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Benthic near-shore microbial communities of Arthur Harbor, Antarctic Peninsula

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Arthur Harbor benthic microbial communities were described for four sites (figure). Analysis of membrane phospholipid ester-linked fatty acids (PELFA) provided information on total microbial biomass and community structure. Metabolic activities were determined for the four sites by incorporation of sodium [^{14}C]-acetate and methyl [^{3}H]-thymidine into lipid and bacterial DNA, respectively.

All sample collections were made by scuba divers (assisted by zodiacs) hand coring sediments at depths of 10–26 meters. All samples were taken in ice-free areas, maintained at ambient seawater temperature, and transported within 1 hour to Palmer Station for analysis. Laboratory procedures and instrumentation used in the analysis are described elsewhere (Smith et al. 1986).

The determinations for Arthur Harbor were compared to previously studied McMurdo Sound sites. A greater average biomass (20.0×10^8 cells per gram of dry weight) was observed at McMurdo (Smith et al. 1986), compared to 3.5×10^8 per gram of dry weight average of Arthur Harbor (table 1). Analysis of PELFA for community structure determination revealed only a slight difference in bacterial signature lipids between the sites within Arthur Harbor; however, one site AH(13) contained lower (34 percent) amounts of these signature lipids when compared to the average of the four sites. Diatom signature lipids were present in greater proportion at a deeper trough site adjacent to Elephant Rock where phytoplankton were believed to be accumulating upon senescence and sedimentation (Smith et al. in preparation). Proportions of microeucaryotic signature lipids revealed little site-to-site difference. Only the shallower sites at AH(10) and HI appeared to contain slightly greater amounts of lipids from this microbial group.

Metabolic activities were determined to be higher for all Arthur Harbor sites when compared to McMurdo (Smith et al. 1986) for both ^{14}C-acetate and ^{3}H-thymidine incorporation (table 1). Incorporation of ^{3}H-thymidine into bacterial DNA (excluding sulfate-reducing bacteria) showed a 77 percent higher rate for Arthur Harbor when compared to McMurdo. Likewise, the rate of incorporation of ^{14}C-acetate into lipid was 53 percent greater. Care was taken to establish dilution pools and time course points for ^{3}H-thymidine using the methods of Pollard and Moriarty (1984). Activities for the four Arthur Harbor sites were determined to be the highest at Elephant Rock where the rates were 30 percent greater for both incorporations (table 2).

Continued studies of near-shore benthic microbial communities will provide base-line information on these primary food sources. Another equally important use of these analyses is the capability they provides for monitoring microbial community structure and metabolic activities in the advent of future anthropogenic contamination (Parker et al. 1984; White 1983; Smith et al. 1982). Future studies in this area by could focus on sediment microbial communities in deeper water regions of Arthur Harbor (30–60 meters). In addition, water-column studies are planned using sediment traps to determine microbial biomass and species composition. Such data will be used to measure the contribution of planktonic organisms to the sediments during the productive antarctic summer season.

This work was supported by National Science Foundation grant DPP 86-12348 awarded to Anna C. Palmisano and David C. White.

Table 1. Biomass and metabolic activity comparisons for benthic microbial communities of Arthur Harbor and McMurdo Sound, Antarctica.

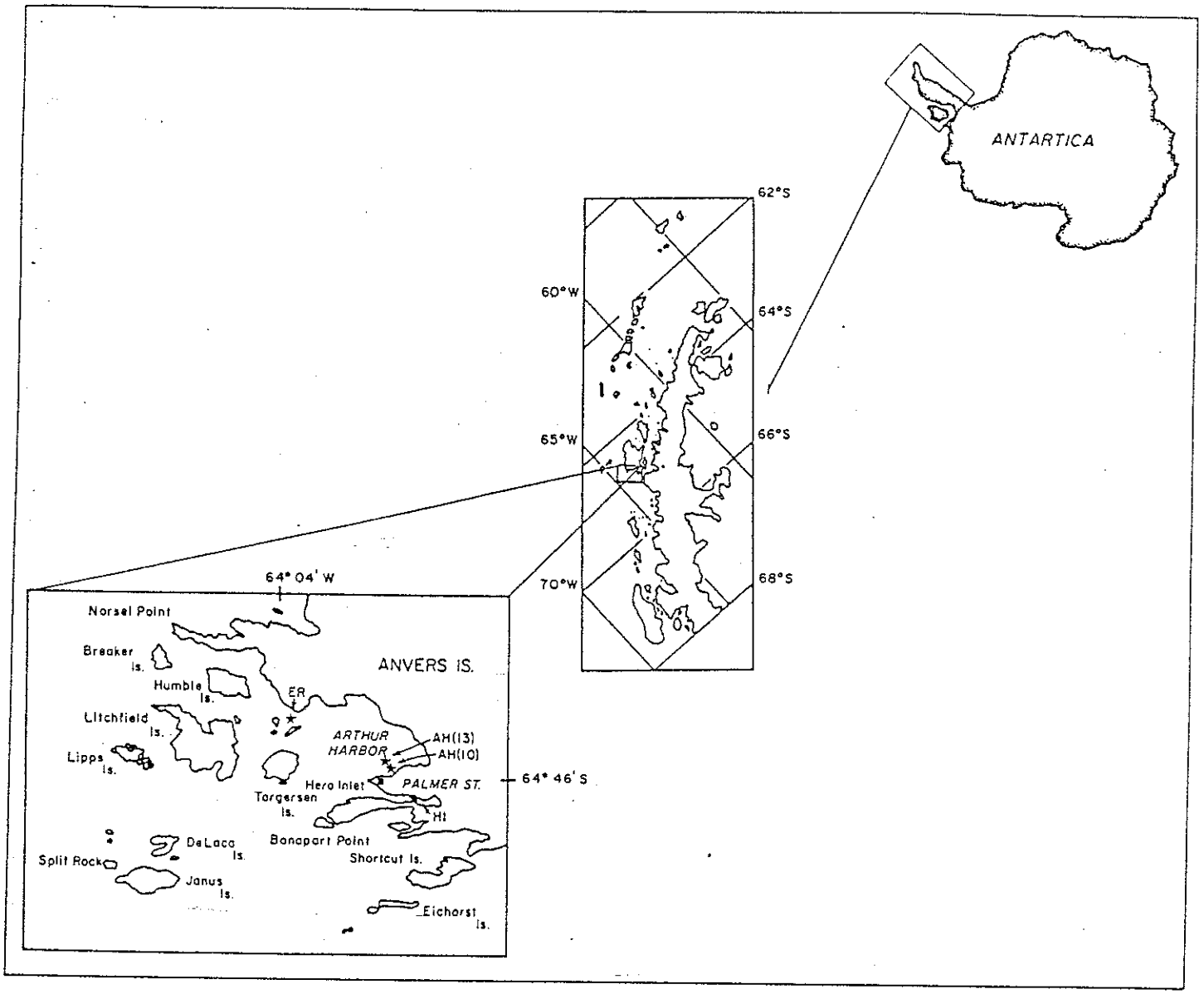
Activity	Arthur Harbor	McMurdo Sound
Total biomass ($\times 10^8$ cells per gram of dry weight)	3.5[a]	20.4
Methyl [^{3}H]-thymidine[b] ($\times 10^4$ DPM[c] per gram per hour)	3.1	0.7
Sodium [^{14}C]-acetate ($\times 10^4$ DPM per gram per hour)	8.3	3.9

[a] All numbers are the mean (n = 3) for biomass, and (n = 4) for incorporations for the four sites at Arthur Harbor and three sites at McMurdo Sound.
[b] Does not include sulfate-reducing bacteria.
[c] DPM denotes discintigrations per minute.

Table 2. Metabolic activities four Arthur Harbor sites.

Activity	ER[a]	AH(10)	AH(13)	HI
Methyl [^{3}H]-thymidine (§ 10^4 DPM per gram per hour)[b]	4.5[c]	4.0	2.0	1.9
Sodium [^{14}C]-acetate (§ 10^4 DPM per gram per hour	12.0	6.0	9.0	6.0

[a] Study sites in Arthur Harbor. (See figure.)
[b] Does not include sulfate-reducing bacteria.
[c] Numbers are the mean of four determinations.



Arthur Harbor study sites. AH(10) denotes Arthur Harbor at 10 meters. AH(13) denotes Arthur Harbor at 13 meters. ER denotes Elephant Rock at 26 meters. HI denotes Hero Inlet at 10 meters.

References

Parker, J.H., J.S. Nickels, R.F. Martz, M.J. Gehron, N.L. Richards, and D.C. White. 1984. Effects of well-drilling fluids on the physiological status and microbial infection of the reef building coral *Montastera annularis*. *Archives of Environmental Contamination and Toxicology*, 13, 113–118.

Pollard, P.C., and D.J.W. Moriarty. 1984. Validity of the tritiated thymidine method for estimating bacterial growth rates: Measurements of isotope dilution during DNA synthesis. *Applied and Environmental Microbiology*, 48(6), 1076–1083.

Smith, G.A., J.S. Nickels, J.D. Davis, R.H. Findlay, N.L. Richards, and D.C. White. 1982. Effects of oil and gas well drilling fluids on the biomass and community structure of microbiota that colonize sands in running seawater. *Archives of Environmental Contamination and Toxicology*, 11, 17–23.

Smith, G.A., P.D. Nichols, and D.C. White. 1986. Fatty acid composition and microbial activity of benthic marine sediments from McMurdo Sound, Antarctica. *FEMS Microbiology Ecology*, 38, 219–231.

Smith, G.A., J.D. Davis, A.M. Muscat, R.L. Moe, and D.C. White. In preparation. Lipid composition and metabolic activities for benthic near-shore microbial communities of Arthur Harbor, Antarctic Peninsula: Comparisons with McMurdo Sound. *Polar Biology*.

White, D.C. 1983. Analysis of microorganisms in terms of quantity and activity in natural environments. In J.H. Slater, R. Whitenbury, J.W.T. Wimpenny (Eds.) *Microbes in their natural environments*. (Society of General Microbiology Symposium, Vol. 34.)