BIOMASS ESTIMATES FROM BORGE BAY, SIGNY ISLAND, SOUTH ORKNEY ISLANDS

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ABSTRACT. The marine benthos on the Antarctic continental shelf is reputed to be characterized by a high biomass but few quantitative estimates validate this statement. Results from a small number of epibiotic biomass samples from Signy Island, South Orkney Islands, are presented, and although they are of a preliminary nature, they agree quantitatively with those reported from the Haswell Islands region of the continent but not with those from the South Shetland Islands.

THE Antarctic marine benthos is diverse when compared with other polar ecosystems and is allegedly characterized by a high biomass of sessile filter-feeding organisms on the continental shelf below the level of seasonal ice scour. However, very few quantitative data are available and those which are known are usually numerical rather than weight estimations.

Russian investigators (Belyaev, 1958; Ushakov, 1963) were among the first to provide biomass analyses, from grab samples, and these indicated that although wet-weight biomass-density estimates for bathyal and abyssal levels were of the same order as for other oceans, biomass values on the Antarctic continental shelf were higher than those recorded elsewhere, often by as much as a power. It also became apparent that in water shallower than 500 m. sponges and bryozoans predominate while below this level the proportion of molluscs, polychaetes and Crustacea increases.

Collections made by divers at the Haswell Islands (lat. 66°32′S., long. 93°00′E.) demonstrated that these high biomass levels continued into shallow water with wet weights of epibenthic organisms of up to 6 kg./m.^{2} at depths of between 45 and 50 m. The major components were sponges, hydroids and bryozoans. Alcyonaria, hydroids and sedentary polychaetes attained biomass levels of 1–2 kg./m.^{2} at depths between 14 and 40 m. (Andriashev, 1968). Everson and White (1969) were able to provide preliminary evidence that these high biomass levels continued into the seasonal ice-abrasion zone at Signy Island (lat. 60°43′S., long. 45°38′W.) as an interstitial fauna of 1–4 kg./m.^{2} composed mainly of bivalve molluscs between 5 and 30 m. depth. Much of the contribution to this biomass has been shown to be made by the large lamellibranch *Laternula elliptica* (King and Broderip) at densities up to 50/m.^{2}. Significant contributions were also made, because of their high population densities, by the smaller *Yoldia* (*Aequiyoldia*) *eightsi* (Couthouy) and *Mysella charcoti* Lamy. Densities of *Yoldia* in excess of 2,700/m.^{2} were recorded by Rabarts (1971) and *Mysella* in excess of 75,000/m.^{2} by Robins (1972). Amphipods and polychaetes were also significant components of the near-shore interstitial benthos by virtue of their high densities. For further descriptive accounts of the benthic communities at Signy Island, the reader is referred to the work of Price and Redfearn (1968), Everson (1970), Bone (1972), Bregazzi (1972), Thurston (1972), and Walker (1972).

Propp (1970) gave additional data for the epibenthos at the Haswell Islands where biomass levels varied through 20–25 g./m.^{2} at 2–10 m., 450 g./m.^{2} at 6–25 m., 1,000 g./m.^{2} at 25–30 m., and up to 3 kg./m.^{2} at depths greater than 30 m. It is not at all obvious why the maximum weights should differ from those given by Andriashev (1968).

Gallardo and Castillo (1968) commented on 18 benthic samples taken from soft substrates at Deception Island (lat. 62°57′S., long. 60°38′W.), South Shetland Islands, during December 1967. These were primarily taken to discover the effect on the benthic fauna of an episode of volcanic activity within this sea-breached caldera during the same month. No direct comparison was possible with the fauna before the eruption, since data were not available, but they were able to show that the fauna was more numerous, and the biomass was higher, outside Port Foster. There was also a trend towards progressive quantitative and qualitative impoverishment within Port Foster as samples were taken towards the new ash cone in Telefon Bay. The mean wet weight of four samples taken outside Port Foster was 260 g./m.^{2} at a depth of 35 m. The

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TABLE I. BIOMASS (WET WEIGHT) RECORDS FROM BORGE BAY, SIGNY ISLAND, SOUTH ORKNEY ISLANDS

Site	*Depth* (m.)	*Habitat*	*Area sampled* ($m.^2$)	*Biomass* ($g./m.^2$) *Flora*	*Fauna*	*Total*	*Groups represented*	*Numbers*
Bare Rock	5	Cliff overhang	0·25	0	4,200	4,200	Echinoderms	261
							Annelids	6
							Pycnogonids	7
							Nemerteans	3
							Sponge	Mass
							Hydroids	Mass
							Bryozoa	Mass
Berntsen Point	6	Boulders	1	1,230	166	1,396	Macro-algae	Mass
							Echinoderms	3
							Annelids	57
							Molluscs	32
							Crustacea	16
							Pycnogonids	3
							Nemerteans	13
Bare Rock	6·5	Boulders sloping	1	1,723	137	1,860	Macro-algae	Mass
							Echinoderms	10
							Molluscs	25
							Annelids	11
							Nemerteans	16
							Pycnogonids	2
Bare Rock	6·5	Boulders horizontal	0·5	1,040	200	1,240	Macro-algae	Mass
							Echinoderms	9
							Molluscs	14
							Annelids	18
							Pycnogonids	2
							Crustacea	1
Powell Rock	26	Boulder slope	1	218	53	271	Macro-algae	Mass
							Echinoderms	15
							Molluscs	11
							Annelids	18
							Nemerteans	1
							Sipunculids	5
							Pycnogonids	2
							Tunicates	1
							Crustacea	1
Powell Rock	26	Rock surface	0·75	1,487·5	1,347·5	2,835	Macro-algae	Mass
							Echinoderms	38
							Molluscs	6
							Annelids	68
							Nemerteans	2
							Tunicates	4
							Sipunculids	6
							Pycnogonids	7

same authors reported on 38 grab samples of soft substrate fauna from depths of 35–100 m. and 100–355 m. at Discovery Bay (lat. 62°28′S., long. 59°43′W.), Greenwich Island, South Shetland Islands (Gallardo and Castillo, 1969). They did not present wet-weight measurements for individual stations but noted that the sample sites at depths shallower than 100 m. had a mean total biomass of 164 g./m.^{2} and those from deeper than 100 m. had an average biomass of 180 g./m.^{2}.

The results from a small number of samples from Borge Bay, Signy Island, collected by the divers O. Darling, A. Losh, M. Robins and R. Townley-Malyon, are presented for comparison with former collections from different geographical localities and as a basis for more detailed quantitative investigations at Signy Island (Tables I and II). Clearly, more samples are required before firm conclusions can be drawn about the near-shore benthos at Signy Island but a number of preliminary observations may be made.

TABLE II. BENTHIC BIOMASS (WET WEIGHT) ESTIMATES FROM HASWELL ISLANDS AND SIGNY ISLAND

	Haswell Islands (Andriashev, 1968)				*Signy Island*			
Depth (m.)	*Total* (g./m.^{2})	*Flora* (g./m.^{2})	*Fauna* (g./m.^{2})	*Fauna percentage of total*	*Total* (g./m.^{2})	*Flora* (g./m.^{2})	*Fauna* (g./m.^{2})	*Fauna percentage of total*
2–10	20–25	0	20–25	100	1,499	1,331	168	11·6
6–25	450	0	450	100	—	—	—	—
25–30	1,000	0	1,000	100	1,553	852	700	54·9
30	3,000	0	3,000	100	4,200*	0*	4,200*	100*

* Sample from overhang at 5 m. but assumed to be representative of the deeper-water sponge/bryozoan community.

The sample from 5 m. is anomalous, since it was collected from an overhang where the biota would be more typical of the filter-feeding assemblages from deeper water. This type of habitat, often found at Signy Island where former beach levels, cliffs and caves occur below the present sea-level, commonly exhibits a phenomenon of emergence by deep-water fauna where low illumination levels exclude macro-algae (Fig. 1). The three samples from 6 and 6·5 m. indicate an epibenthic biomass of $1{\cdot}5 \pm 0{\cdot}32$ kg./m.^{2} which is largely composed of macro-algae and an associated errant fauna (Fig. 2; Table I). This is rather greater than the weights recorded at the Haswell Islands (450 g./m.^{2}) but the latter locality is somewhat unusual in that macro-algae are more or less absent (Propp, 1970). The standard deviation of the two samples from 26 m. is high but their mean (1,553 g./m.^{2}) is of the same order as the collections at the Haswell Islands. Similarly, if the 5 m. sample is assumed to be more typical of the sponge/bryozoan community, then that also is of the same order as recorded by Propp (1970) for a depth in excess of 30 m. A more precise parallel is possible if algae are excluded from the Signy Island observations (Table II).

The biomass estimates from both of the sites in the South Shetland Islands (Gallardo and Castillo, 1968, 1969) are lower than those reported from either the South Orkney Islands or the Haswell Islands but this is probably due to a combined sampling and substrate effect. The Peterson grab was unlikely to have sampled the large deep-burrowing lamellibranchs that are often the principal infauna biomass component, and also the filter-feeding attached fauna that usually attains high biomass levels was not represented on the silts and sands of Discovery Bay or Deception Island.

Further observations are necessary before any justifiable generalizations can be made about marine benthic biomass estimates from the Antarctic but this new information from Signy Island on the Scotia arc appears to agree with that reported from the Haswell Islands region of the continent but not with those from the South Shetland Islands.

Fig. 1. A predominantly filter-feeding community on a near-vertical rock surface below the seasonal ice abrasion zone at Signy Island, depth 23 m. Groups represented are brachiopods, bryozoans, octocorals, sponges, hydroids, tunicates and holothurians with an associated errant fauna of asteroids and echinoids. Some red and brown macro-algae are still present at this depth.

Fig. 2. Macro-algae with an errant fauna on boulders from the ice abrasion zone at Signy Island, depth 7 m.

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REFERENCES

ANDRIASHEV, A. P. 1968. The problem of the life community associated with the Antarctic fast ice. (*In Symposium on Antarctic Oceanography, Santiago, Chile, 13–16 September 1966.* Cambridge, Scott Polar Research Institute, 147–55.)

BELYAEV, G. M. 1958. Nekotorye zakonomernosti kolichestvennogo raspredeleniya donnoi fauny v Antarktike [Some patterns in the quantitative distribution of the bottom fauna in the Antarctic]. *Inf. Byull. sov. antarkt. Eksped.*, No. 3, 43–44. [English translation: Vol. 1 (1964), No. 3, 119–21.]

BONE, D. G. 1972. Aspects of the biology of the Antarctic amphipod *Bovallia gigantea* Pfeffer at Signy Island, South Orkney Islands. *British Antarctic Survey Bulletin*, No. 27, 105–22.

BREGAZZI, P. K. 1972. Life cycles and seasonal movements of *Cheirimedon femoratus* (Pfeffer) and *Tryphosella kergueleni* (Miers) (Crustacea : Amphipoda). *British Antarctic Survey Bulletin*, No. 30, 1–34.

EVERSON, I. 1970. The population dynamics and energy budget of *Notothenia neglecta* Nybelin at Signy Island, South Orkney Islands. *British Antarctic Survey Bulletin*, No. 23, 25–50.

———. *and* M. G. WHITE. 1969. Antarctic marine biological research methods involving diving. *Rep. Underwa Ass.*, **4**, 91–95.

GALLARDO, V. A. *and* J. G. CASTILLO. 1968. Mass mortality in the benthic infauna of Port Foster resulting from the eruptions in Deception Island (South Shetland Islands). *Publ. Inst. antárt. chil.*, No. 16, 11 pp.

———. *and* ———. 1969. Quantitative benthic survey of the infauna of Chile Bay (Greenwich Island, South Shetland Islands). *Gayana*, No. 16, 18 pp.

PRICE, J. H. *and* P. REDFEARN. 1968. The marine ecology of Signy Island, South Orkney Islands. (*In Symposium on Antarctic Oceanography. Santiago, Chile, 13–16 September 1966.* Cambridge, Scott Polar Research Institute, 163–64.)

PROPP, M. V. 1970. The study of bottom fauna at Haswell Islands by scuba diving. (*In* HOLDGATE, M. W., *ed. Antarctic ecology.* London and New York, Academic Press, 239–41.)

RABARTS, I. W. 1971. Physiological aspects of the ecology of some Antarctic lamellibranchs (B.A.S. No. N9/1971/H), 11 pp. [Unpublished.]

ROBINS, M. W. 1972. A new commensal hydroid from Antarctica. *British Antarctic Survey Bulletin*, No. 28, 75–81.

THURSTON, M. H. 1972. The Crustacea Amphipoda of Signy Island, South Orkney Islands. *British Antarctic Survey Scientific Reports*, No. 71.

USHAKOV, P. V. 1963. Nekotorye osobennosti raspredeleniya donnoi fauny u beregov Vostochnoi Antarktidy [Some characteristics of the distribution of the bottom fauna off the coast of East Antarctica]. *Inf. Byull. sov. antarkt. Eksped.*, No. 40, 5–13. [English translation: Vol. 4, No. 5 (1964), 287–92.]

WALKER, A. J. M. 1972. Introduction to the ecology of the Antarctic limpet *Patinigera polaris* (Hombron and Jacquinot) at Signy Island, South Orkney Islands. *British Antarctic Survey Bulletin*, No. 28, 49–69.