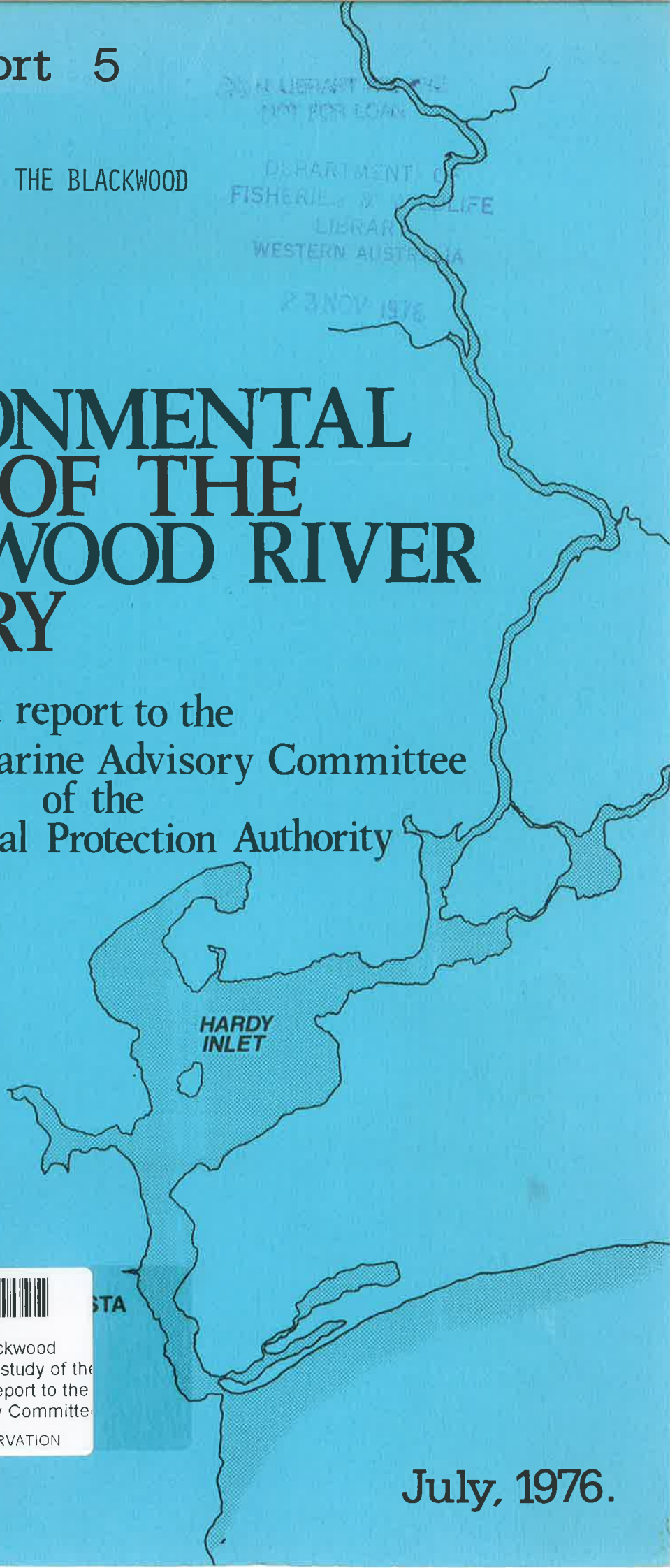
Technical Report 5

THE FOOD OF THE FISH OF THE BLACKWOOD RIVER ESTUARY

ENVIRONMENTAL STUDY OF THE BLACKWOOD RIVER ESTUARY

a report to the
Estuarine and Marine Advisory Committee
of the
Environmental Protection Authority



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THE FOOD OF THE FISH OF THE BLACKWOOD RIVER ESTUARY

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The Food of the Fish of the Blackwood River Estuary.

Introduction

The diets of several species of fish taken by commercial and amateur fishermen in some West Australian estuaries were examined by Thomson (1957), while Kowarsky (1975) studied the diet of cobbler *(Cnidoglanis macrocephalus)* in the Swan River Estuary. However, no detailed study of the feeding habits of both the commercially and non-commercially important fish cohabitating a Western Australian estuary has been made.

The aim of this study was to determine the diet of each species of fish found in the Blackwood River Estuary, and to show whether diet changed seasonally for a given species. It was not possible to sample each species with the same frequency, but the numbers taken reflect the abundance of the various species at the time of sampling.

Methods

a) Stomach collection and examination

Stomachs were taken from fish, caught in the estuary with set and seine nets, every second month from March 1974, to March 1975 inclusive. The total length to the nearest millimetre, date, time, area, and method of capture was recorded for each fish sampled. The stomachs of larger fish were removed and individually preserved in a 5-10% solution of formalin, while small fish were preserved intact in a similar solution.

Only stomachs were examined for contents since food in the intestine was usually in an advanced state of digestion. For species such as cobbler and toadfish with poorly developed stomachs, examination was restricted to the anterior portion of the digestive tract.

The contents of each stomach were examined with a low-powered (x6.3 to x40) binocular microscope. Food items were identified where possible to the species level, and recorded.

b) Content analysis

Initially both the occurrence and dominance methods (Hynes 1950) were used to assess the composition of the stomach contents. The occurrence method involved recording the number of stomachs in which each food type occurred and expressing this number as a percentage of the total number of stomachs examined which contained food. In the dominance method the number of fish in which each food item occurred as the dominant foodstuff was expressed in the same way as for the occurrence method. The number of stomachs which contained no food was recorded.

Data collected later in the programme was analysed by the points method (Hynes 1950) in addition to the techniques outlined above. The points method involved assigning a number of points to each stomach according to a subjective estimate of "stomach fullness" (the criteria of Ball, 1961 were used) and this number was then divided between the food types according to the visually estimated volumes of each type present. The sum of points for each food type was expressed as a percentage of the sum of points for the combined food types in all the stomachs of the sample for the particular species being considered.

Results

A total of 4 489 stomach samples from 39 species of fish caught in the Blackwood River Estuary were collected between March 1974 and March 1975 (Table 1)

a) Methods of Stomach Content Analysis

Comparison of the results from the analysis of the same set of stomach contents data (Table 2), using the points, occurrence and dominance methods, showed that these methods provided substantially similar results for the species tested.

b) Composition of the diet of different fish species

Occurrence method results were used to determine the composition of the diet of 24 species of fish sampled frequently in the twelve month period (Table 3). Summaries of results of stomachs examined from less abundant fish are shown in Table 4.

Fish caught in the estuary were found to have eaten estuarine plants or animals, rather than plants or animals from outside the estuary.

The highest carnivores such as tailor, mulloway, small toothed flounder, and flathead fed mainly on small fish and shrimp. However, the carnivores such as Western yellow fin whiting, King George whiting, long finned gobies, South West goby, and long snouted flounder fed mainly on polychaetes. Crustaceans were the dominant food of herring, while hardyheads, cobbler and toadfish shared a more generalised diet of polychaetes, crustaceans, molluscs and chironomid larvae. Blue and sandy sprat were the only fish which appeared to feed dominantly on zooplankton.

Yelloweye mullet, black bream and silver bream were the dominant omnivores feeding mainly on molluscs and crustaceans. However, plant material occurred frequently in the stomachs of each of these species and at times the stomachs of yelloweye mullet contained nothing but plants. Trevally ate mainly crustaceans and chironomid larvae, but often contained some plant material, while leather jackets, brindled gobies and blue spot gobies

fed mainly on polychaetes, chironomid larvae, and small crustaceans.

Although no fish was found to be entirely herbivorous, aquatic plants were consistently found in large volumes in the stomachs of striped perch and dusky sea garfish. Animal material was rarely present in the stomachs of either species and in most instances its volume, relative to the volume of plant material in the same stomach, was insignificant.

Sea mullet was the only species amongst those examined found to feed entirely on mud, which contained small living plants and animals and putrifying organic matter (detritus).

c) Seasonal Feeding Pattern

Fish stomach sampling was sufficiently frequent to allow comparison of seasonal feeding patterns for the following species: sea mullet, yelloweye mullet (>100 mm); black bream, silver bream (>100 mm), western yellow fin whiting, herring, and tailor (Table 5 a-g). The available evidence would suggest there was little change in the type of food eaten by the above species during the year. However, there were some exceptions.

In July, the shrimp, *Palaemonetes* became very abundant near the mouth in the Inlet Channel due to the winter freshwater flush which swept them downstream (Bray, 1975). On the other hand, polychaete numbers were declining (this report part 1). In this situation Western yellow fin whiting fed mainly on shrimp, rather than polychaetes, which were the dominant food eaten in other months.

Benthic sampling (report part 1) showed polychaetes to increase in abundance from winter to summer, peak abundance was in January - March of 1975. The changing abundance was reflected in the diets of both black and silver bream, which fed more frequently on polychaetes in March than in other months.

The percentage of empty stomachs for each of the more abundant species (Table 6) did not appear to be significantly different on a seasonal basis.

d) Regional Feeding Pattern

The estuary was arbitrarily divided into five areas which were to some extent separate. They were:

(i) Swan Lakes and the Deadwater,
(ii) the Inlet Channel,
(iii) the Lagoon,
(iv) the basins around Molloy Island, and
(v) the river.

The occurrence method was used to show the diet of three species of fish - black bream, yelloweye mullet, and Western yellow fin whiting in each of these areas (Table 7 a-c). The sample obtained from each area in

the separate months for a given species was small and only the yearly total was compared. Most other species of fish were not sampled with sufficient frequency from each area to permit a regional comparison to be drawn for them.

The percentage of empty stomachs for black bream was similar in each of the areas (Table 8). However, for both yelloweye mullet and Western yellow fin whiting the percentage of empty stomachs was highest in the Swan-Lakes-Deadwater area.

The food of black bream was markedly different between the five areas (Table 7 a). The dominant items in the diet in each area correlated positively with the abundance of invertebrate species (see report part 1). The food of yelloweye mullet (Table 7b) and western yellow fin whiting (Table 7c) differed slightly between the areas. The major difference in the composition of the food of yelloweye was the low occurrence of univalves in the diet at the Lagoon and Basin areas; while the major difference for whiting was the greater occurrence of bivalves in their diet at the basin and river stations.

e) Variation in feeding in Relation to fish size

Size was found to influence the type of food eaten in only 2 species, yelloweye mullet and silver bream (Table 3). Small yelloweye mullet (<100 mm) fed mainly on polychaetes, chironomid larvae, and diatoms; while larger yelloweye (>100 mm) fed mainly on molluscs, chironomid larvae, and benthic sea grasses or algae. Small silver bream (<100 mm) fed dominantly on chironomid larvae and crustaceans, particularly ostracods. Molluscs and crustaceans were the main food of large silver bream (>100 mm).

Discussion

The occurrence method was used in the presentation of the stomach contents analysis since it provided essentially the same results as the dominance and points methods, yet was a more rapid technique of analysis. No information on the quantity of each food type was provided by the occurrence method (Hynes, 1950) and consequently the method was biased to small frequently occurring food items. However, the accuracy of the points method suffers from its subjectivity and from the difficulty in maintaining a constant grading level (McDowall, 1965).

The importance of the estuary as a feeding ground for fish was demonstrated by the high incidence of estuarine plants and animals in the stomachs of the fish examined. Some of the fish were temporary marine invaders, and could have been expected to have some food of marine origin, but had only food from the estuary in their gut.

Fish species were grouped into three categories according to the frequency of occurrence of plant and animal matter in their stomachs. Herbivores were those containing dominantly plant material; carnivores were those containing dominantly animal material; and omnivores were those containing dominantly animal material but also a substantial amount of plant material. However, it may have been more valid to group the fish according to their ability to digest cellulose. Black bream, silver bream and trevally, which have been classed as omnivores, did not appear to be able to digest plant material, as sea grass from the stomach and intestine of these species usually appeared unchanged. Blaber (1974) using a technique where plant material from the stomach and intestine was compared photographically, demonstrated that neither silver bream *(Rhabdosargus sarba)* or black bream *(Mylio butcheri)* in South African Estuaries were digesting plant material. Furthermore, Stickney and Shumway (1974) found no cellulose activity in the stomachs examined from species of fish in the Sparidae family. Therefore it is suggested that the frequent ingestion of plant matter that was apparent for the above species may have been related to their feeding behaviour, rather than as a dietary alternative. However, they may have obtained nutrients from the epiphytic fauna which were often dense on the stems and leaves of the sea grasses.

The herbivorous feeding habit of dusky sea garfish in West Australian estuaries, previously reported by Thomson (1957), contrasts with their planktonic feeding habit in South African estuaries (Talbot 1955). Plankton was not abundant in the Blackwood, and the epiphytic fauna may have been important as a food. Plants such as *Ruppia* appeared to be digested in part by garfish and so were of nutritional value to this species.

Seasonal changes in the diet of 3 species of fish correlated positively with changes in the relative abundance of potential food species. The apparent lack of seasonal changes in the feeding patterns of other species may be an indication that a sufficient supply of the preferred food of each species was present throughout the year. However, sample sizes were generally small; perhaps too small to show seasonal variations.

Empty stomachs could not be used as an indicator of food availability since the feeding intensity, daily rations, and evacuation rates of the different fish species were not known. Furthermore some carnivorous fish, such as tailor, may regurgitate food when hooked or meshed (Thomson 1957), and so empty their stomach. A high percentage of tailor had no food in their stomach, but it was impossible to determine whether this was due to a shortage of food or to regurgitation. There was also evidence which suggested that some species entering the estuary had little or no food in their stomachs at the time of entry. A high percentage of Western yellow fin whiting and yelloweye mullet caught in the Deadwater had empty stomachs (Table 8). However, the Deadwater had a very rich invertebrate fauna (see report part 1).

Since netting was done on a rising or high tide, and the entrance to the Deadwater was at the mouth of the estuary, some of the fish caught in this area may have entered just prior to being caught and had not eaten. Fewer fish of these two species had empty stomachs in areas further into the system where the fauna was less rich. As it was impossible to tell if a fish had recently entered the estuary, the condition of the fish stomachs, at least near the mouth, could not be used as a measure of food availability.

Black bream fed on the most abundant invertebrate species in each of the five areas examined, which emphasises their opportunistic feeding nature. This would suggest that black bream did not move far in the estuary during the course of their daily feeding. Western yellow fin whiting and yelloweye mullet were also opportunistic feeders, but their diet between areas was less varied. Perhaps these species were more mobile than bream and moved greater distances in the estuary.

The juveniles of some fish species utilize a different food source to the adults of the same species. Juvenile sea mullet are pelagic feeders, and eat zooplankton (Zismann, 1975), while larger sea mullet are benthic feeders and eat detritus (Thomson 1954). The transition in feeding occurred when fish attained a length of about 25 - 30 mm T.L. All sea mullet examined from the Blackwood River were benthic feeders; the smallest examined was 49 mm T.L. Silver bream and yelloweye mullet showed a size related change in diet, but it involved a change in the size of the food, rather than a change in the source. Post larval fish (less than 20 mm T.L.) were not sampled for any species of fish. Hence those examined had already adopted the adult feeding pattern.

The findings of the present study compare favourably with those of the study of Thomson (1957). The same type of feeding pattern was evident for a given species of fish in each of the West Australian estuaries; that is, fish identified as carnivores in the Blackwood, were also shown to be carnivorous in other estuaries, and so on. However, the items constituting the diet of a given species differed between the estuaries sampled and reflected the opportunistic feeding nature of the various fish species.

The macrobenthic invertebrate fauna was a major source of food for most of the fish in the Blackwood River estuary. The percentage occurrence of invertebrate species in the stomachs of all the fish sampled (Table 9) provided a measure of their utilization, since the number of each species of fish sampled was roughly proportional to its abundance in the estuary. A strong relationship between occurrence as a food item (Table 9) and relative abundance in the estuary (Table 10) was evident for the macrobenthic invertebrates. The most abundant invertebrates, particularly those living in the water column or on the surface of the sediment, were eaten most frequently, perhaps because they were more easily seen by fish. The low occurrence in fish stomachs of the very abundant polychaete worms *Capitella*

and *Scoloplos* may in part be attributed to their burrowing habit. However, neither had distinguishing hard parts, such as the jaws of *Ceratonereis* or the head capsule of chironomid, by which they could be easily recognised in stomachs where digestion was more advanced. It is therefore possible that they have been under-estimated in the stomach contents analysis study.

Conclusions

1. The food of the fish caught in the estuary was estuarine in origin, rather than marine.

2. Most of the fish were benthic feeders and the major food source was the macrobenthic invertebrate fauna. Most fish were carnivorous, but several omnivorous and herbivorous species were present.

3. The fish were predominantly opportunistic feeders. They ate a wide variety of food items; and fed dominantly on the most abundant invertebrate species.

4. Seasonal changes in the diets of the fish were not marked. The frequency of empty stomachs could not be used as an indicator of food availability.

5. The diet of three species of fish changed along the length of the estuary and correlated with a change in the fauna, further showing the opportunistic nature of these species.

6. Change in feeding habit, resulting from a change in size for a given species was not demonstrated because small fish were not sampled.

7. The results of this study confirmed and supported the results of a study of the diet of the same species in other West Australian estuaries.

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TABLE 1. Number of Fish Stomachs sampled in each month, March 74 to March 75.

FAMILY	SCIENTIFIC NAME	COMMON NAME	1974 Mar.	May	July	Sept	Nov	1975 Jan	Mar	Total
Mugilidae	*Mugil cephalus*	Sea mullet	29	38	40	59	58	88	63	375
	Aldrichetta forsteri	Yelloweye mullet	60	63	63	57	80	167	171	661
Sillaginidae	*Sillago schomburgkii*	Western Yellow Fin Whiting	70	21	47	27	40	78	60	343
	Sillao punctata	King George Whiting	31	10	18	18	17	57	125	276
Plotosidae	*Cnidoglanis macrocephalus*	Cobbler	5	1	-	4	10	9	10	39
Arripidae	*Arripis georgianus*	Herring	26	27	10	40	50	49	97	299
	Arripis trutta esper	Australian salmon	2	1	1	3	-	-	1	8
Exocoetidae	*Hemiramphus melanochir*	Dusky sea garfish	10	-	-	-	-	-	10	20
Sparidae	*Mylio butcheri*	Black Bream	72	51	82	91	55	51	64	466
	Chrysophrys unicolor	Snapper	1	4	-	-	-	-	1	6
	Rhabdosargus sarba	Silver Bream (Tarwhine)	77	2	9	69	59	79	197	497
Carangidae	*Usacaranx georgianus*	Trevally	27	1	-	2	6	4	34	74
	Trachurus mc.cullochi	Yellow tail	1	-	-	-	-	-	-	1
Pleuronectidae	*Ammotretis rostratus*	Long snouted flounder	1	2	2	6	3	8	4	26
Bothidae	*Pseudorhombus jenynsii*	Small toothed flounder	9	5	-	-	-	3	9	26
Pomatomidae	*Pomatomus saltator*	Tailor	31	28	1	29	48	28	27	192
Engraulidae	*Engraulis australis fraseri*	Anchovy	-	-	-	-	-	-	3	3
Theraponidae	*Helotes sexlineatus*	Striped perch	28	3	2	3	29	15	24	104
Enoplosidae	*Enoplosus armatus*	Old wife	3	4	-	-	-	3	1	11
Balistidae	*Novodon* spp.	Leather Jacket	3	25					1	29
	Scobinichthys granulatus									
	Acanthalateres brownii									
	Meuschenia sp.									
Gobiidae	*Favonigobius tamarensis*	South west goby	-	-	10	52	43	28	30	163
	Favonigobius lateralis	Long finned goby	-	-	-	42	32	55	71	200
	Arenogobius bifrenatus	Brindled goby	4	-	-	2	10	13	14	43
	Lizagobius dorum	Blue Spot goby	-	-	-	42	20	3	2	67
Atherinidae	*Atherinisoma* spp.	Hardyhead	21	16	41	60	40	79	40	297
Odacidae	*Heletta semifasciata*	Blue rock whiting	-	-	-	-	-	-	11	11
Dussumieriidae	*Spratelloides robustus*	Blue Sprat	-	10	-	-	-	-	-	10
Clupeidae	*Hyperlophus vittatus*	Sandy sprat	-	7	-	-	-	10	8	25
Tetraodontidae	*Sphaeroides pleurogramma*	Banded Toadfish	13	29	1	19	14	7	39	122
	Contusus richei	Prickly Toadfish	7	3	9	-	9	4	15	47
Labridae	*Pseudolabrus parilus*	Brown Spotted parrot fish	-	-	-	-	-	-	5	5
Sciaenidae	*Sciaena antarctica*	Mulloway	-	-	-	1	1	5	14	21
Elopidae	*Elops australis*	Giant herring	-	-	-	-	-	-	1	1
Platycephalidae	*Platycephalus* sp.	Flathead	-	-	-	-	3	4	7	14
Cheilodactylidae	*Psilocranium nigricans*	Dusky morwong	-	-	-	-	-	-	2	2
	Goniistius vizonatus	Magpie morwong	-	-	-	-	-	-	2	2
Triglidae	*Chelidonichthys kumu*	Red gurnard	-	-	-	-	-	-	1	1
Dasyatidae	*Dasyatis brevicaudata*	Stingray	-	-	-	-	-	-	1	1
Rhinobatidae	*Trygonorhina fasciata*	Fiddler Ray	-	-	-	-	-	-	1	1

TABLE 2. Comparison of three methods of assessing the percentage composition of the food of 138 Western Yellow fin Whiting and 115 Black Bream from the Blackwood River Estuary.

FISH SPECIES	Western Yellow Fin Whiting Composition of food (%)			Black Bream Composition of food (%)		
	Occurrence Method	Dominance Method	Points Method	Occurrence Method	Dominance Method	Points Method
POLYCHAETES	41.5	57.3	59.5	17.6	20.4	20.5
Capitella capitata	11.8	4.8	8.8	2.5	1.0	1.3
Haploscoloplos sp.	3.2	3.9	3.5	2.9	1.0	1.8
Arenicola sp.	-	-	-	1.3	3.3	3.6
Ceratonereis erythraeensis	31.7	44.7	42.5	12.6	15.4	12.8
Nereis sp.	0.4	1.9	2.9	-	-	-
Armandia sp.	0.8	1.9	1.8	2.1	-	1.0
CRUSTACEANS	20.7	21.4	20.4	14.8	20.2	17.1
Mysidacea	4.7	1.9	2.3	0.4	-	0.2
Sphaeroma quoyana	0.4	-	0.2	0.4	-	-
Paracorophium sp.	0.4	-	0.1	-	-	-
Melita sp.	2.0	1.0	1.2	1.3	-	0.8
Shrimp	11.1	16.5	12.2	11.4	19.2	13.7
Prawn	0.4	1.0	2.4	0.8	1.0	2.2
INSECTS	5.2	1.0	1.4	2.4	-	0.4
Chironomid	5.2	1.0	1.4	2.4	-	0.4
MOLLUSCS - Bivalves	10.4	2.9	7.0	16.7	6.3	11.5
Xenostrobus securis	0.8	-	0.8	3.8	3.3	3.6
Anticorbula amara	6.3	1.9	3.8	4.2	1.0	2.3
Arthritica helmsii	0.4	-	0.2	6.3	1.0	2.7
Katelysia scalarina	-	-	-	1.3	-	0.6
Sanguinolaria biradiata	-	-	-	1.3	-	0.7
Tellina spp.	-	-	-	1.3	1.0	1.6
Siphon tubes	2.8	1.0	2.1			
MOLLUSCS - Gastropods	-	-	-	5.2	5.4	4.8
Bulla sp.	-	-	-	0.4	-	0.4
Hydrococcus graniformis	-	-	-	1.7	1.0	0.8
Potamopyrgus sp (estuarine)	-	-	-	3.0	4.4	3.6
PLANTS	8.0	2.9	3.0	25.7	27.0	28.2
Algae	2.8	1.9	1.1	8.0	10.0	10.9
Aquatic Angiosperms	4.0	1.0	1.9	16.4	17.0	17.3
OTHER	14.1	14.6	8.4	17.6	18.6	18.0
Fish matter	3.2	4.8	2.6	8.0	14.3	13.8
Ova	-	-	-	0.4	-	0.2
Detritus	8.3	9.7	5.7	1.7	1.0	0.6
Sand	0.4	-	0.1	5.0	-	1.9
Digested (unidentifiable) matter	-	-	-	1.3	3.3	1.5

TABLE 3

OCCURRENCE (%) OF ITEMS IN THE STOMACH CONTENTS OF FISH FROM THE BLACKWOOD RIVER ESTUARY - MARCH 1974 to MARCH 1975.

	SEA MULLET	YELLOWEYE MULLET		WESTERN YELLOW FIN WHITING	KING GEORGE WHITING	COBBLER	HERRING	DUSKY SEA CARPISH	BLACK BREAM	SILVER BREAM		TREVALLY	LONG SNOUTED FLOUNDER	SMALL TOOTHED FLOUNDER	TAILOR	STRIPED PERCH	LEATHER JACKET	LONG FINNED GOBY	SOUTH WEST GOBY	BRINDLED GOBY	BLUE SPOT GOBY	HARDYHEAD	BANDED TOADFISH	PRICKLY TOADFISH	MULLOWAY	FLATHEAD
Number examined	375	175	486	343	276	39	295	20	466	194	303	74	26	26	182	104	29	200	163	43	67	297	122	47	21	1
Number with contents	300	135	397	245	248	35	224	20	420	178	245	65	16	22	125	101	29	153	139	38	64	262	112	44	16	1
Size range (mm)	49-560	48-100	102-362	64-366	62-293	85-610	192-300	128-386	140-400	25- 99	122-268	42-280	86-270	47-330	49-400	57-250	36-142	25- 74	40- 90	62-158	29-73	27-107	100-154	42-194	214-390	250-72
Mean length (mm)	228.6	73.9	249.1	233	123.6	384.5	240.8	252.4	227.3	49.2	193.4	172.5	172	144.7	245.9	192.2	70.8	56.3	62.7	116.5	42.8	65.8	122.5	84.0	298 9	391.0
STOMACH CONTENTS:																										
POLYCHAETES	1.0	44.4	27.9	76.7	87.5	57.1	21.4	20.0	23.1	23.0	10.2	0	62.5	9.1	0	1.0	38.0	76.5	68.3	68.4	23.4	31.3	10.7	22.7	-	-
Capitella capitata	-	9.6	11.3	19.8	13.7	-	0.9	-	1.9	-	-	-	6.2	-	-	-	-	0.6	-	15.8	6.7	-	1.8	-	-	-
Mapicacolplos sp.	-	4.4	6.3	24.1	11.3	-	0.4	-	5.0	-	2.7	-	6.2	-	-	-	-	3.2	1.4	5.3	-	-	1.8	-	-	-
Sabellid sp.	-	-	1.0	-	-	-	-	-	-	5.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ceratonereis erythraeensis	1.0	35.6	20.9	64.1	81.4	57.1	20.9	-	18.3	18.5	9.8	-	56.2	9.1	-	1.0	38.0	72.5	67.6	50.0	21.9	31.3	7.1	15.9	-	-
Nereis sp.	-	-	0.2	1.6	-	-	-	-	1.4	-	-	-	-	-	-	-	-	-	-	-	1.6	-		9.1	-	-
Armandia sp.	-	0.7	0.8	-	9.7	5.7	-	-	1.2	-	0.4	-	-	-	-	-	-	2.0	-	10.5	-	-	1.8	-	-	-
CRUSTACEANS	3.0	9.6	26.7	37.9	44.4	60.0	84.8	-	36.2	62.9	46.5	87.7	12.5	50.0	37.6	12.9	55.2	22.2	41.0	34.2	48.4	28.6	43.7	25.0	56.2	80
Cladocera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.7	-	12.5	-	-	-	-	-
Ostracoda	1.3	0.7	6.3	-	-	-	-	-	0.7	20.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Harpacticoida	1.7	-	3.0	-	-	-	-	-	-	2.2	-	-	-	-	-	2.0	-	1.3	5.0	2.6	7.8	3.4	0.9	2.3	-	-
Gladiofurens sp.	-	-	4.0	-	-	-	-	-	-	6.7	-	-	-	-	-	-	3.4	5.2	-	5.3	26.6	6.1	-	-	-	-
																		2.6	2.2	7.9	14.0	5.0	-	-	-	-
Mysidacea	-	2.9	3.3	6.9	4.8	-	40.6	-	0.5	5.6	5.7	46.2	-	4.5	-	-	-	1.3	-	2.6	-	-	-	-	-	-
Amphipods	-	2.9	4.8	4.5	25.0	31.4	11.6	-	2.1	29.2	29.0	50.8	6.2	4.5	-	4.0	51.7	18.3	10.8	7.9	7.8	5.7	14.3	2.3	-	-
Sphaeroma quoyana	-	-	1.0	1.2	1.6	14.3	21.9	-	1.9	7.7	3.3	1.5	-	-	-	-	3.4	1.3	3.6	5.3	-	4.2	15.2	6.8	-	-
Shrimp (*Palaemonetes* sp.)	-	5.2	10.8	23.3	7.2	34.3	42.4	-	27.4	15.2	10.0	32.3	6.2	36.4	28.0	6.9	-	1.3	10.8	7.9	-	6.9	14.3	2.3	56.2	60
Prawn (*Metapenaeus dalli*)	-	-	0.5	3.7	0.8	2.8	9.4	-	2.9	-	0.4	-	-	9.0	9.6	-	-	-	0.7	-	-	0.4	-	2.1	-	-
Crab	-	-	0.2	3.3	3.2	2.8	0.4	-	2.6	0.6	2.4	12.3	-	9.0	-	-	3.4	-	-	-	-	-	10.7	6.8	-	20
INSECTS	-	38.5	41.6	6.5	20.4	2.8	4.9	5.0	3.8	47.8	13.5	41.5	6.2	0	0.8	5.0	62.0	12.4	25.2	21.0	25.0	20.2	8.0	2.3	-	
Chironomids	-	38.5	41.6	6.1	20.4	2.8	0.9	5.0	3.8	47.8	13.5	41.5	6.2	-	0.8	5.0	62.0	12.4	25.2	21.0	25.0	17.9	8.0	2.3	-	
Non-aquatic	-	-	-	0.4	-	-	4.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.7	-	-	-	
MOLLUSCS : Pelecypods	3.0	0.7	37.5	22.0	2.8	40.0	0.4	5.0	56.7	17.4	54.7	12.3	6.2	0	0	0	17.2	0.6	40	10.5	0	32.4	29.5	43.2	-	10
Xenostrobus securis	2.0	-	1.0	-	0.4	14.3	-	5.0	21.9	2.2	23.7	-	-	-	-	-	10.3	-	-	-	-	0.4	13.4	20.4	-	-
Anticorbula amara	-	-	3.3	13.5	-	11.4	-	-	26.4	5.6	32.6	-	-	-	-	-	-	-	-	-	-	9.9	8.9	13.6	-	-
Arthritica helmii	3.0	0.7	36.3	3.3	-	2.8	-	-	22.4	2.8	33.5	6.2	6.2	-	-	-	10.3	0.6	-	10.5	-	24.8	16.0	29.5	-	-
Katelysia scalarina	0.3	-	-	0.4	-	2.8	-	-	6.4	-	3.7	9.2	-	-	-	-	-	-	-	-	-	-	5.4	13.6	-	-
Sanguinolaria biradiata	-	-	-	-	-	5.7	-	-	1.4	-	1.6	-	-	-	-	-	-	-	-	-	-	-	3.6	-	-	-
Tellina spp.	-	-	-	-	0.4	20.0	0.4	-	2.9	-	-	-	-	-	-	-	-	-	-	-	-	-	2.7	2.3	-	10
Siphon Tubes	-	-	-	4.9	2.1	-	-	-	-	9.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MOLLUSCS - Gastropods	0.3	0.0	17.6	0	0	20.0	0	-	26.9	10.1	59.2	3.1	0	0	0	1.0	0	0	2.2	0	1.6	14.1	69.6	47.7	-	-
Epillaria estuarina	-	-	1.8	-	-	17.1	-	-	0.7	-	8.2	-	-	-	-	-	-	-	-	-	-	-	-	9.1	-	-
Bittium granarium	-	-	0.2	-	-	-	-	-	-	-	0.8	-	-	-	-	-	-	-	-	-	-	-	0.9	-	-	-
Diala lauta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.9	2.3	-	-
Hydrococcus granitormis	0.3	-	14.4	-	-	14.3	-	-	5.0	10.1	31.4	3.1	-	-	-	-	-	-	0.7	-	-	6.1	68.8	45.4	-	-
Tarcanasca sp.	-	-	-	-	-	-	-	-	-	-	0.4	-	-	-	-	-	-	-	-	-	-	-	3.6	-	-	-
Petrogyrgus sp.	-	-	7.6	-	-	-	-	-	22.1	-	31.0	-	-	-	-	-	-	-	1.4	-	1.6	8.4	7.1	6.8	-	-
Tatea preissi	-	-	-	-	-	-	-	-	1.2	-	2.0	-	-	-	-	-	-	-	-	-	-	0.8	0.9	-	-	-
Bulla sp.	-	-	-	-	-	-	-	-	0.7	-	-	-	-	-	-	1.0	-	-	-	-	-	-	0.9	-	-	-
PLANT	31.7	37.0	51.6	17.9	3.2	17.1	1.7	100.0	43.0	16.8	41.2	32.3	6.2	0	12.8	92.1	100	0.6	4.3	29.0	29.7	5.7	21.4	4.5	-	-
Diatoms	31.7	25.2	2.3	-	-	-	-	-	-	6.7	-	-	-	-	-	*	-	-	2.2	-	14.0	-	-	-	-	-
Algae	1.3	9.6	28.5	3.7	1.6	11.4	0.4	-	11.7	4.5	14.3	3.1	-	-	-	57.4	55.2	-	1.4	15.8	9.4	1.5	7.1	-	-	-
Aquatic Angiosperms	1.7	3.7	26.4	15.1	1.6	8.6	1.3	100.0	41.9	7.3	29.2	29.2	6.2	-	12.8	69.3	100	0.6	0.7	15.8	3.1	4.2	14.3	4.5	-	-
OTHER	97.0	61.5	56.9	31.0	15.7	57.1	18.8	5.0	37.1	9.0	24.5	55.4	93.8	77.3	77.6	21.8	58.6	38.6	31.6	57.9	75.0	25.6	13.4	20.4	81.2	70.0
Fish	-	-	1.3	6.9	6.0	-	16.0	5.0	10.7	-	5.7	44.6	12.5	77.3	74.4	-	-	-	5.8	7.9	-	-	2.7	2.3	81.2	70.0
Ova	-	-	-	-	-	-	-	-	0.7	0.6	1.2	-	-	-	-	4.0	-	1.3	-	-	-	2.7	-	-	-	-
Sand	91.0	45.2	45.0	1.2	4.0	42.8	-	-	10.9	3.4	6.1	23.1	50.0	-	-	10.9	41.4	14.0	10.0	15.8	4.7	5.7	5.4	11.4	-	-
Detritus	67.0	21.5	28.9	13.9	7.7	22.8	2.2	-	17.9	5.6	13.0	21.5	50.0	-	3.2	10.9	20.7	31.0	22.3	47.4	70.3	16.8	6.2	18.2	-	-
Digested matter (unidentifiable)	28.7	3.7	1.0	19.6	-	-	0.9	-	2.5	-	-	-	-	-	-	-	-	-	-	-	-	6.1	-	-	-	-

* Diatoms present with weed and algae

TABLE 4. OCCURRENCE (ACTUAL) OF FOOD ITEMS IN THE STOMACHS OF LESS ABUNDANTLY SAMPLED FISH FROM THE BLACKWOOD RIVER ESTUARY, MARCH '74 TO MARCH '75.

	Anchovy	Blue sprat	Sandy sprat	Old wife	Blue rock whiting	Brown spotted parrot fish	Giant herring	Dusky morwong	Magpie morwong	Red gurnard	Salmon Trout	Snapper	Yellow tail	Shovel-nose shark	Sting ray.
Average length (mm)	83.3	62.8	58.5	52.8	140.3	84.8		607	203	247	269.2	1695.	162		
Length range (mm)	75-95	55-67	37-80	30-85	124-153	57-96	-	204-1010	199-207	-	217-296	105-242	-		
Sample Size	3	10	25	11	11	5	1	2	2	1	8	6	1	1	1
No. with stomach contents	3	10	19	10	8	4	1	2	2	1	8	6	1	1	1
POLYCHAETES	2	-	-	-	1	-	-	1	-	-		2	-		
Ceratonereis	2	-	-		1	-	-	1	-	-		2	-		
CRUSTACEANS	3	10	13	10	6	3	1	2	2	-	4	4	1	1	1
Harpacticoida	-	9	6	-	-	-	-	-	-	-	-	-	-	-	-
Gladioferens	1	10	9	3	-	-	-	-	-	-	-	-	-	-	-
Ostracods	-	-		-	-	-	-	-	-	-	-	-	-	-	-
Mysidacea	3	-		-	-	-	-	-	2	-	-	-	1	-	-
Amphipods	-	-		4	6	1	-	2	2	-	-	-	-	-	-
Isopods	-	-		-	2	3	-	-	-	-	-	-	-	-	-
Palaemonetes	-	-		4	-	-	1	1	-	-	1	2	-	-	-
Metapenaeus	-	-		1	-	-	-	-	-	-	3	1	-	1	1
Crab	-	-		-	-	-	-	1	-	-	-	1	-		-
Chironomidae *	-	1	8	-	3	-	-	-	1	-	-	1	-		
Bivalves	-	-		-	4	-	-	-	-	-	-	-	-		
Arthritica					4	-	-	-	-	-	-	-	-		
GASTROPODS	-	-		1	7	2	-	-	-	-	-	-	-		
Hydrococcus	-	-		1	7	2	-	-	-	-	-	-	-		
SEA GRASS	-	-		1	-	-	-	2	-		1	2	-		
ALGAE	-	-		-	-	-	-	-	-	-	-		-		
DIATOMS	-	3		-	-	-	-	-	-	-	-		-		
OTHER	-	2		-	1	3	1	1	-	1	7	1	-		
Sand	-	-		-	-	1	-	-	-	-	-	-	-		
Detritus	-	2		-	-	1	-	1	-	-	-	1	-		
Fish	-	-		-	1	2	1	-	-	1	7	-	-		
Digested			13												

Table 5a Occurrence (%) of the Main Food Items in the Stomach Contents of Black Bream every second month, March 1974 to March 1975.

	Mar.	May	Jul.	Sept.	Nov.	Jan	Mar.
Stomachs sampled	72	51	82	91	55	51	64
Stomachs with contents	70	47	74	85	52	39	52
Size range (mm)	156-396	151-383	140-329	123-338	165-400	172-306	181-316
Mean length (mm)	233	227	231	217	213	229	242
FOOD ITEM							
POLYCHAETES	20	6	32	12	17	3	69
Ceratonereis	13	-	26	12	17	3	56
CRUSTACEANS	34	36	42	35	37	38	31
Palaemonetes	29	19	23	31	31	35	25
INSECTS	-	6	3	-	12	3	8
Chironomids	-	6	3	-	12	3	8
BIVALVES	74	62	64	54	56	25	48
Xenostrobus	37	19	16	31	19	15	6
Anticorbula	49	36	39	45	48	20	4
Arthritica	46	30	7	13	33	-	29
GASTROPODS	19	30	32	35	40	18	8
Potamopyrgus	17	13	30	29	40	18	-
PLANTS	57	45	42	42	44	62	56
Algae	-	13	12	12	10	18	23
Sea grass	57	36	38	38	38	52	35
OTHER	33	77	31	28	25	40	40
Fish	4	4	11	9	6	38	10
Unidentifiable/ Detritus	17	72	18	13	15	5	10

Table 5b Occurrence (%) of the Main Food Items in the Stomach Contents of Silver Bream (> 100 mm) every second month, March 1974 to March 1975.

	Mar.	May	Jul.	Sept.	Nov.	Jan	Mar.
Stomachs sampled	54	2	9	36	49	67	86
Stomachs with contents	54	2	3	32	35	53	66
Size range (mm)	138-245	*	*	155-268	140-256	122-249	138-255
Mean length (mm)	195			205	202	184	192
FOOD ITEM							
POLYCHAETES	2	-	-	6	6	2	24
Ceratonereis	0	-	-	6	6	2	24
CRUSTACEANS	35	-	-	47	43	76	38
Amphipod	13	-	-	25	23	47	35
Sphaeroma	0	-	-	13	3	2	3
Palaemonetes	13	-	-	3	29	43	5
INSECTS	0	-	-	53	17	6	11
Chironomids	0	-	-	53	17	6	11
BIVALVES	82	-	-	56	43	45	47
Anticorbula	61	-	-	25	29	34	15
Arthritica	46	-	-	50	23	9	39
Xenostrobus	50	-	-	22	14	30	5
GASTROPODS	48	-	-	81	71	59	55
Potamopyrgus (estuarine)	32	-	-	44	23	45	15
Hydrococcus	19	-	-	56	43	17	38
PLANT	57	-	-	50	32	28	36
Algae	0	-	-	31	32	7	15
Sea grass	57	-	-	25	6	21	23
OTHER	35	-	-	16	31	15	23
Detritus	33	-	-	3	14	4	6

* not analysed due to small sample size.

Table 5c Occurrence (%) of the Main Food Items in the Stomach Contents of Yellow-eye Mullet (> 100 mm) every second month, March 1974 to March 1975.

	Mar.	May	Jul.	Sept.	Nov.	Jan	Mar.
Stomachs sampled	60	63	63	56	60	84	100
Stomachs with contents	54	56	51	46	48	67	75
Size range (mm)	105-336	210-362	195-340	112-332	140-340	107-350	102-357
Mean length (mm)	183	288	255	242	239	271	252
FOOD ITEM							
POLYCHAETES	22	32	22	28	8	42	33
Capitella	0	20	0	9	0	24	19
Ceratonereis	9	18	14	26	8	33	31
CRUSTACEANS	35	27	25	43	21	10	29
Amphipod	2	5	2	4	2	4	11
Palaemonetes	7	9	14	28	10	6	7
INSECTS	39	45	41	50	17	54	41
Chironomids	39	45	41	50	17	54	41
BIVALVES	48	43	22	32	35	45	35
Arthritica	46	43	20	32	31	45	35
GASTROPODS	13	23	10	13	15	31	15
Hydrococcus	7	16	10	13	15	24	13
Potamopyrgus (estuarine)	7	7	8	6	6	13	4
PLANT	31	54	84	46	38	37	68
Diatoms	0	0	0	0	0	0	12
Algae	0	13	71	28	33	27	24
Sea grass	31	45	31	23	2	10	37
OTHER	67	63	33	61	56	63	55
Detritus	46	45	10	46	46	16	8
Sand	50	41	25	48	46	51	49

Table 5d Occurrence (%) of the Main Food Items in the Stomach Contents of Sea Mullet every second month, March 1974 to March 1975.

	Mar.	May	Jul.	Sept.	Nov.	Jan	Mar.
Stomachs sampled	29	38	40	59	58	88	63
Stomachs with contents	28	20	28	49	53	69	53
Size range (mm)	90-332	185-303	240-450	140-560	49-430	56-451	63-463
Mean length (mm)	190	251	349	274	184	216	172
FOOD ITEM							
POLYCHAETES	0	15	0	0	0	0	0
Ceratonereis	0	15	0	0	0	0	0
CRUSTACEANS	0	0	0	15	0	3	0
Harpacticoid	0	0	0	10	0	0	0
Ostrocod	0	0	0	4	0	3	0
BIVALVES	29	5	0	0	0	0	0
Arthritica	29	5	0	0	0	0	0
Xenostrobus	21	0	0	0	0	0	0
GASTROPODS	0	0	0	2	0	0	0
Hydrococcus	0	0	0	2	0	0	0
PLANTS	4	0	7	44	45	41	45
Diatoms	*	*	*	42	45	39	45
OTHERS	82	90	100	100	100	99	98
Detritus	75	90	57	83	57	54	75
Sand	64	85	43	52	49	59	83
Unidentifiable matter **	0	0	46	25	47	41	15

* Diatoms present but not recorded.
** Possibly stomach lining.

Table 5e Occurrence (%) of the Main Food Items in the Stomach Contents of Western Yellow fin whiting every second month, March 1974 to March 1975.

	Mar.	May	Jul.	Sept.	Nov.	Jan	Mar.
Stomachs sampled	70	21	47	27	40	78	60
Stomachs with contents	53	15	31	14	29	60	43
Size range (mm)	146-362	198-326	220-330	191-328	180-330	129-366	64-327
Mean length (mm)	229	274	259	282	234	220	197
FOOD ITEM							
POLYCHAETES	87	100	19	71	79	83	81
Capitella	-	40	-	7	31	33	23
Ceratonereis	72	47	16	50	69	81	72
Scoloplos	58	73	3	29	14	7	9
CRUSTACEANS	17	40	74	50	14	46	37
Palaemonetes	11	20	48	14	10	25	30
INSECTS	-	-	3	21	3	7	16
Chironomid	-	-	-	21	3	7	16
BIVALVES	22	47	-	21	34	26	14
Anticorbula	19	-	-	14	17	20	9
Sea grass	30	27	13	14	3	13	5
OTHERS	52	53	13	21	10	28	30
Detritus	-	47	13	-	7	28	9

Table 5f Occurrence (%) of the Main Food Items in the Stomach Contents of Herring every second month, March 1974 to March 1975.

	Mar.	May	Jul.	Sept.	Nov.	Jan	Mar.
Stomachs sampled	26	27	10	40	50	49	97
Stomachs with contents	21	23	10	31	33	37	69
Size range (mm)	193-276	192-266	230-260	212-300	211-291	220-290	208-290
Mean length (mm)	246	239	248	250	242	247	241
FOOD ITEM							
POLYCHAETES	0	17	40	0	15	16	42
Ceratonereis	0	17	40	0	12	16	42
CRUSTACEANS	86	91	100	90	79	97	74
Melita	24	4	40	0	9	13	9
Sphaeroma	19	30	20	32	15	11	25
Mysid	19	30	10	6	36	73	55
Metapenaeus	29	43	0	0	6	8	0
Palaemonetes	43	13	100	81	45	30	32
INSECTS	0	0	0	6	21	0	13
BIVALVES	0	4	0	0	0	0	0
Sea grass	0	0	10	3	0	5	0
OTHER	33	17	10	16	18	19	17
Fish	19	13	10	16	12	19	17

Table 5g Occurrence (%) of the Main Food Items in the Stomach Contents of Tailor every second month, March 1974 to March 1975.

	Mar.	May	Jul.	Sept.	Nov.	Jan	Mar.
Stomachs sampled	31	28	1	29	48	28	27
Stomachs with contents	22	20	0	14	33	22	14
Size range (mm)	60-325	190-270	-	190-390	133-400	204-333	49-345
Mean length (mm)	148	223	-	240	266	261	239
FOOD ITEM							
CRUSTACEANS	23	40		64	24	68	14
Metapenaeus	5	25		0	3	18	7
Palaemonetes	18	15		64	21	50	7
Chironomid	0	0		0	3	0	0
Fish	86	70		43	82	59	100
Sea grass	27	20		0	15	5	0
Detritus	5	15		0	0	0	0

Table 6 Percentage of fish species collected which had empty stomachs

Species	Mar	May	Jul	Sept	Nov	Jan	Mar	Average
Sea mullet	3.4	47.7	30.0	16.9	8.6	21.6	15.9	20.0
Yelloweye mullet (T.L. >100 mm.)	10.0	11.1	19.0	17.8	20.0	20.2	25.0	18.3
Western yellow fin whiting	24.3	28.6	34.0	48.1	27.5	23.1	28.3	28.6
King George whiting	25.8	10.0	44.4	0	0	7.0	5.6	10.1
Herring	19.2	14.8	*	22.5	34.0	24.5	28.9	25.1
Black Bream	2.8	7.8	9.8	6.6	5.4	23.5	18.8	9.9
Silver Bream (T.L. >100 mm.)	0	*	*	11.1	28.6	20.9	23.2	19.1
Tailor	29.0	28.6	*	51.7	31.2	21.4	48.1	34.9
Striped perch	10.7	*	*	*	0	0	0	2.9
Long finned goby	NS	NS	NS	9.5	25.0	16.4	36.6	23.5
South West goby	NS	NS	NS	5.8	20.9	10.7	30.0	14.7
Hardyhead	9.5	12.5	9.8	15.0	7.5	10.1	12.5	11.8

* Sample too small

NS No Sample

Table 7a Regional food preferences of Black Bream in the Blackwood River Estuary, as % occurrence.

	Deadwater & Swan lakes	Channel	Lagoon	Basins	River
Stomachs with contents	96	19	115	114	69
Stomachs empty	15	3	12	11	9
food items:					
POLYCHAETES	32.3	21.0	41.7	10.5	3.0
Capitella capitata	2.1	-	4.3	1.0	1.4
Scoloplos simplex	2.1	-	12.2	2.6	1.4
Armandia sp.	-	-	4.3	-	-
Arenicola sp.	3.1	-	-	-	-
Ceratonereis erythraeensis	24.0	15.8	35.6	10.5	1.4
Nereidae spp.	4.2	5.2	-	-	-
CRUSTACEANS	61.4	78.9	19.1	26.3	39.1
Ostracoda	-	-	-	2.6	-
Mysidacea	1.0	-	-	1.0	-
Paracorophium sp.	-	-	2.6	-	-
Melita sp.	2.1	-	1.7	1.0	3.0
Sphaeroma quoyana	1.0	15.8	2.6	1.0	-
Palaemonetes sp.	56.2	36.8	7.0	19.3	37.7
Metapenaeus dalli	2.1	5.2	5.2	2.6	-
Crab (*Halicarcinus* sp.).	2.1	36.8	1.7	-	-
INSECTS					
Chironomid larvae	2.1	5.2			
Molluscs - Bivalves	19.8	63.2	74.0	76.3	44.9
Anticorbula amara	-	-	39.1	71.9	34.8
Xenostrobus securis	1.0	-	35.6	29.8	18.8
Arthritica helmsii	3.1	10.5	42.6	30.7	5.8
Katelysia scalarina	11.4	42.1	7.0	-	-
Sanquinolaria biradiata	3.1	5.2	3.4	-	-
Tellina spp.	3.1	5.2	1.0	1.0	3.0
- Univalves	15.6	21.0	20.0	47.4	21.7
Batillaria estuarina	2.1	5.2	-	-	-
Bulla sp.	1.0	-	-	-	-
Hydrococcus graniformis	13.5	10.5	5.2	-	-
Potamopyrgus sp (estuarine)	4.2	10.5	14.8	47.4	21.7
Tatea preissi	-	10.5	1.7	-	-
PLANT	53.1	57.9	45.2	44.7	52.2
Sea grass	45.8	47.4	34.4	43.0	44.9
Algae	16.6	26.3	11.3	2.6	11.6
OTHER	30.2	68.4	39.1	30.7	37.7
Fish	6.2	52.6	7.8	5.2	3.0
Ova	1.0	-	-	2.6*	11.6
Sand	9.4	-	7.8	10.0	-
Digested matter	3.1	-	2.6	2.6	3.0
Detritus	12.5	15.8	20.8	19.3	17.4

Table 7b Regional food preferences of Yelloweye Mullet (> 100m) in the Blackwood River Estuary, as % occurrence.

	Deadwater & Swan Lakes	Channel	Lagoon	Basins	River
Stomachs with contents	163	78	106	50	
Stomachs empty	49	10	26	4	
Items:					
POLYCHAETES	19.0	30.8	34.9	42.0	
Capitella capitata	5.5	16.7	14.2	14.0	
Scoloplos simplex	2.4	0	14.2	12.0	
Armandia sp.	0	1.3	1.9	0	
Ceratonereis erythraeensis	12.9	25.6	28.3	24.0	
Eunereis sp.	0.6	0	0	0	
Sabellid sp.	1.8	0	0	0	
CRUSTACEANS	31.3	20.5	27.4	22.0	
Ostracoda	6.1	2.6	5.7	14.0	
Gladioferens	0.6	6.4	9.4	0	
Harpacticoida	0.6	3.8	7.6	0	
Mysidacea	5.5	1.3	2.8	0	
Amphipoda	4.3	7.7	5.7	0	
Sphaeroma quoyana	1.8	0	1.9	0	
Palaemonetes sp.	18.4	5.1	2.8	10.0	
Metapenaeus dalli	1.2	0	0.9	0	
Crab	0.6	0	0	0	
INSECTS	30.7	48.7	52.8	42.0	
Chironomid larvae	30.7	48.7	52.8	42.0	
MOLLUSCS - BIVALVES	32.5	42.3	50.0	20.0	
Anticorbula amara	0	0	6.6	12.0	
Xenostrobus securis	0.6	0	4.7	2.0	
Arthritica helmsii	32.5	42.3	47.2	16.0	
- UNIVALVES	26.4	26.9	4.7	2.0	
Batillaria estuarina	3.7	0	0	0	
Bittium granarium	1.2	0	0	0	
Hydrococcus graniformis	23.9	20.5	1.9	0	
Potamopyrgus sp. (est.)	9.2	12.8	3.8	2.0	
PLANT	60.7	52.6	46.2	36.0	
Sea grass	33.1	11.5	32.1	20.0	
Algae	37.4	41.0	17.9	2.0	
Diatoms	0	1.3	0	16.0	
OTHER	49.7	53.8	63.2	82.0	
Fish	1.8	0	1.9	0	
Sand	41.1	48.7	40.6	70.0	
Digested Matter	2.4	0	2.8	0	
Detritus	20.9	15.4	40.6	54.0	

Table 7c Regional food preferences of Western Yellow fin Whiting in the Blackwood River Estuary, as % occurrence.

	Deadwater & Swan lakes	Channel	Lagoon	Basins	River
Stomachs with contents	83	47	73	42	0
Stomachs empty	59	11	18	9	1
Items:					
POLYCHAETES	79.5	59.6	83.6	76.2	
Capitella capitata	24.1	19.1	15.1	14.3	
Ceratonereis erythraeensis	61.4	46.8	74.0	69.0	
Eumereis sp.	2.4	6.4	0	0	
Scoloplos sp.	13.2	10.6	41.1	31.0	
Armandia sp.	2.4	0	0	0	
CRUSTACEA	55.4	36.2	28.8	28.6	
Amphipod spp.	7.2	2.1	5.5	0	
Crab	0	10.6	4.1	0	
Isopod	1.2	4.2	0	0	
Mysid	12.0	4.2	6.8	0	
Metapenaeus dalli	3.6	8.5	4.1	0	
Palaemonetes australis	37.3	12.8	12.3	28.6	
INSECTA	7.2	4.2	2.7	14.3	
Chironomid	6.0	4.2	2.7	14.3	
Beetle	1.2	0	0	0	
MOLLUSCA - Bivalve	3.6	23.4	38.4	28.6	
Anticorbula amara	0	6.4	20.5	28.6	
Arthritica helmsii	0	12.8	5.5	0	
Katelysia sp.	0	2.1	0	0	
Tellina spp.	3.6	6.4	6.8	0	
Xenostrobus securis	0	0	9.6	0	
PLANT	19.3	17.0	13.7	23.8	
Weed	14.4	12.8	13.7	23.8	
Algae	4.8	6.4	0	0	
OTHERS	16.9	27.6	32.9	59.2	
Fish	2.4	8.5	0	26.2	
Detritus	9.6	17.0	16.4	7.1	
Sand	1.2	2.1	1.4	2.4	
Digested matter	4.8	2.1	15.1	23.8	

Table 8 Percentage of Empty Stomachs for 3 species of fish in different parts of the estuary.

Areas:	Black Bream	Western Yellow fin whiting	Yelloweye mullet
Swan Lakes - Deadwater	13.5	41.5	23.1
Inlet Channel	13.6	19.0	11.4
Lagoon	9.4	19.8	19.7
Basins	8.8	17.6	7.4
River	11.5	*	N.S.

* Sample too small

N.S. - No Sample.

Table 9 Occurrence of food items (animal only) in the total fish stomach sample

(No. stomachs sampled 4 489
No. stomachs with contents 3710)

FOOD ITEM	ACTUAL OCCURRENCE	% OCCURRENCE
Ceratonereis erythraeensis	1058	28.5
Chironomid larvae	624	16.8
Palaemonetes australis	570	15.4
Arthritica helmsii	457	12.3
Amphipods	417	11.2
Anticorbula amara	335	9.0
Hydroccus graniformis	305	8.2
Potamopyrgus sp. (estuarine)	234	6.3
Mysids	203	5.5
Xemostrobus securis	189	5.1
Capitella capitata	161	4.3
Scoloplos simplex	159	4.3
Sphaeroma quoyana	142	3.8
Gladioferens	83	2.2
Harpacticoida	80	2.2
Ostracoda	72	1.9
Prawn	73	2.0
Crab	65	1.8
Katelysia scalarina	57	1.5
Armandia sp.	45	1.2
Batillaria estuarina	41	1.1
Tellina sp.	38	1.0
Bivalve siphon tubes	22	0.6
Nereidae	17	0.4
Sanguinolaria biradiata	16	0.4
Sabellid	16	0.4
Tatea preissi	14	0.4
Diala lauta	11	0.3
Nassarius	5	0.1
Bittium granarium	4	0.1
Bulla sp.	5	0.1
TOTAL	5518	

Table 10 Infaunal species ranked in order of abundance (July 1974 to May 1975)

	TOTAL NO. COLLECTED	% OF TOTAL	CUMULATIVE %
Arthritica helmsii	13 586	23.1	23.1
Ceratonereis erythraeensis	11 824	20.1	43.2
Hydrococcus graniformis	10 846	18.5	61.7
Capitella capitata	9 988	17.0	78.7
Scoloplos simplex	3 240	5.5	84.2
Chironomid larvae	1 589	2.8	86.9
Potamopyrgus sp. (estuarine)	1 536	2.6	89.5
Batillaria estuarina	960	1.6	
Anticorbula amara	858	1.5	
Prionospio sp.	846	1.4	
Amphipods (total)	1 564	2.7	
Corophium sp.	563	1.0	
Melita zeylanica kauerti	556		
Paracorophium sp.	445		
Armandia sp.	490		
Sphaeroma quoyana	303		
Xemostrobus securis	248		
Prionospio sp. B	116		
Mysid	83		
Sabellid	82		
Sanguinolaria biradiata	76		
Tellina deltoidalis	72		
Katelysia scalarina	50		
Tellina sp.	28		
Tatea preissi	27		
Diala lauta	25		
Nassarius pauperatus	16		
Bittium granarium	12		
Syncassidina aestuaria	12		
Potamopyrgus sp. (fluviatile)	11		
Nereidae (3 species)	9		
Aerenicola sp.	6		
Halicarcinus oratus	6		