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Feeding Biology of the Blackfin Sculpin (*Malacocottus kincaidi* Gilbert and Thompson, 1905) and the Spinyhead Sculpin (*Dasycottus setiger* Bean, 1890) in the Northeastern Gulf of Alaska[1]

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ABSTRACT: We examined the feeding biology of two species of sculpins in the northeastern Gulf of Alaska. The blackfin sculpin (*Malacocottus kincaidi*) fed primarily on benthic amphipods and nektobenthic shrimps, although it took a wide assortment of both infaunal and epifaunal organisms; it also displayed a tendency to feed within, as well as at, the sediment surface. The spinyhead sculpin (*Dasycottus setiger*) ate a less diverse suite of prey that was dominated by nektobenthic shrimps; no subsurface feeding was evident.

SCULPINS (COTTIDAE) are a major component of the demersal fish fauna of the continental shelf of the Gulf of Alaska (Ronholt et al. 1976, 1978). Two common species for which little biological information is available are the blackfin sculpin (*Malacocottus kincaidi* Gilbert and Thompson) and the spinyhead sculpin (*Dasycottus setiger* Bean). Information on identifying characteristics, size, range, and habitat are included in Hart (1973) and Eschmeyer et al. (1983). Some trophic data for these species from the southeastern Bering Sea are included in Mito (1974). Blackfin sculpin occur from Washington to Alaska and in Japan. Another species, *M. zonuris* Bean, has been reported within the range of *M. kincaidi*; however, so little is known about both fishes that they may be the same species (Eschmeyer et al. 1983). Spinyhead sculpin range from Washington to the Bering Sea and Japan (Hart 1973). The habitat of both species is on soft bottoms (Eschmeyer et al. 1983). This paper presents information on the food and feeding habits of these two sculpin species in the northeastern Gulf of Alaska. A comparison of these results is made with data from the Bering Sea (Mito 1974).

MATERIALS AND METHODS

Forty *Malacocottus kincaidi* and 69 *Dasycottus setiger* were collected with a 400-mesh Eastern Otter trawl at 14 stations in the northeastern Gulf of Alaska during November 1979. These fishes were caught incidentally while demersal trawling for epifaunal invertebrates on the continental shelf and slope between 138°53′ W and 141°52′ W long. (Feder et al. 1981). *Malacocottus* were caught at depths of 115–348 m ($\bar{x} = 238$ m), with most specimens taken at depths of 284–348 m ($\bar{x} = 319$ m) and bottom temperatures of 5.4–6.3°C ($\bar{x} = 5.7$°C). *Dasycottus* were caught at depths of 64–152 m ($\bar{x} = 110$ m) and at bottom temperatures of 6.3–10.0°C ($\bar{x} = 8.6$°C). Fishes were preserved in 10% buffered formalin and stomach contents were transferred to alcohol and examined in the laboratory.

Standard lengths were measured in the laboratory to the nearest 1.0 mm. The average sizes of blackfin sculpin and spinyhead sculpin were 102 mm SL (range, 42–166 mm) and 96 mm SL (range, 37–161 mm), respectively. Because of the small sample sizes, food habits of all sizes were combined in the analyses.

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The sex of each fish was determined by examination under a microscope. Sex ratios were relatively balanced in both species, with the male: female ratio in blackfin sculpin 1:0.7 ($\chi^2 = 0.90$; df = 1; $P>0.05$; $n = 40$) and in spinyhead sculpin 1:0.8 ($\chi^2 = 1.18$; df = 1; $P> 0.05$; $n = 69$). Because of small sample sizes, food habits of both sexes were combined in the analyses.

For each fish, all prey items were identified to the lowest possible taxon. For each taxon, the number of recognizable individuals was counted, and the food material weighed to the nearest 0.01 g. A sponge mass or hydroid aggregate was counted as a single individual. When two or more different taxa were present together in unknown quantities (as in a mixture of crustaceans and polychaetes), the weights were divided equally among the taxa involved. In the data analyses, a trace of a particular taxon was treated as less than 0.01 g. For each fish species, the following percentages were calculated for each prey taxon: (1) F, the percentage frequency of occurrence relative to the number of fish containing food; (2) N, the percentage of the total number of recognizable individuals of all prey taxa combined; and (3) W, the percentage of the total weight of all prey taxa combined. Using these data we calculated an Index of Relative Importance (IRI) for each taxon with an equation modified from Pinkas et al. (1971) to IRI = F (N + W).

RESULTS

All 40 of the blackfin sculpin examined contained food. Blackfin sculpin consumed a wide array of organisms (63 taxa), with crustaceans as the primary prey group (Table 1). The foods of blackfin sculpin were mainly benthic (47% of food weight) and nektobenthic (42%) types. Amphipods (IRI = 4186) and decapods (IRI = 4018) were nearly equal in importance. Amphipods accounted for a greater percentage of the number of organisms than did decapods; however, decapods accounted for a greater percentage of the weight. The primary amphipods taken were the surface-dwelling lysianassids (*Anonyx* spp., *Valettiopsis dentatus*, and *Orchomene* spp.) and caprellids. Nektobenthic pandalid shrimps were the most important decapods. Other prey, in decreasing order of importance, were polychaetes (IRI = 2471; primarily surface-dwelling polynoids), nektobenthic mysids (IRI = 793), and shallow-burrowing cumaceans (IRI = 249; primarily *Diastylis* spp.). Epibenthic hydrozoans (IRI = 39) and infaunal polychaetes of the families Aphroditidae, Ampharetidae, Goniadidae, and Glyceridae were of minor importance. Approximately one-half of the blackfin sculpin stomachs contained sediment.

Sixty-four (93%) of the 69 spinyhead sculpin contained food. This species was more restricted in the variety of food items taken (34 taxa; Table 1) than was the blackfin sculpin. The foods of spinyhead sculpin were mainly nektobenthic (67% of food weight) and benthic (19%) types. It was mainly a shrimp-feeder (Dendrobranchiata; IRI = 6812), preying primarily on young crangonid and pandalid shrimps. *Crangon septemspinosa* and *Pandalus montagui tridens* were the primary taxa taken from these two families, respectively. Other, less important crustaceans were epibenthic mysids (IRI = 788) and epibenthic amphipods (IRI = 731). Polychaetes (IRI = 356), primarily surface-dwelling polynoids, were next in importance. Finally, crabs (IRI = 53) and fishes (IRI = 39) were of minor importance. None of the spinyhead sculpin stomachs contained sediment.

DISCUSSION

Based upon the stomach contents, both the blackfin sculpin and the spinyhead sculpin displayed opportunistic feeding behavior, taking an assortment of benthic and nektobenthic taxa. In addition, blackfin sculpin took a greater array of minute, surface-dwelling taxa, plus some infaunal species. In all, blackfin sculpin consumed almost twice the number of taxa that were found in spinyhead sculpin. Blackfin sculpin also had substantially higher IRI values of surface-dwelling polychaetes and amphipods and shallow-burrowing

TABLE 1

PERCENT FREQUENCY OF OCCURRENCE, NUMBER, WEIGHT, AND INDEX OF RELATIVE IMPORTANCE OF FOOD ITEMS FROM THE SCULPINS *Malacocottus kincaidi* AND *Dasycottus setiger*, NORTHEASTERN GULF OF ALASKA, NOVEMBER 1979

	Malacocottus kincaidi ($n^{\dagger} = 40$)				*Dasycottus setiger* ($n^{\dagger} = 64$)			
	%			INDEX OF RELATIVE IMPORTANCE	%			INDEX OF RELATIVE IMPORTANCE
FOOD ITEMS*	FREQUENCY F	NUMBER N	WEIGHT W	F(N + W)	FREQUENCY F	NUMBER N	WEIGHT W	F(N + W)
Plant material	2.5	0.2	0.1	0.8	—	—	—	—
Protozoa (Total)	7.5	0.7	0.1	6.0	—	—	—	—
Foraminifera	7.5	0.7	0.1	6.0	—	—	—	—
Porifera (Total)	22.5	2.1	4.2	141.8	—	—	—	—
Cnidaria (Total)	17.5	1.9	0.6	43.8	—	—	—	—
Sertulariidae	12.5	1.2	0.5	21.2	—	—	—	—
Unid. Hydrozoa	5.0	0.5	0.1	3.0	—	—	—	—
Annelida (Total)	67.5	14.8	21.8	2,470.5	26.6	6.2	7.2	356.4
Polychaeta (Total)	67.5	14.8	21.8	2,470.5	26.6	6.2	7.2	356.4
Aphrodita spp.	7.5	0.7	4.2	36.8	—	—	—	—
Polynoidae	47.5	6.8	10.0	798.0	25.0	5.9	7.2	327.5
Antinoella macrolepida	2.5	0.2	2.4	6.5	—	—	—	—
Ampharetidae	5.0	2.8	0.3	15.5	—	—	—	—
Cirratulidae	2.5	0.2	0.5	1.8	—	—	—	—
Goniadidae	2.5	0.2	0.5	1.8	—	—	—	—
Goniada annulata	2.5	0.2	0.5	1.8	—	—	—	—
Glyceridae	2.5	0.2	1.5	4.2	—	—	—	—
Glycera capitata	2.5	0.2	1.5	4.2	—	—	—	—
Unid. Polychaeta	15.0	2.6	2.0	69.0	1.6	0.3	<0.1	0.6
Mollusca (Total)	7.5	0.7	0.1	6.0	1.6	0.3	<0.1	0.6
Pelecypoda (Total)	2.5	0.2	<0.1	0.8	1.6	0.3	<0.1	0.6
Nuculana spp.	—	—	—	—	1.6	0.3	<0.1	0.6
Gastropoda								
Trochidae	5.0	0.5	0.1	3.0	—	—	—	—
Arthropoda (Total)	100.0	79.1	69.7	14,880.0	98.4	90.7	84.5	17,239.7
Pycnogonida	2.5	0.2	0.1	0.8	—	—	—	—
Crustacea (Total)	100.0	79.1	69.6	14,870.0	98.4	90.7	84.5	17,239.7
Copepoda								
Gaetanus spp.	2.5	0.2	<0.1	0.8	—	—	—	—

TABLE 1 (continued)

	Malacocottus kincaidi ($n^{\dagger} = 40$)				*Dasycottus setiger* ($n^{\dagger} = 64$)			
	%			INDEX OF RELATIVE IMPORTANCE	%			INDEX OF RELATIVE IMPORTANCE
FOOD ITEMS*	FREQUENCY F	NUMBER N	WEIGHT W	F(N + W)	FREQUENCY F	NUMBER N	WEIGHT W	F(N + W)
Mysidacea (Total)	47.5	10.3	6.4	793.2	23.4	30.4	3.3	788.6
Acanthomysis spp.	2.5	0.2	1.0	3.0	—	—	—	—
Holmesiella anomala	2.5	0.5	0.4	2.2	—	—	—	—
Meterythrops robusta	17.5	3.8	1.2	87.5	—	—	—	—
Neomysis spp.	2.5	0.2	0.1	0.8	—	—	—	—
Pseudomma truncata	5.0	0.5	0.2	3.5	—	—	—	—
Unid. Mysidacea	32.5	5.2	3.6	286.0	23.4	30.4	3.3	788.6
Cumacea (Total)	35.0	5.9	1.2	248.5	3.1	1.0	1.0	6.2
Diastylidae	2.5	0.2	<0.1	0.8	—	—	—	—
Diastylis spp.	27.5	4.7	1.0	156.7	1.6	0.7	<0.1	1.3
Leptostylis spp.	2.5	0.5	0.1	1.5	—	—	—	—
Unid. Cumacea	5.0	0.5	<0.1	3.0	1.6	0.3	1.0	2.1
Isopoda	2.5	0.2	0.2	1.0	1.6	0.3	0.7	1.6
Bopyridae	2.5	0.2	0.1	0.8	—	—	—	—
Gnathiidae	2.5	0.2	<0.1	0.8	—	—	—	—
Amphipoda (Total)	65.0	47.2	17.2	4,186.0	28.1	20.8	5.2	730.6
Gammaridea	5.0	0.5	0.1	3.0	—	—	—	—
Eusirus spp.	2.5	0.2	0.1	0.8	—	—	—	—
Rhachotropis spp.	12.5	2.1	0.4	31.2	4.7	1.0	0.1	5.2
Lysianassidae	15.0	2.6	0.2	42.0	1.6	0.3	<0.1	0.6
Anonyx spp.	7.5	1.2	0.3	11.2	4.7	1.0	0.5	7.0
Anonyx nugax pacifica	2.5	13.8	6.2	50.0	—	—	—	—
Prachynella lodo	2.5	0.2	<0.1	0.8	—	—	—	—
Orchomene spp.	10.0	2.6	0.3	29.0	3.1	11.4	0.1	35.6
Hippomedon spp.	2.5	0.5	0.1	1.5	—	—	—	—
Socarnes bidenticulatus	2.5	0.2	0.4	1.5	—	—	—	—
Valettiopsis dentatus	2.5	10.3	6.3	41.5	—	—	—	—
Melphidippidae	7.5	1.2	0.1	9.8	—	—	—	—
Oedicerotidae								
Westwoodilla caecula	5.0	0.5	0.1	3.0	—	—	—	—
Pardaliscidae	2.5	0.2	0.1	0.8	—	—	—	—
Nicippe tumida	2.5	0.5	<0.1	1.5	1.6	0.3	<0.1	0.6

TABLE 1 (continued)

PERCENT FREQUENCY OF OCCURRENCE, NUMBER, WEIGHT, AND INDEX OF RELATIVE IMPORTANCE OF FOOD ITEMS FROM THE SCULPINS *Malacocottus kincaidi* AND *Dasycottus setiger*, NORTHEASTERN GULF OF ALASKA, NOVEMBER 1979

	Malacocottus kincaidi ($n^{\dagger}$ = 40)				*Dasycottus setiger* ($n^{\dagger}$ = 64)			
	%			INDEX OF RELATIVE IMPORTANCE	%			INDEX OF RELATIVE IMPORTANCE
FOOD ITEMS*	FREQUENCY F	NUMBER N	WEIGHT W	F(N + W)	FREQUENCY F	NUMBER N	WEIGHT W	F(N + W)
Stegocephalidae	7.5	1.2	0.2	10.5	—	—	—	—
Stenothoidae	7.5	1.7	0.2	14.2	—	—	—	—
Caprellidae	12.5	6.1	1.5	95.0	—	—	—	—
Unid. Amphipoda	10.0	1.7	0.4	21.0	17.2	6.6	4.4	189.2
Euphausiacea								
Euphausia spp.	2.5	0.2	1.7	4.8	—	—	—	—
Decapoda (Total)	82.5	13.6	35.1	4,017.8	75.0	35.3	68.4	7,777.5
Dendrobranchiata (Total)	80.0	13.1	34.1	3,776.0	70.3	32.9	64.0	6,812.1
Crangonidae (Total)	2.5	0.7	0.7	3.5	23.4	6.9	17.0	559.3
Crangon spp.	—	—	—	—	6.2	1.7	1.9	22.3
Crangon communis	—	—	—	—	1.6	0.3	1.8	3.4
Crangon dalli	—	—	—	—	1.6	0.3	0.3	1.0
Crangon septemspinosa	—	—	—	—	7.8	1.7	8.3	78.0
Argis alaskensis	—	—	—	—	1.6	0.3	0.3	1.0
Unid. Crangonidae	2.5	0.7	0.7	3.5	9.4	2.4	4.4	63.9
Hippolytidae (Total)	10.0	1.2	8.7	99.0	1.6	0.3	6.4	10.7
Heptacarpus spp.	5.0	0.5	2.8	16.5	—	—	—	—
Heptacarpus moseri	2.5	0.2	5.1	13.2	—	—	—	—
Lebbeus washingtonianus	—	—	—	—	1.6	0.3	6.4	10.7
Unid. Hippolytidae	5.0	0.5	0.7	6.0	—	—	—	—
Pandalidae (Total)	47.5	6.6	18.2	1,178.0	25.0	8.0	26.7	867.5
Pandalus spp.	10.0	0.9	11.4	123.0	4.7	1.0	11.3	57.8
Pandalus borealis	—	—	—	—	1.6	0.3	6.3	10.6
Pandalus jordani	—	—	—	—	1.6	0.7	0.5	1.9
Pandalus montagui tridens	—	—	—	—	6.2	1.4	2.2	22.3
Unid. Pandalidae	37.5	5.6	6.9	468.8	14.1	4.5	6.4	153.7
Unid. Dendrobranchiata	35.0	4.7	6.5	392.0	37.5	17.6	19.9	1,406.2

TABLE 1 (continued)

FOOD ITEMS*	*Malacocottus kincaidi* ($n^{\dagger}$ = 40)				*Dasycottus setiger* ($n^{\dagger}$ = 64)			
	%			INDEX OF RELATIVE IMPORTANCE	%			INDEX OF RELATIVE IMPORTANCE
	FREQUENCY F	NUMBER N	WEIGHT W	F(N + W)	FREQUENCY F	NUMBER N	WEIGHT W	F(N + W)
Stenopodidea (Total)	2.5	0.2	1.0	3.0	7.8	2.4	4.4	53.0
Chionoecetes bairdi	—	—	—	—	6.2	1.7	3.2	30.4
Unid. Stenopodidea	2.5	0.2	1.0	3.0	1.6	0.7	1.2	3.0
Unid. Decapoda	2.5	0.2	<0.1	0.8	—	—	—	—
Unid. Crustacea	35.0	0.9	7.6	297.5	28.1	2.8	5.9	244.5
Echinodermata (Total)	—	—	—	—	1.6	0.3	0.2	0.8
Ophiuroidea	—	—	—	—	1.6	0.3	0.2	0.8
Chordata (Total)	5.0	0.5	1.1	8.0	10.9	2.4	7.6	109.0
Osteichthyes	5.0	0.5	1.1	8.0	7.8	1.7	3.3	39.0
Ammodytes hexapterus	—	—	—	—	1.6	0.3	2.3	4.2
Cottidae	—	—	—	—	1.6	0.3	2.0	3.7
Unid. animal tissue	20.0	—	2.2	—	6.2	—	0.4	—
Sediment	52.5	—	—	—	0.0	—	—	—

* Lowest level of identification, unless otherwise noted.
$^{\dagger}n$ = number of fish containing food.

cumaceans. All caprellid amphipods were found in the same stomachs that contained hydroids, so it is probable that the caprellids were ingested along with the hydroids, as has been demonstrated in the food of buffalo sculpin, *Enophrys bison* (Johnson 1968). The tendency for blackfin sculpin to excavate for their prey is suggested by the presence of sediment-burrowing cumaceans, burrowing polychaetes of the families Goniadidae and Glyceridae, and, to a lesser extent, polychaetes such as *Aphrodita* spp., which plow through surface muds. The high incidence of sediment in the stomachs of blackfin sculpin also suggests a tendency for this species to excavate for its prey.

Conversely, spinyhead sculpin mainly consumed larger nektobenthic shrimps. They contained fewer small organisms such as polychaetes, cumaceans, and amphipods. In addition, infaunal organisms and sediment rarely were present.

The information on the foods of blackfin sculpin and spinyhead sculpin from the Gulf of Alaska is somewhat similar to that reported for these genera from the southeastern Bering Sea. Mito (1974) found nearly twice as many prey taxa (40 versus 24) in stomachs of *Malacocottus zonuris* ($n = 28$) as in spinyhead sculpin ($n = 44$). Further, the greater number of taxa in *M. zonuris* mainly consisted of small prey that reside on and beneath the sediment surface. *M. zonuris* fed primarily on benthic prey (78% of food weight; mainly polychaetes *Aphrodita* spp.; Tanner crabs, *Chionoecetes bairdi*; and gammarid amphipods), although nektobenthic prey (6%; mainly mysids, euphausiids, and pandalid and crangonid shrimps) and pelagic prey (16%; mainly squids) also were taken. A greater amount of nektobenthic prey (42% by weight) and no pelagic prey occurred in blackfin sculpin in the present study. The prey of spinyhead sculpin in the southeastern Bering Sea was primarily nektobenthic (56% by weight; mainly pandalid and crangonid shrimps), followed by benthic organisms (34%; mainly *C. bairdi*) and pelagic organisms (10%; mainly age-0 walleye pollock, *Theragra chalcogramma*). In the present study nektobenthic prey (67%) also dominated spinyhead sculpin food, followed by benthic types (19%). No pelagic prey occurred in specimens from the Gulf of Alaska.

In conclusion, the diets of blackfin sculpin and spinyhead sculpin are similar to those of several other sculpin species, in that they consist primarily of benthic and nektobenthic crustaceans (e.g., mysids, cumaceans, amphipods, shrimps, and crabs) and secondarily of a wide array of other organisms (e.g., foraminiferans, sponges, hydrozoans, polychaetes, echinoderms, and fishes) (Jones 1962, Johnson 1968, Nakamura 1971, Mito 1974, Moore and Moore 1974, Jewett and Powell 1979).

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LITERATURE CITED

ESCHMEYER, W. N., E. S. HERALD, and H. HAMMANN. 1983. A field guide to Pacific coast fishes of North America, from the Gulf of Alaska to Baja California. Houghton-Mifflin, Boston.

FEDER, H. M., S. C. JEWETT, S. G. MCGEE, and G. E. M. MATHEKE. 1981. Distribution, abundance, community structure, and trophic relationships of the benthos of the northeastern Gulf of Alaska from Yakutat Bay to Cross Sound. U. S. Dep. Commer., NOAA, OCSEAP Final Rep. 54(1987): 1–206.

HART, J. C. 1973. Pacific fishes of Canada. Fish. Res. Board Can. Bull. 180.

JEWETT, S. C., and G. C. POWELL. 1979. Summer food of the sculpins, *Myoxocephalus* spp. and *Hemilepidotus jordani*, near Kodiak Island, Alaska. Mar. Sci. Commun. 5: 315–331.

JOHNSON, C. R. 1968. Food of the buffalo sculpin, *Enophrys bison*. J. Fish. Res. Board Can. 25:807–812.

JONES, A. C. 1962. The biology of the euryhaline fish *Leptocottus armatus* Girard. Univ. Calif. Berkeley Publ. Zool. 67:321–365.

MITO, K. 1974. Food relationships in the demersal fish community in the Bering Sea—on the walleye pollock fishing grounds in October and November of 1972. M. S. Thesis, Hokkaido University, Hakodate, Japan.

MOORE, I. A., and J. W. MOORE. 1974. Food of shorthorn sculpin, *Myoxocephalus scorpius*, in the Cumberland Sound area of Baffin Island. J. Fish. Res. Board Can. 31: 355–359.

NAKAMURA, R. 1971. Food of two cohabiting tide-pool Cottidae. J. Fish. Res. Board Can. 28:928–932.

PINKAS, L., M. S. OLIPHANT, and I. L. K. IVERSON. 1971. Food habits of albacore, bluefin tuna, and bonito in California waters. Calif. Fish Game, Fish. Bull. 152: 1–105.

RONHOLT, L. L., H. H. SHIPPEN, and E. S. BROWN. 1976. An assessment of the demersal fish and invertebrate resources of the northeastern Gulf of Alaska, Yakutat Bay to Cape Cleare, May–August 1975. U. S. Dep. Commer., NOAA, NMFS, Seattle, Wash.

———. 1978. Demersal fish and shellfish resources of the Gulf of Alaska from Cape Spencer to Unimak Pass, 1948–1976: A historical review (4 vols.). U. S. NMFS, Processed Rep., Seattle, Wash.