									○									
Corycaeus speciosus	◀	○	○	○	○	○	◀	○	○	◀	◀	○	◀		◀	◀		
Corycaeus sp.	○	○					○				○	○	○	◀				
Oncaea venusta									○			○					○	○
O. sp.				○									○	○		○		
Macrosetella gracilis										○	○	○	○	○				
Oithona tenuis								○	○			○						
Oithona sp.			○			○		○										
Copilia mirabilis		○	○			○		○	○	○		○						
Sapphirina sp.	○	○	○						○	○	○	○	○	○				
Copepoda larvae			○	○	○	○	○	○	◀	◆	○		○	◀	▶	●	○	
Nyctiphanes australis	◀		○		◀	○		○	●	●	●	●	▶	◆	◀	◀	○	
Stylocheiron abbreviatum									○	○		○	○					
Brachyscelus crusculum										★				○		○		
Primno macropa													○	○		○	○	
Amphipoda	○		○	○				◀	◀	◀	○	◀	○	○	○	◀	○	
Brachyura larvae		○		◀		○		○	▶	◆	◀	◀	◀	○	◀	○		

Decapoda larvae	▲	▼	◆	●	▲	▲	▲	▲	●	○		○		○		○		
Cladocera	○		◆	◆	○	○	▲	▲	●	○			○	○		○	○	○
Ostracoda	○		▼	▲	▲	○	▲	○	▼	○			○	○				○
Sagitta enflata	○	○	◆	▲	▲	▲	▲	▲	◆	▲	▲	▲	○	▲	▼	▲	▲	▼
S. lyra											○	▲	▲	○			○	
S. hexaptera															○		○	
S. bedoti		○	○	○		○	○	○	○	○	○	○		○	○	○	○	▲
S. pulchra					○		○		○			○		○	○	○		○
S. bipunctata					○	○									○	○	○	
S. serratodentata			○	○	▲	○		○	▲	○	○	▼	▼	▲	▲	○	○	▲
S. regularis			▲	○	○	○	▲	○	▲	○	○			○	○	○	○	
S. neglecta			○		○	○	▲	○	▲	▲	○	○		▲	▲	▲	▲	▲
S. minima	○	○	▼	▼	○	▲	○	○			▲	▼	▲	▲		▲	○	▲
S. robusta		○			○	○	○	○	○						○		○	○
S. ferox					○	○	○			○		○	○	○	○	○	○	○
S. decipiens								○										
S. planktonis														○	○			
Pterosagitta draco			○	○	○	○					○	○	○	○	○		○	○
Krohnitta pacifica					○	○	▲	○	○	○	○	○		○	○	○	○	○
K. subtilis			○		○													
Eukrohnia hamata						○		○										
Foraminifera	○			▼	▲	▲	▲	▲	▲	○			○	○	○	○		
Ceratium sp.			◆	★	▼	▲	▼		◆	○	○		○	○	○	○		
Polychaeta			○	○	▲	○	○	○	○	○		○		○	○	○		
Siphonophora		○	▼	▼	▲	▲	▲	▲	▼	○	○	○	○	○	▲	▲	▲	○
Pteropoda	○	○	◆	◆	▲	▲	▲		▼	○	○	○	○	○	○	○	○	○
Heteropoda	○		○	▲	○	○	○	○	○	○		○		○				
Janthinidae	○	◆	◆	▲	○	○	○		▲	○	○				○			○
Thalia democratica	●		▼	▲	▲	○	○	○	○	○	○	○						
Oikopleura sp.	○		◆	●	●	●		▲	●	▼	○	○	○	○	○	▲	○	○
Doliolum sp.			◆	▲	▲	▲	▲	▲	▲	○	○	○	○	○	○	○	○	○
Fish larvae			○	○		○	○	○	○	○	○	○	○			○	○	

*Watt. =Wattamolla
*Cron. =Cronulla
*Sola. =Cape Solander
*Jibb. =Jibbon
*Marl. =Marley
*J&M=Between Jibb. & Marl.
○= <2 specimens/m³
▲= 2~9.9 specimens/m³
▼=10~19.9 specimens/m³
◆=20~34.9 specimens/m³
★=35~49.9 specimens/m³
●=>50 specimens/m³

cold tolerant mesoplanktonic species (Thomson 1947) were present in one deeper hauls but not in shallow hauls from the same area.

The concentrations of euphausiids were due almost entirely to *Nyctiphanes australis*, predominantly the larvae. Euphausiid abundance was low in December, high in January, extremely high in February and low during April and May.

Decapod larvae were present in large numbers in December, January and February but disappeared after that time. Pteropods were represented by two species, *Creseis acicula* and *Creseis virgula conica*. Their largest numbers were in January and February. *Appendicularia*, mainly *Oikopleura rufescens*, were particularly abundant in February and to a lesser extent March, but present only in small numbers during the rest of the period. *Thalia democratica* appeared in large numbers in December but disappeared rapidly after that time. Amphipoda (mainly *Brachyscelus crusculum*) and Cladocera (mainly *Evadne tergestina* and *Penelia schmackeri*) occurred in quite large numbers in February but were quite rare at all times during the period.

Fish larvae were present in the plankton samples in very small numbers throughout the survey period.

III. Relationships between composition of food organisms and that of plankton

The composition and abundance of the major food organism of skipjack were related to those of the plankton (Table 3).

The percentage species composition of the most important copepods in the plankton samples and stomachs is shown in Figure 2. In January *T. turbinata* formed the highest percentage composition of total organisms in both the plankton and the stomachs (>30% in each). *Paracalanus* sp. was the next most common in the plankton but only approximately equal with *Acartia* sp. and *Oncaea* sp. in the diet abundance.

In February *T. turbinata* was the dominant copepod in the plankton (89%) although it comprised only 33% of the food items found in the fish stomachs. *U. vulgaris* comprised 33% of the food items although it made up only 3% of the plankton. In April *Acartia* sp. had the highest plankton percentage (36%) but was only 18% in the stomach sample, equal with *N. minor*, *Candacia* sp. and *Oncaea* sp. The highest stomach percentage composition was for *U. vulgaris* 28% even though its percentage of the plankton was only 11%. *T. turbinata* was not present in this stomach sample even though it

Table 3. Relationship between number of fish caught and the plankton abundance and stomach composition

Sample / Species	Skipjack tuna - number of fish caught									
	3		6		22		1		1	
	St	Pl	St	Pl	St	Sl	St	Pl	St	Pl
N. australis	28	8	—	20	303	605	3	2	23	8
Brachyura	7	2	53	2	34	24	3	—	8	2
Decapoda	10	38	14	8	14	49	—	2	—	2
Amphipoda	—	6	3	2	1	45	—	2	—	2
T. turbinata	8	175	—	93	16	2,247	—	48	—	26
Calanidae	8	155	—	83	18	150	10	67	202	133
Fish larvae	7	R	26	R	3	R	1	R	5	R
Date	15/1/76		30/1/76		19/2/76		15/4/76		6/5/76	

St=stomach - total nos. Pl=plankton - nos/m^3 R=very rare

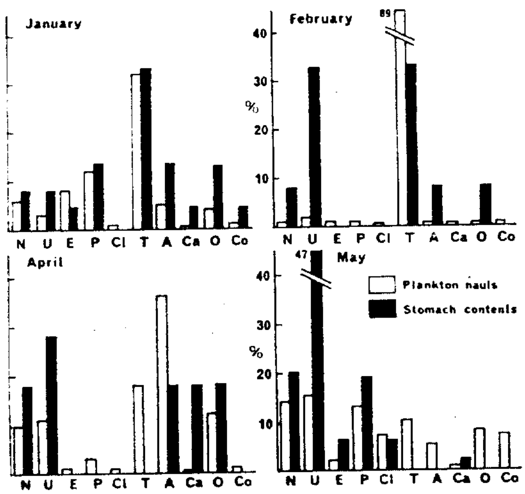

Fig. 2. Comparison of percentage composition of copepoda in sea waters and in skipjack stomachs. N: *Nannocalanus minor*, U: *Undinula vulgaris*, E: *Eucalanus crassus*, P: *Paracalanus* sp., Cl: *Clausocalanus* sp., T: *Temora turbinata*, A: *Acartia* sp., Ca: *Candacia* sp., O: *Oncaea* sp., Co: *Corycaeus* sp.

was still the second most abundant copepod species in the plankton. During May, *U. vulgaris* while marginally the most abundant organism in the plankton (15%) was overwhelmingly the most common in the stomach sample (47%). *N. minor* (12%), *Paracalanus* sp. (19%) were also important constituents in the stomach in May.

Food species which had higher electivity values were *Undinula vulgaris*, *Candacia* sp., *Oncaea* sp., *Acartia* sp. and *Nanocalanus minor*, although the values varied from month to month (Table 4). It is particularly significant that *Undinula vularis* have always showed high values of electivity throughout the survey period.

DISCUSSION

The survey was limited to only five months of the year for logistic reasons and was carried out on an opportunistic basis. It is known that skipjack is not available in these waters year round but a sampling program for one full year would have been desirable. However the results suggest that skipjack is not only opportunistic feeders but actively select at least one copepod species and fish larvae. The largest catches of fish made in February when plankton organisms, especially *N. australis*, copepods and brachyura larvae were very abundant in both stomachs and plankton indicate that skipjack tuna distribution is related to areas of abundance of these plankton species.

The use of an index of selection in non-controlled conditions as we have in this case is subject to many dangers—not the least of which is the territory that can be covered by the fish (in this case a fast swimming tuna) in a short time. It is possible the fish has fed in areas with a food complex quite different to the one in which it was caught. The safeguard against this here is that the digestion process is quite fast and any organisms in the stomach for more than a short time will be broken down so as to be beyond identification.

Comparison of the E values for the same species from month to month is different because other changes have taken place in the available food supply and what bearing these changes have on the preference for a particular copepod

Table 4. Comparison of the values for electivity of different copepods for skipjack in different months

Food species	Electivity values			
	Jan.	Feb.	April	May
N. minor	+0.18	+0.78	+0.28	+0.18
U. vulgaris	+0.52	+0.88	+0.43	+0.52
E. crassus	−0.33	−1.0	−1.0	+0.50
Paracal. sp.	+0.06	−1.0	−1.0	+0.19
Clausocal. sp.	−1.0	−1.0	−1.0	−0.08
T. turbinata	+0.02	−0.46	−1.0	−1.0
Arcartia sp.	+0.53	+0.88	−0.39	−1.0
Candacia sp.	+0.88	−1.0	+0.94	+0.33
Oncaea sp.	+0.51	+0.88	+0.20	−1.0
Corycaeus sp.	+0.78	−1.0	−1.0	−1.0

is unknown. It must also be remembered that the E values are calculated using the percentages of copepods only and does not take into account other portions of the diet or available food supply (fish, decapods etc.).

Apparently the low values in the plankton for *N. minor* and *U. vulgaris* in February (1% and 2%) are not yet below a critical minimum beyond which the species will not be selected any longer. It may be that in May the percentage composition of *T. turbinata* dropped below this critical minimum and was not selected at all, although this could be a sampling error. Some other figures too are of special interest e.g. *Candacia* sp. where E values vary between +0.94 and −1.0 i.e. almost the entire range.

The plankton net used cannot have been suitable for the collection of fish larvae and thus plankton composition of fish larvae abundance cannot be compared to stomach contents. But other food items particularly *N. australis* and brachyuran larvae showed similarities between plankton and stomach content composition.

The present study has pointed to some discriminatory feeding behavior by skipjack tuna in S.E. Australian waters. This finding may be useful in determining habitat preferences of these commercially important fish, and as such we consider that a large scale investigation of skipjack food preferences in Australian waters would be a valuable contribution.

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