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Food and Reproduction of *Glyptonotus antarcticus* (Crustacea: Isopoda) at McMurdo Sound, Antarctica

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Abstract

The exceptionally large idotheid isopod *Glyptonotus antarcticus* Eights is both a predator and scavenger at McMurdo Sound. Based on an examination of the gut contents of 118 adults, the most frequently occurring foods are ophiuroids, gastropods, isopods, echinoids, and pelecypods. A high percentage of echinoderm prey is unusual for isopods. The species is cannibalistic. A comparison of food items found in individuals taken on a gravel, sand, and shell-debris bottom and from a sponge-coelenterate mat suggests that availability of food is more important than type of prey. Of 152 females examined, 23 contain eggs or larvae in the marsupium. Numbers of eggs per marsupium range from 356 to 1,020. The presence of brood eggs in specimens taken throughout the year and the presence of larvae in specimens collected in June and December suggest a variable reproductive period.

Introduction

During the years 1958–61 benthic research programmes were operated at McMurdo Sound by American and New Zealand parties. This paper reports on some aspects of the biology of *Glyptonotus antarcticus* Eights, an exceptionally large idotheid isopod, of which numerous specimens were obtained in the course of work carried out by the Stanford University Biological Programme in Antarctica. Inferences on feeding are drawn on the basis of gut contents, and some observations are also included on reproduction and epizoons.

The genus *Glyptonotus* is presently considered monotypic (Sheppard, 1957). Although several systematic and morphological papers deal with the type species (e.g., Pfeffer, 1887; Richardson, 1906, 1913; Hodgson, 1910; Collinge, 1918; Tattersall, 1921; Sheppard, 1957) there is, as for most Antarctic invertebrates, a lack of data concerning its ecology and physiology. Specimens have been recorded from off South Georgia, the South Orkney and South Shetland Islands, the Antarctic Peninsula, and the Ross Sea in depths ranging from 1 to 585 metres.

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Materials and Methods

Between 18 November 1958 and 26 November 1961, 176 specimens of *Glyptonotus* were collected at or near McMurdo Station (77° 51′ S, 166° 40′ E) in the south-western Ross Sea. Of these specimens 172 were obtained through holes in the sea ice within 3km of McMurdo Station and the remaining four individuals were obtained along the north shore of Cape Evans about 23.5km north of McMurdo Station. Methods of capture included baited wire traps, tangles, and dip nets. Specimens were collected from the shoreline to a depth of 585 metres. The occurrence of a specimen from 585 metres deep at Stanford University Sta. TOS (77° 53′ S, 166° 44′ E) is apparently a new depth record for this species.

Specimens ranged from 51mm to 111mm in total length measured from the antero-dorsal edge of the labrum to the tip of the pleotelson. Ratios of body length to body width ranged from 2.26 : 1 to 2.64 : 1. The collection comprised 23 males, 152 females, and one unsexed. The ratio of males to females was 1 : 6.6.

During this study I examined the gut contents of 118 adult specimens, 15 males and 103 females. These individuals ranged from 71mm to 111mm in total length. Depths of capture ranged from 1–136 metres. These animals were taken in baited wire traps except for eight individuals collected by dip net or tangle. Trap baits included seal meat and blubber, frozen seal blood, and fish. Some specimens were examined immediately after capture. Others were dissected, the alimentary tract removed and preserved in alcohol, and the contents examined at a later date.

Results and Discussion

Individuals were collected on a variety of bottom types throughout the year indicating *Glyptonotus* is not restricted to a particular substrate.

Foods and Feeding Habits

Alimentary tracts were empty in nine (7.6%) of the 118 individuals examined.

Table I lists gut contents, the number of individuals containing each item, and the per cent frequency of occurrence of each item based on the 109 specimens that did have material in the gut. Most individuals contained more than one type of food. Three foods are listed separately at the bottom of Table I because they were present apparently as a result of baited trapping. None of the eight individuals taken by means other than traps contained these items.

The most frequently occurring foods in *Glyptonotus* were ophiuroids (52.3%), gastropods (19.3%), isopods (17.4%), and echinoids (14.7%). Two species of ophiuroids could be identified from the gut contents. These were *Ophiacantha antarctica* Koehler and *Ophiurolepis gelida* (Koehler), the two most abundant ophiuroid species at McMurdo Sound. A common trochid, *Margarella refulgens* (Smith) was the only species I could identify from the gastropod remains present. Small isopods were taken as food by 19 individuals. In seven of these instances the prey isopods included one or more *Glyptonotus*. Thus, the species is cannibalistic. Pieces of testes and spines of an echinoid, *Sterechinus neumayeri* (Meissner), were present in 16 specimens. Remains of no other species of echinoids were found.

Two specimens contained crinoids. Part of the remains from one of these *Glyptonotus* was identified as *Anthometra adriani* Bell, one of the two most abundant species of crinoids in McMurdo Sound.

Amphipods of the genus *Orchomenella* (probably *O. plebs* Hurley; see Hurley, 1965) were attracted in great numbers to baited traps. They were so abundant at times that in a few hours they reduced to scraps and hard parts any seal meat, fish, or other bait present. *Glyptonotus* readily fed on these amphipods in this artificial situation. There was no evidence that *Orchomenella* constitutes a natural food for *Glyptonotus*. None of the eight specimens of this isopod captured by non-baited methods contained these amphipods. Tait (1917) referred to amphipods, dead meat, and ophiuroids as natural foods of *Glyptonotus*. But Tait's specimens were obtained by members of the Scottish National Antarctic Expedition, 1902–1904, who used baited traps in making collections. It seems reasonable to assume that the amphipods Tait found in the specimens he examined were eaten because they were concentrated in large numbers in the traps. However, the possibility of *Glyptonotus* feeding on dead amphipods in the natural environment cannot be excluded.

TABLE I.—Gut contents of 109 *Glyptonotus antarcticus* from McMurdo Sound, Antarctica, 1958–1961.

Contents	Number of specimens containing item	Per cent frequency of occurrence
Ophiuroids	57	52.3
Gastropods	21	19.3
Isopods	19	17.4
Echinoids	16	14.7
Pelecypods	10	9.2
Polynoid polychaetes	7	6.4
Ectoprocts	7	6.4
Calcareous polychaete tubes	6	5.5
Pycnogonids	3	2.8
Sponge	2	1.8
Crinoids	2	1.8
Brachiopods	1	0.9
Algae	1	0.9
Orchomenella (Amphipoda)*	48	44.0
Seal meat bait*	46	42.2
Fish*	1	0.9

* These foods are listed separately as they are apparently present as a direct result of the baited-trap method of capture. See text.

TABLE II.—Gut contents of *Glyptonotus antarcticus* from differing bottom types at McMurdo Sound, Antarctica.

	Volcanic sand, gravel, sponge spicules and shell debris 1–43 metres (50 specimens)		Sponge-coelenterate complex 51–136 metres (59 specimens)	
Contents	Number of specimens containing item	Per cent frequency of occurrence	Number of specimens containing item	Per cent frequency of occurrence
Ophiuroids	21	42.0	36	61.0
Gastropods	14	28.0	7	11.9
Isopods	7	14.0	12	20.3
Echinoids	9	18.0	7	11.9
Pelecypods	8	16.0	2	3.4
Polynoid polychaetes	6	12.0	1	1.7
Ectoprocts	1	2.0	6	10.2
Calcareous polychaete tubes	4	8.0	2	3.4
Pycnogonids	3	6.0		
Sponge	2	4.0		
Crinoids			2	3.4
Brachiopods	1	2.0		
Algae			1	1.7

Glyptonotus were attracted to seal meat, frozen seal blood, and blubber placed as bait in the traps, yet most specimens contained one or several other food items. Presumably remains of fish and seals, if naturally available, would be taken for food.

Table II shows a comparison between the gut contents of *Glyptonotus* collected on a bottom of coarse sand, gravel, and sponge and shell debris, 1–43 metres deep, and specimens taken on a thick mat of living sponges and colonial coelenterates, 51–136 metres deep. In the first instance the isopods had fed more heavily on gastropods, pelecypods, and polynoid polychaetes, while specimens from the living sponge mat contained more ophiuroids. These differences suggest that availability of food is probably more important than the type of prey.

In *Glyptonotus* (Subfamily Glyptonotinae) the three anterior pairs of legs are modified such that the propodus is dilated and with the reflexible dactylus forms a prehensile hand. These legs are termed gnathopods in contrast to the condition found in the Subfamily Idotheinae wherein members lack the specialised gnathopods and all thoracic limbs are similar. As pointed out by Tait (1917), the flexure of the gnathopods, the arrangement of setae on a limited ventral portion of the anterior limbs, and the ability for ventral flexure of the body in this region all suggest that food is gathered or secured under the body. *Glyptonotus* apparently bestrides or settles down on its prey and the prehensile gnathopods manipulate the food already in the vicinity of the mouth.

Recent observations of live *Glyptonotus* in aquaria at the USARP Laboratory at McMurdo Sound have shown that this species can swim quite rapidly with the ventral surface uppermost (D. E. Wohlschlag, pers. comm.). Whether such movements are used in obtaining prey remains undetermined.

Large powerful mouth parts (see fig. 2) and gnathopods enable *Glyptonotus* to feed on such animals as crinoids, ophiuroids, and echinoids. The high percentage of echinoderm prey is unusual for isopods.

An interesting morphological adaptation in this species, cited by Marshall and Orr (1960), is that several of the thoracic somites are divided along the mid-line, evidently so that the body can expand after ingesting large quantities of food. Many of the individuals examined during this study were expanded.

The ecological role of *Glyptonotus* as a large predator and scavenger on the bottom most closely resembles that of crabs and lobsters in the benthic economy of more temperate zones.

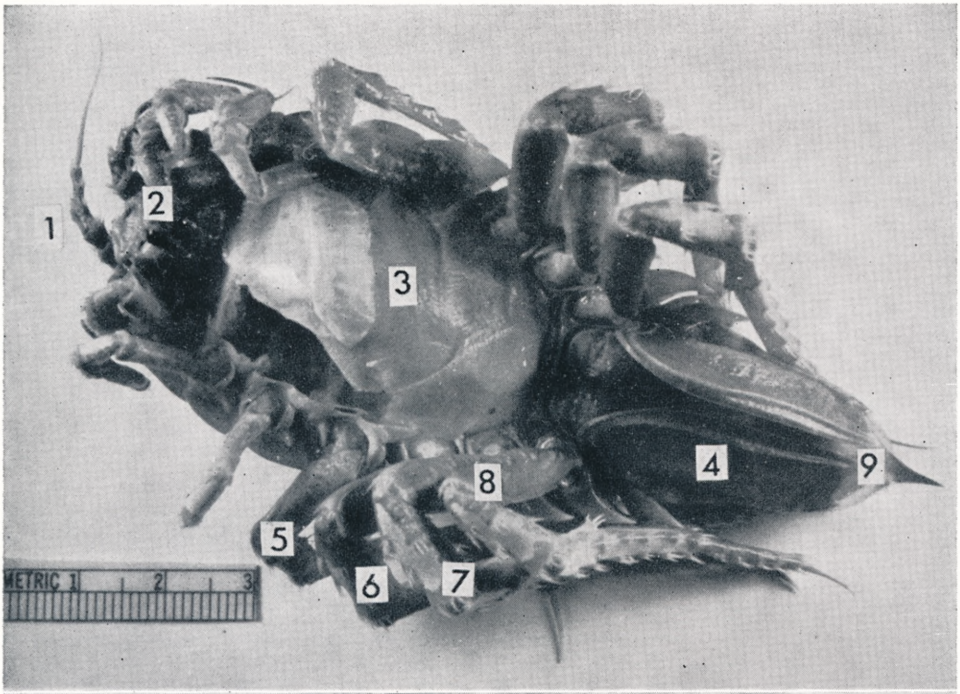
Glyptonotus as Prey

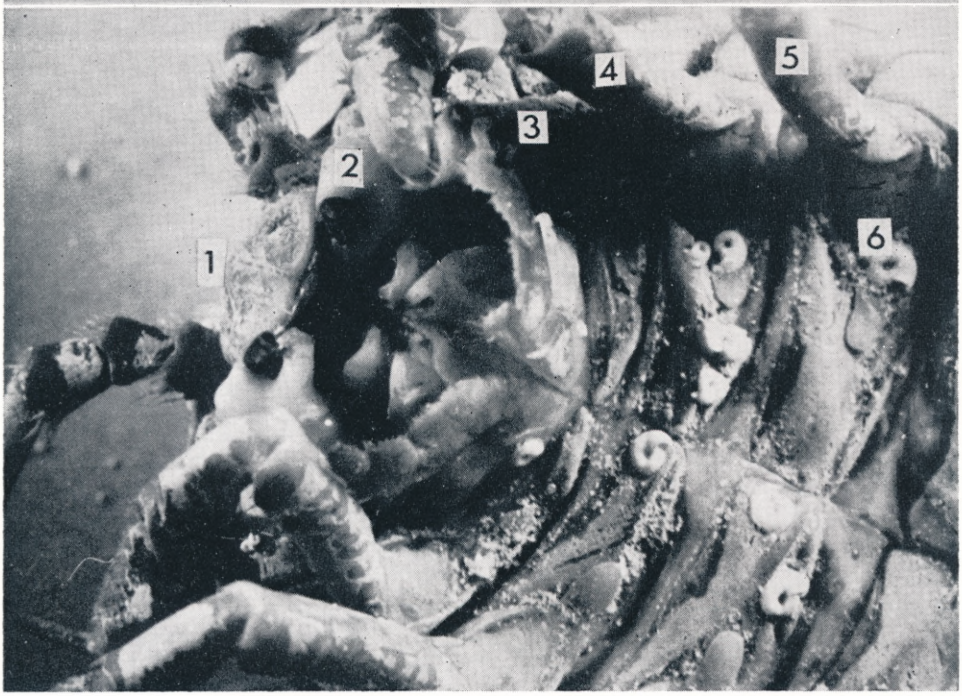
No records of predation on adult *Glyptonotus* have been noted. No specimens were found in an examination of the stomach contents of 44 Weddell seals at McMurdo Sound, although several species of smaller isopods were present (Dearborn, 1965). Heavy armour and in particular the stiff spinous terminal segment (pleotelson) probably make adult *Glyptonotus* undesirable as food for potential vertebrate predators (see fig. 1).

I have found very small *Glyptonotus* in the stomach contents of *Trematomus bernacchii,* the most abundant benthic fish in the area.

Epizoons

Individual *Glyptonotus* are hosts to a variety of organisms that live on or attached to the outside of the body. At McMurdo Sound these associated organisms included several species of sponges, hydroids, flatworms, gastropods, ectoprocts, and a polychaete of the genus *Spirorbis* which secretes a coiled calcareous tube usually on the ventral surface of the isopod (fig. 2).





Glyptonotus antarcticus Eights. Fig. 1 (above).—Ventral aspect, female, × 1.3; showing marsupium made up of overlapping oostegites arising at the bases of thoracic limbs 1–5; the right side of the marsupium has been cut away, and the brooding eggs removed. Fig. 2 (below).—Ventral aspect, male, × 2.5.

Abbreviations.—Figure 1: 1, right second antenna; 2, mandible; 3, marsupium; 4, uropod; 5, fourth peraeopod; 6, fifth peraeopod; 7, sixth peraeopod; 8, seventh peraeopod; 9, terminal segment (pleotelson). Figure 2: 1, labrum; 2, mandible; 3, first gnathopod; 4, second gnathopod; 5, third gnathopod; 6, *Spirorbis* attached to ventral plate.

Reproduction

In *Glyptonotus* the penis is a double structure located mid-ventrally between the thorax and abdomen. The individual penes are equipped with terminal bristles. In males the endopodites of the second pair of pleopods are modified to long spinous elements collectively termed the appendix masculina. This structure apparently develops later than the penis although there may be considerable variation (Sheppard, 1957). Specimens I examined included an individual, 51mm in length, with a well-developed penis but no appendix masculina. A specimen 86mm long was the smallest male in the present collection to have the appendix masculina present as a free stylet not fused to a lobe of the pleopod. The appendix masculina aids in the transmission of bundles of spermatozoa during copulation (Calman, 1909).

The female broods the eggs in a typical marsupium formed by overlapping oostegites. Whereas most isopods have only four pairs of oostegites, one set arising at the base of each pair of thoracic limbs, 1–4 or 2–5, in *Glyptonotus* the marsupium is made up of five pairs (fig. 1). Age of females at sexual maturity varies with locality and hydrological conditions. Nordenstam (1933) reported a brooding female 64.5mm in length among specimens taken by the Swedish Antarctic Expedition at South Georgia. The smallest brooder I collected at McMurdo Sound was 85mm in length.

During the present study 152 female *Glyptonotus* were examined. These included 23 individuals with eggs or larvae in the marsupium. Volumes of ovaries from 92 females were determined by using graduated tubes to measure the amount of displacement when the ovarian tissue was added to a known volume of sea water. Sizes of individual eggs taken from the ovary were measured in 46 animals.

The number of eggs per marsupium ranged from 356 to 1,020 (mean = 746). Larger females produced more eggs. A correlation coefficient of 0.796 (significant at the 1% level) was obtained for the relationship of body length to number of brooding eggs present. Brood eggs are bright orange in colour. Eggs in the ovary are usually light pink to light purple. Ovarian eggs are released into the brood pouch after reaching about 1.9mm or more in diameter.

In brooding females the ovaries were very small. In two such specimens the ovarian volumes were 0.1ml and 0.5ml. In four other individuals carrying eggs the ovaries were difficult to find. The largest brood eggs in these instances were 2.3mm to 2.4mm in diameter. For 69 non-brooders, ovarian volumes ranged from 0.9ml to 3.7ml.

A given generation of ova apparently grow, become fertilised, and develop, mature, and hatch in the marsupium before the next generation of oocytes is well established in the ovary.

Brooders were present in the samples as follows (first value is the number of brooders present, second value is total number of adult females taken during the month, and in parentheses, the per cent that were brooders): January, 2, 6 (33%); March, 1, 2 (50%); June, 1, 4 (25%); August, 2, 12 (17%); September, 6, 30 (20%); October, 9, 40 (23%); December, 2, 14 (14%). The small number of animals available for comparison makes it difficult to interpret these data. Because the length of time eggs remain in the marsupium has not been established, the precise seasons of greatest brooding activity, if any, are speculative. Females bearing larvae have been observed on only two occasions, widely separated in time. A specimen collected on 20 June 1961 contained eggs and larvae in about equal numbers. A second female carrying only larvae was collected in December (J. S. Pearse, pers. comm.). Within the population of *Glyptonotus* at McMurdo Sound the reproductive period is obviously quite variable and additional sampling is needed to determine any seasonal reproductive cycle.

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