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FREELIVING MARINE NEMATODES OF ANTARCTICA A CURRENT APPRAISAL

by

H. M. PLATT
British Museum (Natural History),
Cromwell Road, London SW7 5BD, England (*)

ABSTRACT

Early studies of marine nematodes from Antarctic waters, based on collections made by various national expeditions between 1882 and 1931, were primarily descriptive in nature and specimens were often poorly preserved and unrepresentative of the total fauna. Emanating from broader-based approaches to problems of life in low-temperature environments, new and more comprehensive collections have recently been made. In the Atlantic sector of the Antarctic Ocean, material from shallow sublittoral areas in South Georgia and the west coast of the Antarctic Peninsula have been obtained by diving and by grab-sampling in deeper waters off South Georgia and in the Weddell Sea. The new material should enable some of the earlier descriptions to be improved in addition to providing new information. It is suggested that detailed studies of nematode communities could provide a valuable method of addressing some of the classical aspects of Antarctic biology.

INTRODUCTION

The Antarctic Ocean is one of the richest biological provinces on earth. Man's current interest in its resources is directed primarily towards exploiting the krill and fish stocks. As coastal regions, particularly around South Georgia, are of prime importance to the breeding and early development of certain commercially important species, near-shore benthic ecosystems are currently the subject of investigation by the British Antarctic Survey.

Much recent work has addressed fundamental ecological and physiological problems of life in these low-temperature environments. With increasing awareness of the possible importance of nematodes, the group has been included in some of these investigations.

This submission gives a brief review of past and current interest in Antarctic marine nematology and describes the scope and progress of the British Antarctic Survey's work in the field.

GENERAL REVIEW

The marine Antarctic region, for the purposes of this review, is considered to

(*) Formerly : British Antarctic Survey, Madingley Road, Cambridge CB3 OET, England.

be that area south of the Antarctic Convergence (Fig. 1). But because of their proximity to the Convergence and the present lack of agreement on the limits of various biogeographical areas (HEDGPETH, 1970), the sub-Antarctic Kerguelen and Macquarie Islands have been included.

Scientific publications concerned with Antarctic nematodes are few. The first nematode to be described from Antarctic waters was *Deontostoma antarcticum* (v. LINSTOW, 1892) collected at South Georgia during the German International Polar-Year Expedition (1882-1883). Subsequently, less than thirty taxonomic papers have been published, recording about 500 species (~ 70 % new) : most describe animals collected by various national expeditions (Table 1). Unfortunately, many are descriptions of poorly preserved specimens, often unrepresentative of the populations from which they came.

About half the publications are those of ALLGÉN. Initially, he described 13 nematodes collected by Larsen's Ross Sea Expedition (1929-1930) at Macquarie Island and in the Ross Sea (ALLGÉN, 1929-1930). Later, he worked with collections made in South America, the Falkland Islands, South Georgia and the Antarctic Peninsula by Nordenskjold's Swedish Antarctic Expedition (1901-1903), recording almost 400 species of which about 60 % were new (ALLGÉN 1952-1960). Many new species descriptions were of single female or juvenile specimens and the figures, particularly in the two major works (ALLGÉN, 1959, 1960), are rather inadequate. Other reports of nematodes from the Atlantic sector were from the South Orkneys by VON LINSTOW (1907a), from South Georgia by STEINER (1921) and from the Antarctic peninsula by INGLIS (1958).

VON LINSTOW (1907b) also provided the first description of a nematode from the East Antarctic (*Leptosomatum australe* from the Ross Sea). Later, COBB (1914) described 25 new species collected in the Ross Sea by Shackleton's expedition (1907-1909). Epsilonematidae and Desmoscolecida, collected by the German Antarctic Expedition (1901-1903), were described by STEINER (1931a, 1931b) and TIMM (1970) respectively. MAWSON's two Antarctic expeditions (1911-1914, 1929-1931) provided material which resulted in the valuable contributions of COBB (1930) and MAWSON (1956-1958b). Further descriptions of Enoplida from Kerguelen Island were made by SCHUURMANS STEKHOVEN and MAWSON (1955) and PLATONOVA (1958). Other early papers, dealing with non-taxonomic aspects of Antarctic nematology, were given by ALLGÉN (1934, 1952b, 1952d, 1953c, 1955) and COBB (1916).

In recent times, the establishment of permanent biological facilities in the Antarctic, such as those at Kerguelen Island, Palmer Station, Signy Island and South Georgia, have enabled more detailed long-term biological investigations to be undertaken. The results are only slowly becoming available, but studies involving nematodes have been reported from the Ross Sea (HOPE, 1974 ; TIMM and VIGLIERCHIO, 1970) and Kerguelen Island (ARNAUD, 1974 ; DE BOVÉE, 1975 ; DE BOVÉE and SOYER, 1975), in addition to the work to be described here.

PRESENT INVESTIGATION

Two approaches were adopted. Firstly, a wide ranging series of collections around the Scotia Arc and in the Weddell Sea were made, specifically for nematological purposes. Secondly, a more detailed year-round population study was undertaken at South Georgia. The former was intended to satisfy some basic questions of geographical variation and species diversity. The latter had a more ecological basis, but should also enable infra-specific variation in cold waters to be investigated.

TABLE 1

Antarctic expeditions providing samples from which free-living marine nematodes have been described

Dates	Name of Expedition	Leader	Vessel	Principal collection areas	Principal publications
1882-1883	German International Polar-Year Expedition	Neumayer	Germania	South Georgia	v. Linstow, 1892
1901-1903	Swedish Antarctic Expedition	Nordenskyöld	Antarctic	South Georgia, Antarctic Peninsula	Allgén, 1952-1960
1901-1903	German Antarctic Expedition	Drygalski	Gauss	Kerguelen Island, Wilkes Land	Steiner, 1931a, 1931b ; Timm, 1970
1901-1904	National Antarctic Expedition (British)	Scott	Discovery	Ross Sea	v. Linstow, 1907b
1902-1904	Scottish National Antarctic Expedition	Bruce	Scotia	South Orkney Islands	v. Linstow, 1907a
1907-1909	National Antarctic Expedition (British)	Shackleton	Nimrod	Ross Sea	Cobb, 1914
1910-1912	British Antarctic Expedition	Scott	Terra Nova	Ross Sea	Leiper & Atkinson, 1915
1911-1914	Australasian Antarctic Expedition	Mawson	Aurora	Macquarie Is, Wilkes Land	Cobb, 1930 ; Mawson, 1958a, 1958b
1923-1924	Ross Sea Expedition (Norway)	Larsen	Sir James Clark Ross	Ross Sea, Macquarie Island	Allgén, 1929-1930
1929-1931	British-Australian-New Zealand Expedition	Mawson	Discovery	Various east Antarctic areas	Mawson, 1956, 1958a, 1958b

TABLE 2

Main sampling locations

Location	Bearings	Water depth (m)	Sampling method (*)
Stanley Harbour, Falkland Islands	51°41′S, 57°40′W	2-5	D
King Edward Cove, South Georgia	54°17′S, 36°30′W	5-20	D
« Offshore », South Georgia	53-56°S, 35-37°W	108-282	G
Maxwell Bay, South Shetland Islands	62°12′S, 58°56′W	6	D
Deception Island, South Shetland Islands	62°59′S, 60°34′W	17	D
Kristi Cove, Anvers Island	64°47′S, 64°03′W	20	D
Grotto Island, Argentine Islands	65°14′S, 64°16′W	10	D
Avian Island, Adelaide Island	67°46′S, 68°54′W	18	D
Back Bay, Stonnington Island	68°12′S, 67°0′ W	15	D
Mobster Creek, Halley Bay	75°31′S, 26°42′W	220	G

(*) D = diving, G = grab.

Biogeographical Study. The main sampling locations are detailed in Table 2 and shown in Figs. 1 and 2. Whenever possible, material was obtained quantitatively by SCUBA diving, using hand-held cores. Samples from the Falkland Islands and the Antarctic Peninsula were obtained in March/April 1974 operating from the R.R.S. Bransfield. In February, 1975, a series of Smith-McIntyre grab samples were taken from a depth of 220 m off the Brunt Ice Shelf near Halley Bay. Although the main South Georgia programme was located in King Edward Cove, several samples were obtained from other areas. These included a series of offshore grab samples kindly supplied by the staff of the Polish research vessel Professor Siedlecki in February, 1976. The locations were similar to those of the Swedish Antarctic Expedition quoted by ALLGÉN (1959). From these various South Georgia collections, it is hoped to be able to improve some of the original taxonomic descriptions.

Temporal Population Study. The long-term study was based on a shallow (4-6 m) fine sand area during 1975 and 1976. The annual range of various environmental factors (e.g. water temperature $-0.2°$ to $+3.8°$; salinity 31.4 ‰ to 34.1 ‰) describe the general stability of the habitat. Of those parameters monitored, only pigment values varied significantly, being higher during the austral summer (average sediment chlorophyll *a* values from November to March, 15.5 µg/g and from April to October, 3.9 µg/g). Preliminary data indicated nematode densities within the range generally expected for the substrate type (580 ± 90 ind./cm^2), and an assemblage superficially resembling that normally expected from comparable habitats in European waters. However, the main part of the faunal analysis remains to be completed.

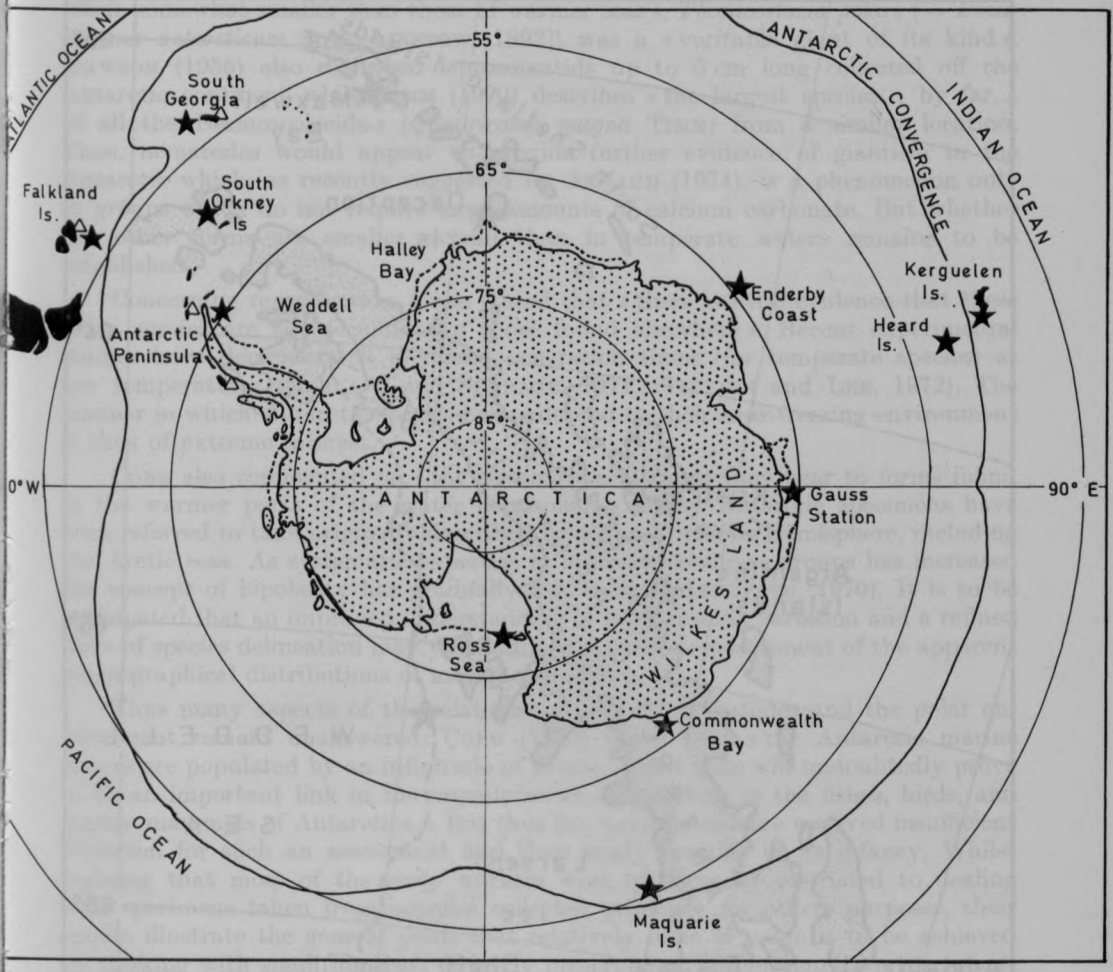

Fig. 1. — Map of Antarctica and the Southern Ocean indicating principal collecting sites of (★) extant publications on Antarctic nematodes and (△) this study.

DISCUSSION

The Antarctic marine environment is characterised by near-constant low temperatures but great seasonal variations in primary productivity (El-Sayed, 1970 ; Everson, 1977). Initial studies of Antarctic benthos, mainly of epifaunal communities, led to suggestions of metabolic cold adaptation, reproductive adaptation, slow growth, low species diversity, high biomass, giantism (much larger size than similar species in other seas) and bipolar species distributions (Arnaud, 1974 ; Everson, 1977 ; Knox, 1970). In addition, attempts were made to delineate major biogeographic regions. Controversy still surrounds many of these concepts, partly because of what Dunbar (1970) referred to as the « taxonomic jungle of the higher latitudes » and partly as more information concerning the infauna becomes available.

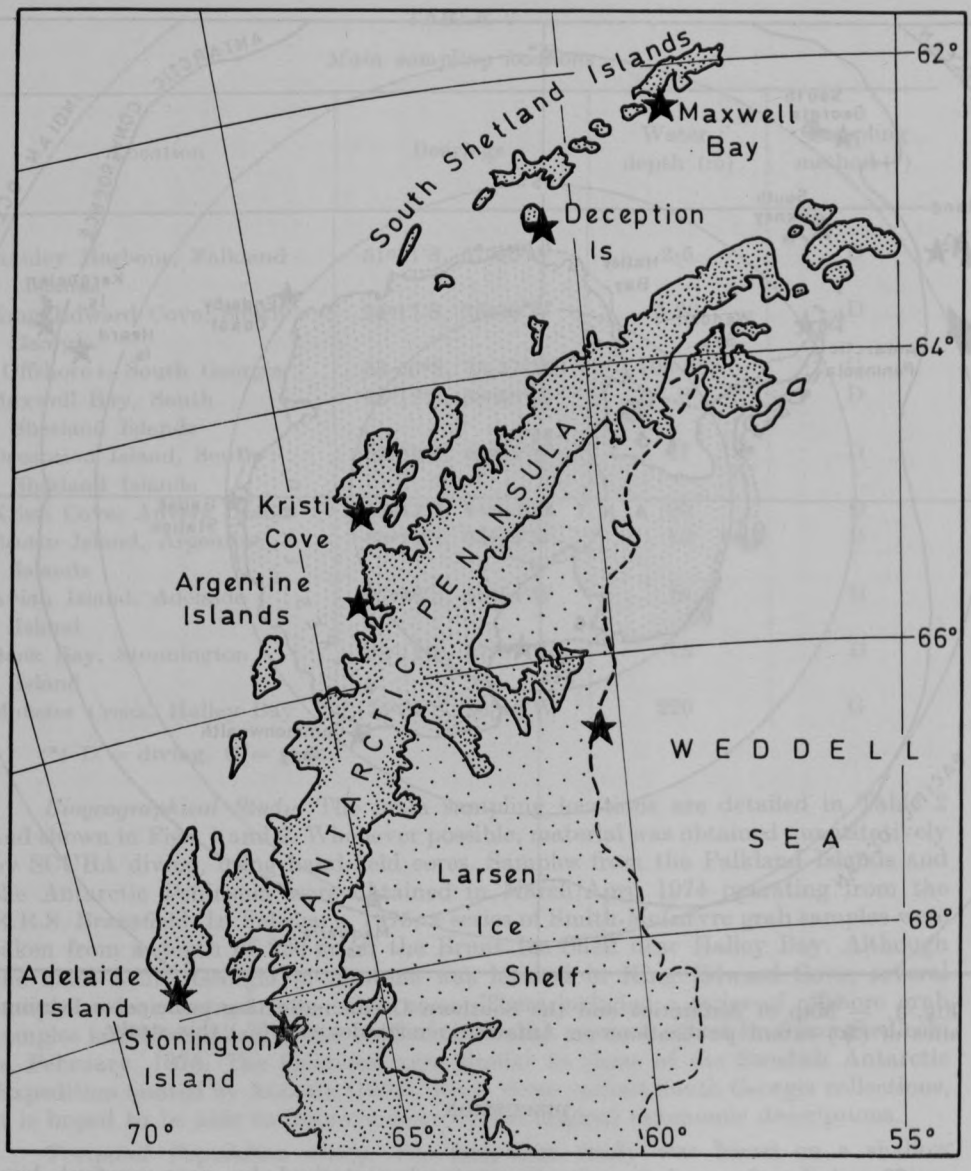

Fig. 2. — Map of Antarctic Peninsula showing (★) main diving locations detailed in Table 2.

The intrinsic advantages of marine nematode populations, namely high densities and species diversity, enable them to be sampled quantitatively with relatively little logistic effort. Thus, they should provide an ideal means of studying some of these classical problems of biology in a polar context.

As long ago as 1914, Cobb made several salient points regarding Antarctic nematodes. On their size, he observed that although « antarctic species are on the

whole somewhat smaller than those of warmer seas », *Thoracostoma polare* (= *Deontostoma antarcticum* [VON LINSTOW, 1892]) was a « veritable giant of its kind ». MAWSON (1956) also described leptosomatids up to 5 cm long collected off the Antarctic continent while TIMM (1970) describes « the largest species... by far... of all the Desmoscolecida » (*Quadricoma magna* TIMM) from a similar location. Thus, nematodes would appear to provide further evidence of giantism in the Antarctic which, as recently suggested by ARNAUD (1974), is a phenomenon only in groups which do not require large amounts of calcium carbonate. But whether the other forms are smaller overall than in temperate waters remains to be established.

Concerning reproduction, COBB stated that « there is little evidence that these polar species are less fecund than those found elsewhere ». Recent experimental studies have demonstrated increased generation times (for temperate species) at low temperatures (GERLACH and SCHRAGE, 1971 ; TIETJEN and LEE, 1972). The manner in which Antarctic species have adapted to their near-freezing environment is thus of extreme interest.

COBB also commented on « the striking resemblance they bear to forms found in the warmer parts of the water hemisphere ». Many Antarctic specimens have been referred to taxa originally described from the Northern Hemisphere, including the Arctic seas. As systematic expertise in other invertebrate groups has increased the concept of bipolarity has gradually lost favour (HEDGPETH, 1970). It is to be anticipated that an improved understanding of infra-specific variation and a refined basis of species delineation may well result in a similar reassessment of the apparent biogeographical distributions of marine nematodes.

Thus many aspects of the relationship between nematodes and the polar environment remain unanswered. COBB (1930) noted that « the Antarctic marine waters are populated by an infinitude of nemas... that time will undoubtedly prove to be an important link in the organic series culminating in the fishes, birds, and marine mammals of Antarctica ». But thus far, nematodes have received insufficient attention for such an assessment and their study remains in its infancy. Whilst realising that most of the early workers were of necessity restricted to dealing with specimens taken from samples collected primarily for others purposes, their results illustrate the general point that relatively little of value is to be achieved by working with small numbers of badly preserved or unrepresentative specimens. With the comparative scarcity of marine nematode expertise, it cannot be recommended too strongly that where opportunities for study occur, more effort should be directed towards meaningful objectives, wherever possible linked to the work of ecologists.

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