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Studies on Phylum Tardigrada and Other Associated Fauna, South Polar Skua and Bird and Mammal Logging During 1994 -1995 Expedition

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Abstract

Schirmacher Oasis is situated on the Princess Astrid coas tin a distance of about 80-100 km from the open sea. The area is about 34 km^2 . The low lying bills in the oasis is interspersed by a few glacial lakes (70°44'33"S to70°46'30"Sand ll°22'40"Eto ll°54'00"E). The Zub lake (Priyadarshini lake) and other four different lakes with moss turf, situated around the Indian summer station Maitri were studied for their f aunal density, diversity and distribution as well as a few physicochemical parameters. Two species of tradigrades, two species of nematodes and one species of rotifer were recorded in the present study. Because of the isolated position of the areas, the animals are poor in species and individual as well.

Studies on South polar skuas were conducted in and around Schirmacher Oasis. Their nesting sites, breeding success were studied and compared with observations over several years. Out of six breeding pairs only one could succeed. One Adelie penguin and six skua (one chick and five adult) were ringed to study the population density and (he migratory pattern, A total of 10 nests were sighted during the present study.

Logging of sea birds and mammals were done during the to and fro voyage. A total of 21 birds and five marrimals were sighted. A total of 400 Adelie penguin, 13 emperor penguin and 93 crabeater seals: were sighted at the pack ice zone and especially during the outward journy the number was more.

Introduction

The harsh combination of rapidly changing temperatures, strong drying winds, irregular water and nutrient supply, frequent snow falls and frosts and continental soil movement due to freezing and thawing, means that only a few plants and invertebrates can survive on the ice-free land (such as Schirmacher Oasis) of Antarctica. These areas are capable of supporting life, mostly microin-vertebrates in the Soil and in moss-water or in the water bodies. They range from Protozoa,'rotifers, tardigrades and nematodes to arthropods.

Somme (1985) has pointed out that our knowledge on Antartic invertebrates is still fragmentary and more works on their taxonomy, zoogeography, population and physiology are needed. So far, very little work has been conducted on these aspects in the accessible areas. Especially in Schirmacher Oasis Matondkar and Gomes (1983) were the first Indians to conduct biological studies on lakes. Ingole and Parulekar (1987) conducted studies on the microfauna of moss-water area and concluded that more study is necessary. A review of the biological studies from 1st to 6th Indian scientific expeditions to Antarctic waters (Dhargalkar, 1988) shows that the data collected so far during summer do not show continuity and lacunae that exist are required to be filled in by taking up systematic and biological programmes. Hence, the present study was undertaken on the Schirmacher Oasis.

Studies on phylum Tardigrada and other associated fauna

Tardigrades are commonly called as 'water bears' since they are strictly aquatic animals. They are minute in size (about 1 mm long) and have a characteristic external and internal structure. The body is flattened or slightly arched and carries ventrally four pairs of stubby leggs bearing claws. This gives the animal the appearence of miniature bear hence they are referred to as water bears. The body surface is covered with variously ornamented plates which sometimes bear spines or hairs. Many species have eyes. The mouth is terminal or ventroterminal. Sexes are separate and the females are oviparous. Development is direct, the cuticle being moulted.

Tardigrades are not planktonic organisms but they are collected in aquatic mosses and algae, on rooted aquatic weeds, or in mud and debris of puddles, ponds and lakes. Active tardigrades are found only in droplets and film of water on terrestrial wet mosses, liverworts and certain angiosperms with a rosette growth form. They are capable of with standing very cold condition (-90°C) by passing into a state of very low metabolic activity. This phenomenon is refered to as anabiosis (Cryptobiosis).

A perusal of the literature shows that out of the fifteen species of Tardigrada recorded from Antartica, seven species are available in high altitude Himalaya (Ramazotti, 1972). So far very little work has been done on Tardigrada diversity in the continental Antarctica (Morikawa, 1951) as well as other microfauna (Dougherty and Harris, 1963; Sudzuki, 1964; Sudzuki and Shimoizumi, 1967). Hence, the present study was undertaken to understand the biodiversity of these microfauna present on the moss-water areas of Schirmacher Oasis.

Studies on south polar skua

Skuas are dark coloured predatory sea birds with consipicuous white flashes in the primary feathers that show in flight. The dark bill is strongly hooked and is covered at the base with a flat horny sheath and the black feet are strongly clawed (Plate 1B). Females are on the average larger than males. The skuas are well known for their aggressive rapacious habits. They have a rapid, sustained and powerful flight which enable them to rob many birds. Skuas prey on chicks and eggs, particularly those of penguins and take a heavy toll of small petrels. Skuas characteristically proclaim jurisdiction over a territory by boldly challenging intruders with open wings raised over the back. The challenge is accompanied by a harsh screaming 'charr charr charr'. They are particularly aggressive in defence of young chicks and engage in a series of swooping dives, striking trespassers with their wings and feet.

In the present study, habitat, reproduction, population density and the behavioural pattern to the recorded and simulated voices of other skua present in the Schirmacher Oasis were conducted.

Studies on bird and mammal logging during voyage

Records of seabirds and mammals seen during open ocean crossing are valuable in providing distributional and ecological data. For many species, even distribution is poorly known. For nearly all, routes and timing of migration or other seasonal movements are either unknown or only inferred from a few sightings. Observations from even a single cruise are useful, but if they can be combined with those from different years and seasons, their value is greatly enhanced. So far, birds and mammals of Antarctic ocean were being studied by Indian expeditioners only on two occasions such as 1981-82 and 1986-87 summers. In the present study informations' such as time of each observation, number, flight direction and behaviour of birds and mammals were recorded.

Material and Methods

Studies on phylum Tardigrada and other associated fauna

The present study involves the collection of tardigrades and their associated fauna in three different habitats such as moss, moss-water, soil and sediments of different lakes in the Schirmacher Oasis (Fig. 1) (Plate 1A).

To study the horizontal distribution of fauna, a known amount of soil was collected from three different areas of Zub lake (Fig. 2), with a round metal tube (Corer) up to 6″ depth at an interval of 10' from the shore line of the lake

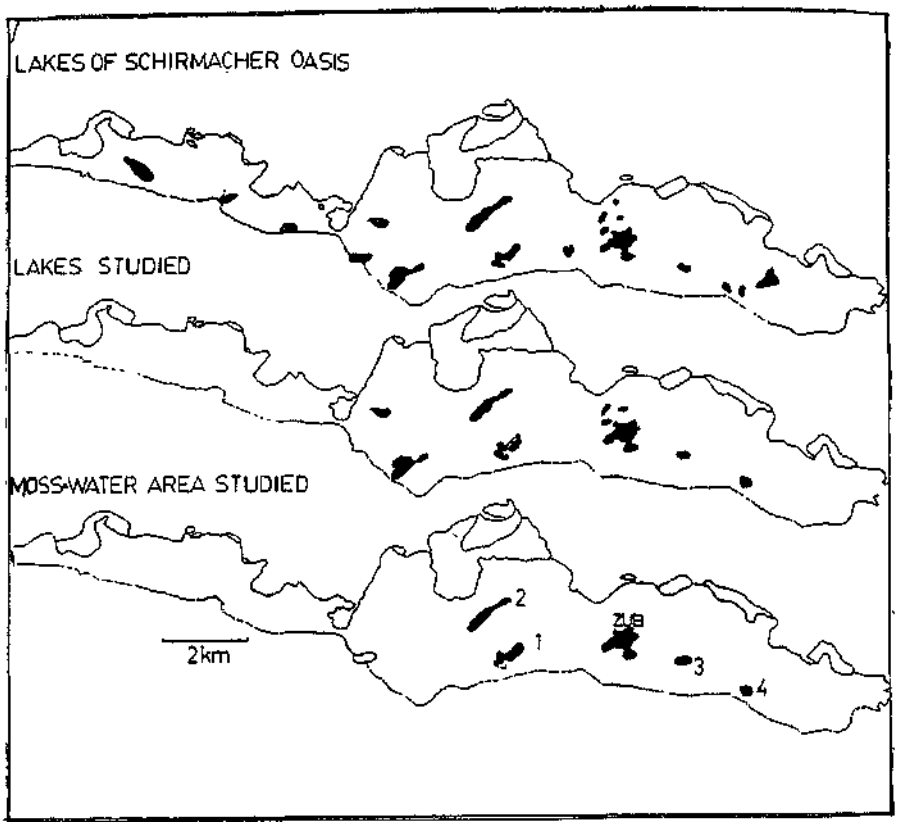

Fig. 1. Different lakes of Schirmacher Oasis and the study area.

up to 50' distance. The vertical distribution of fauna was made in Zub lake with the same corer up to 20 cm depth at an interval of 5 cm each. The sample was carefully removed from the corer and immediately rinsed with water. The animals present were separated and preserved in 5% stained formalin.

A known amount of moss sample from different regions of Zub lake and other lakes visited were collected and brought to the summer hut of Maitri station. Then the collected samples were dissolved in water and the fauna were separated using a 40 μ mesh muslin cloth and were stored in a small container with 5% formalin.

Physico-chemical parameters such as *p*H, dissolved oxygen, conductivity, light penetration and temperature were studied using a portable analyser (Elico, Hyderabad, India).

Plate 1. A- Moss-water fauna collection spot at Zub lake;B- Profile of south polar skua; and C- Moulting Emperor penguins on the ice shelf

Studies on south polar skua

The present study was conducted between Jan 14 to Feb 14,1995. All the nesting sites were visited frequently to assess the breeding success. Mist nets were used to catch the skua for ringing studies. The mist net was spread in a conical shape above the ground with one side open. A piece of meat was kept inside the net as a bait to attract the birds. When the birds were busy eating the meat they were chased inside the conical mist net trap and were caught. Since skua has territorial behaviour this mist net trap was put in different places around Maitri station. Voices of skua were recorded using a tape recorder (Sony, Walkman) and played back to the same bird and different pairs and the behaviour was recorded. On a few occasions the voice was mimicked by the author and the behaviour was noted. The recorded voice and the mimicked voice was played to Adelie penguin and the behaviour was noted.

Metal rings (also called 'bands') bearing a return address (Bombay Natural History Society, Bombay) and serial number have been used to mark birds to study long distance movements, orientation, population ecology and breeding behaviour in Antarctica. Individual birds may thus be recognized and their movements, survival and behaviour studied. The markers used in the present study are tarsus rings made of aluminum. These tarsal rings have numbers large enough to be read with binoculars eliminating the necessity for capturing a bird in order to read its band. Adults are banded on .the right tarsus and chicks on the left tarsus.

Studies on bird and mammal logging during voyage

Onward journey from December 17th to January.l0th and return journey from March 4th to 28th during Antarctica voyage touching Port Louis (Mauritius) was utilized to log the birds and mammals. For observation a 8 x 40 X binocular was used and it was found more useful especially during sparse lighting conditions. Apart from the general observations made throughout the day, main data were collected from 0530 to 0730 and 1600 to 1800 h. While observing birds the poop deck was preferred than the fore deck as many sea birds are attracted towards the back side of the ship due to the upwelling caused by the propeller which increases the availability of food compared to front region. For identification of birds Watson (1975) and Harrison (1989) was used and for mammals Hutchinson (1988) was used.

Results and Discussion

Studies on phylum Tardigrada and other associated fauna

Diversity : The moss species available in continental Antarctica is described as *Bryum argenteum* which is capable of producing more energy by photosynthesis in low light at 5°C than it does at 15°C or higher. Photosynthesis of this moss can start within a few hours of thawing after a prolonged period of freezing and almost immediately following short periods. This moss habitat forms the substratum for the microinvertebrates such as tardigrades,nematodes and rotifers. There are two species of tardigrades found in the present study, namely *Hypsibius chilenensis* (Plate, 1888) and *Macrobiotus polaris* J. Murray, 1910. These are minute animals, less than one millimetre in length (description of these species will be published elsewhere). So far, twenty-three species of tardigrades have been reported from the Antarctica (Jennings, 1976). Most of these species have a world-wide distribution, and only a few of mem are restricted to the Antarctic. Tardigrades are known to tolerate severe desiccation, surviving in a state of anhydrobiosis and this may account for the widespread distribution of many species. Because of the short summer season there is limited time for growth and activity. Despite this, die tardigrades multiply quickly and become very abundant. They also reproduce by parthenogenesis.

The nematodes are an extremely successful group of small animals, occurring almost everywhere in soils, plants and dead organic materials. In the present study three species were found viz. *Tylenchorhynchus* sp., *Dorylaimoides* sp. and *Rhabditis.* They live in terrestrial (Moist soil) or in moss-freshwater habitats. At present approximately 70 species are known from Antarctica out of which 10 species occur in continental zone (Maslen, 1979). Hazra (1994) reported 5 genera occurring in Schirmacher Oasis, which is new to Antarctica. The genus *Tylenchorhynchus* and *Dorylaimoides* which occur widespread in the Indian continent might have been transported along with agricultural products to the Schirmacher oasis especially in the Zub lake area.

Only one species of rotifer *Philodina gregaria* is found associated with the tardigrades. They live partly in freshwater but they prefer moist terrestrial moss-water habitat. These are tiny animals, less than half a millimeter long and are found slightly red in colour. Table 1 shows the occurrence of number of species of different groups of invertebrates of Antarctica including me present study.

Physico-chemical factors of the lakes visited : The physico-chemical characteristics of freshwater lakes at the Schirmacher Oasis was extensively studied by Verlencar *et al.* (1985). In the present study, a few important physico-chemical parameters were taken to correlate with the fauna available

Table 1 : Occurrence of number of species of different groups of invertebrates of Antarctica (moss-water fauna)

Group	Sub-Antarctic Zone	Maritime Antarctic Zone	Continental Zone	Schumacher Oasis
Tardigrada	?	17	6	2*
Nematoda	22	40	10	5(3*)
Rotifera	?	?	13	1*

(* - present study)

(Table 2). The *p*H shows a slightly alkaline nature of (he water. This may be due to the photosynthesis by the algae and diatum mat present at the bottom of the lake. A thick mat consists of blue-green algae *(Anabaena* sp. and *Nostac* sp.*)* and a few diatum species were observed at the bottom of the Zub lake near the water pump. The conductivity of the lakes is between 8-15 μ. MHOS/cm^2. The dissolved oxygen is between 3-7 mg/I which shows the oligotrophic nature of the lakes. The relative humidity ranges between 10-19% depending on the blizzard condition. The dissolved solids are between 3-98 mg/1. The surface water temperature depends on the time of the year and during late February the surface water freezes. The maximum temperature recorded at the surface of the lake was 4°C.

Moss-water area: Moss turfs are seen mainly on the ice-melt water streams from the glaciers (Fig. 2). They tend to grow more on the places with more silty sand than the coarse sand with pebbles (Table 3). Maximum growth of moss turf seen in the Zub lake (West of Maitri Station) is 92% per $feet^2$.

Distribution: Vertical andhorizontal distribution of tardigrades, nematodes and rotifers (Figs 3 & 4) shows that they tend to live more at the near surface area of the soil. Vertical distribution of tardigrades and nematodes reveals that they live up to 15 cm depth and above that no animal could be collected. However, the rotifers live only up to 10 cm depth of the soil (Fig. 3). The occurrence of microfauna on the top layers of the soil may be due to a slight rise in temperature due to sun shine, availability of food etc. They may also migrate up and down in the soil. Further studies might reveal the local dial variation due to temperature and light difference in the occurrence of these fauna in the soil.

Population density: Densities of these microfauna varies from twenty thousand to more than fourteen millian animals per m^2 (Bonner and Walton, 1985). Ingole *et al.* (1985) observed a maximum tardigrade density of 140 per m^2 and 272 per m^2 of nematodes at Zub lake. However, a maximum of 35 per m^2 of tardigrades, 21 per m^2 of nematodes and 10 per m^2 of rotifers were observed in the present study (Table 4). The low density of microfauna in the

Table 2: Physico-chemical parameters of the surface waters of the lakes studied (number of observation in the parentheses)

	Zub lake (9)			Other lakes (4)			
Dates	East	West	North	1	2	3	4
			*p*H				
January	7.8±	7.2±	7.2±	7.4±	7.2±	7.5±	7.9±
	1.1	1.2	0.9	1.2	1.6	2.0	1.8
February	7.9±	7.9±	7.6±	7.5±	7.3±	7.6±	7.9±
	1.0	1.4	0.8	0.8	0.5	1.1	1.2
			Conductivity **(μ MHOS)**				
January	!2.0±	11.2±	12.6±	9.7±	9.6±	10.3±	9.6±
	1.2	1.5	0.8	1.8	0.9	1.4	1.7
February	14.3±	13.2±	13.8±	9.3±	10.5±	11.5±	10.3±
	1.7	1.3	0.2	1.7	1.3	1.8	0.9
			Dissolved oxygen (mg/1)				
January	5.2±	4.9±	5.1±	4.2+	4.8±	4.3±	5.6±
	1.0	0.8	0.4	0.8	0.2	1.2	0.4
February	5.7±	5.2±	5.7±	4.8±	4.6±	4.5±	5.3±
	0.8	0.4	0.2	1.0	0.3	0.8	0.9
			Relative humidity (%)				
January	15.2±	16.3±	17.8±	16.1±	15.9±	16.7±	16.9±
	1.0	0.8	2.4	2.1	3.0	2.1	1.0
February	14.1±	14.6±	13.3±	14.1±	15.2±	15.1±	14.3±
	2.8	1.2	2.1	0.8	1.3	1.2	3.1
			Dissolved solids (mg/1)				
January	23.1±	38.3±	27.6±	11.3±	75.1±	16.3±	22.8±
	12.1	9.2	3.2	7.8	18.3	7.9	9.2
February	33.8±	44.3±	34.4±	15.9±	62.7±	22.7±	36.7±
	16.3	7.8	11.8	6.3	9.8	1.8	1.3
			Temperature (°C)				
January	2.8±	2.2±	1.9±	2.8±	2.6±	2.2±	1.7±
	1.0	0.8	0.9	0.9	1.2	0.8	0.9
February	1.2±	1.6±	1.2±	1.3±	1.8±	1.2±	1.9±
	0.3	0.4	0.8	0.7	0.6	0.4	0.3

present study may be due to less food availability (moss growth) and continuous snow fall. The period in which the study was conducted, (Jan 15 to Feb 15) already the best part of the summer had gone. This may be one of the reasons for the low density of the microfauna. The blizzard between the two study periods may be the reason for the less availability of microfauna (Ingole, *et al.,* 1985). Population density of these microfauna shows a variation with light,

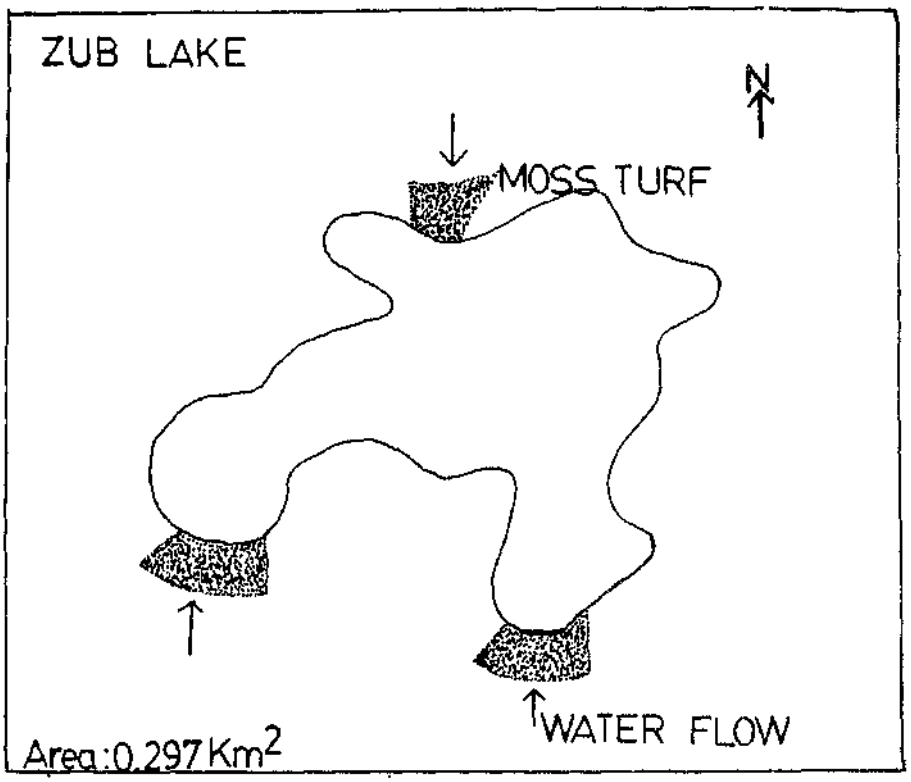

Fig.2. Area in which vertical and horizontal distribution of moss-water fauna studied.

Table 3: Percentage growth of moss in relation to soil condition

Sites	Percentage		
	Coarse sand	Silt	Moss growth per feet^2
Zub lake East*	82	18	88
Zub lake West*	76	24	92
Zub lake North*	88	12	86
Lake 1 East*	82	18	86
Lake 2 East**	62	36	22
Lake 3 West**	92	8	18
Lake 4 West*	95	5	11

(* - silty sand covered with moss turf; ** - coarse sand with pebbles covered with moss turf)

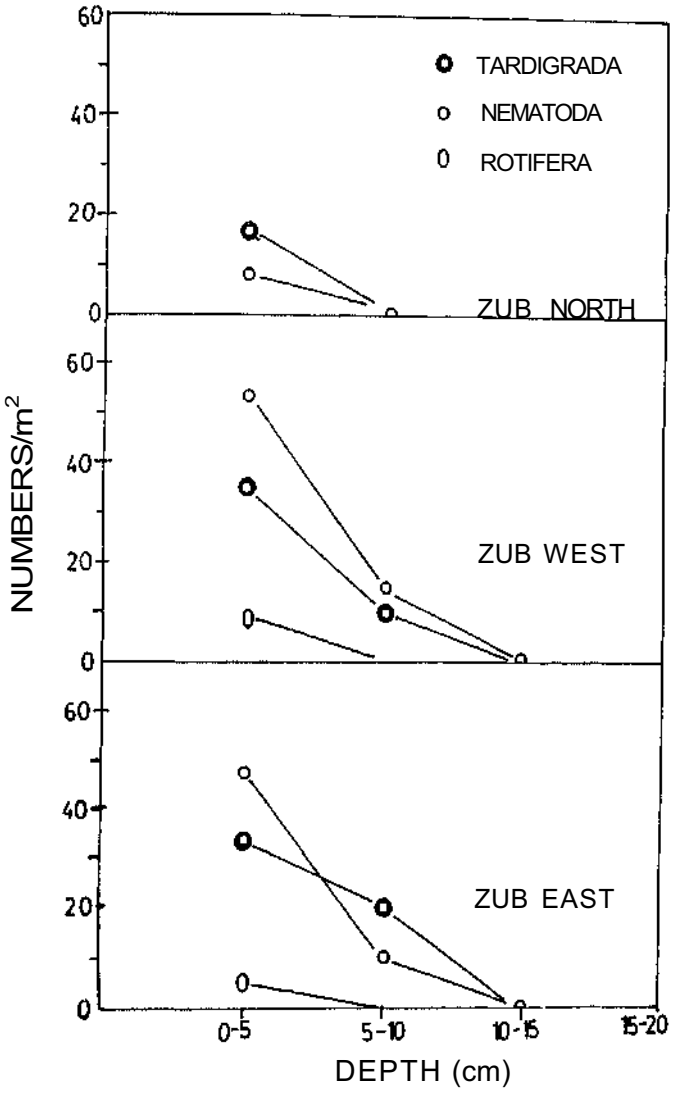

Fig. 3. Vertical migration of moss-water fauna in the Zub lake area.

temperature, level of blizzard, relative humidity and food, these being the major determinants (Fleeger and Hummon, 1975; Hallas and Yeats, 1972; Morgan, 1977).

The lack of detailed ecological and environmental studies allow only speculation in this area. Increased studies on the factors that affect species

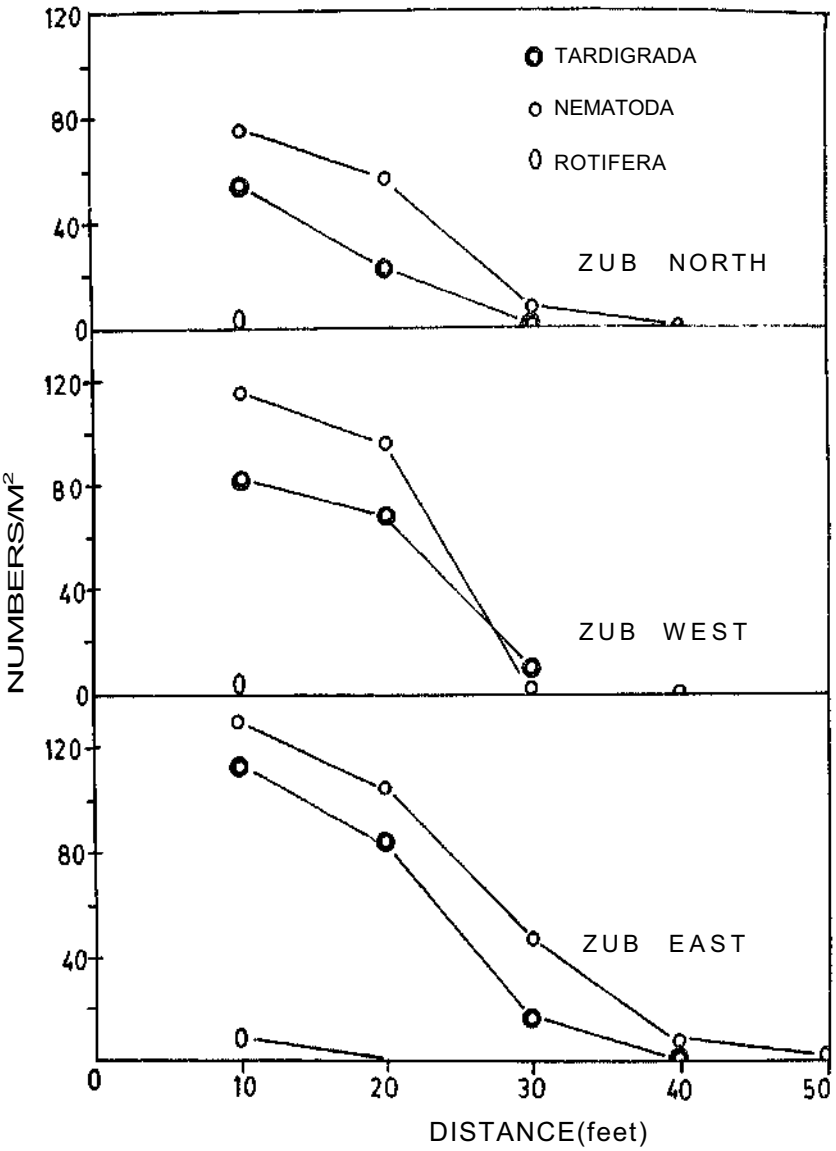

Fig. 4. Horizontal distribution of moss-water fauna in the moss-water area of Zub lake.

diversify and density and development of comparative faunal list to monitor population changes are vital. Greater care must also be directed to the supporting substrates as these are delicate microhabitats which have a direct influence on the microfauna as well as on many other associated fauna and flora. A combined study on the pollution and the microfauna can help in the biomonitoring of the Schumacher Oasis.

Table 4: Faunal density per m^2 in seven different moss-water habitats at Schirmacher Oasis, Antarctica

Location and Date	Tardigrada	Nematoda	Rotifera
Zub lake East	16.2±	27.7±	3.2±
January 14-18,	1.7	7.2	0.8
20, 22, 27, 29 and February 6			
Zub lake West	9.3±	18.3±	1.2±
January 15, 16,18	2.0	3.1	1.8
19,21,27,29			
Zub lake North	10.3±	16.3±	0
January 18,22	3.2	2.8	
February 2			
Lake 1 East	22.3±	7.3±	0
January 17, 28	5.7	1.0	
February 14			
Lake 3 West	65.8±	3.2±	8.3±
January 19,29	19.2	0.8	2.1
February 1			
Lake 4 West	3.2±	1.1±	0
January 23,24,29	1.1	0.8	
February 13			

Table 5: Data on the ringing of the *Catharacta maccorrnicki* and *Pygoscelis adeliae*

Sl.No.	Name of the species	Status	Sex	Ring No.	Date
1.	*Pygoscelis adeliae*	adult	?	K581	3.2.95
2.	*Catharacta maccorrnicki*	chick	?	F13150	24.1.95
3.	-do-	adult	female	F13149	13.2.95
4.	-do-	adult	female	F13148	13.2.95
5.	-do-	adult	male	F13147	13.2.95
6.	-do-	adult	male	F13146	15.2.95
7.	-do-	adult	female	F13145	15.2.95

Studies on south polar skua

Ringing programme: A total of six adult skuas and one chick were ringed (Table 5). A ring (No. 13100) was recovered from an adult skua near Russian station (Novolazarevskaya) at Schirmacher Oasis, which was ringed earlier by Zoological Survey of India, Calcutta. The measurements on the morphometry

Table 6: Data on the morphometery of the *Catharacta rnaccormicki* ringed in and around Maitri, Schirmacher Oasis during 1994-95 summer (length in cm)

Sl.No.	Ring No.	Beak	Wing	Long feather	Wing width	Leg	Toe			Web size	Total wing span
							Middle	Left	Right		
1.	F13150	5.5	30.0	40.0		7.5	5.2	4.5	4	-	80
2.	F13149	5.0	31.4	31.0	-	17.5	8.0	7.4	4	8	-
3.	F13148	5.0	34.0	29.0	17.5	18.0	7.8	6.5	6	8	-
4.	F13147*	5.5	33.0	40.0	19.0	-	7.0	6.0	5	8	133.0
5.	F13146	5.5	32.0	33.0	19.0	19.0	7.0	6.0	5	-	137.0
6.	F13145	5.6	31.0	38.0	19.0	20.0	7.0	6.0	5	-	-
7.	F13100**	5.2	35.0	40.0	18.0	21.0	7.0	6.0	5	-	-

(* bird with torn web on the right leg; * * ring recovered from a bird ringed during 1991-92 summer by ZSI, Calcutta)

Table 7: Data on the ringing programme conducted from 1984-1995 at Schirmacher Oasis

Sl.No.	Name of the Organisation	Number		Year and ring numbers	Remarks
		adult	chick		
1	George Forster**	4	6	1984-85*	No morphometry measurements
2	George Forster	-	9	1988-89*	-do-
3	Maitri Station*** (BNHS, Bombay rings by ZSI, Calcutta)	7	-	1991-92*	-do -
4	- do -	6	-	1994-95 (F13150-F13145)	Measurements taken and ringed in and around Maitri

(* ring numbers not available; ** contact person, W. Richter, Academy of Science of GDR, Central Institute for Isotope, DDR-7050 Leipzig; *** Contact person, Srikumar Chattopadyaya or K. Venkataraman, Zoological Survey of India, New Alipur, Calcutta, 700053)

of various body parts of the skua were made (Table 6) while ringing was done. An adelie penguin stranded at Maitri during January 1995 was also ringed using K ring (K, 581) and measurements such as beak (7 cm), height (43 cm), flapper length (920 cm) and toe length (10 cm) were made.

The ringing programme on the skuas of Schirmacher Oasis was done earlier on two occasions by German scientists in 1984-85 and 1988-89 (Richter *el al.,* 1990) and on one occasion by Zoological Survey of India, Calcutta in 1991-92 (Table 7). However, during 1994-95 only two birds with BNHS,

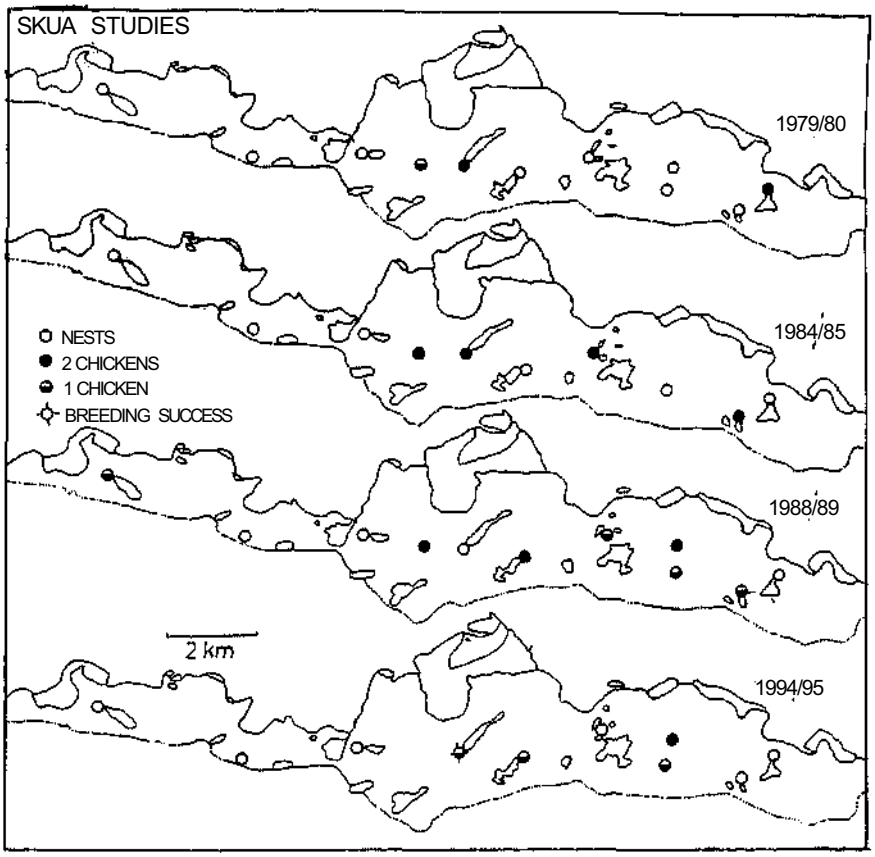

Fig. 5. Breeding success of South polar skua in the Schirmacher Oasis studied by George Forester station and Maitri station

Bombay rings ringed by Zoological Survey of India, Calcutta during 1991-92 summer were observed, out of which one ring was recovered. This data clearly reveals that, the skuas are returning to the Schirmacher Oasis for breeding, however they are coming to the same nest or not is yet to be confirmed due to non-availability of data on the ringing site. During the present study only once the skua was ringed (chick) at the nest. All other birds were ringed in and around Maitri station, when they come for feeding. A continuous programme on ringing and more studies on both adult and chickens will help to confirm how many pairs of skuas return to Schirmacher Oasis, or are they the same pairs or a new pair, or are they returning to the same site or not and whether the young ones visit immediately after the next year or how many years later.

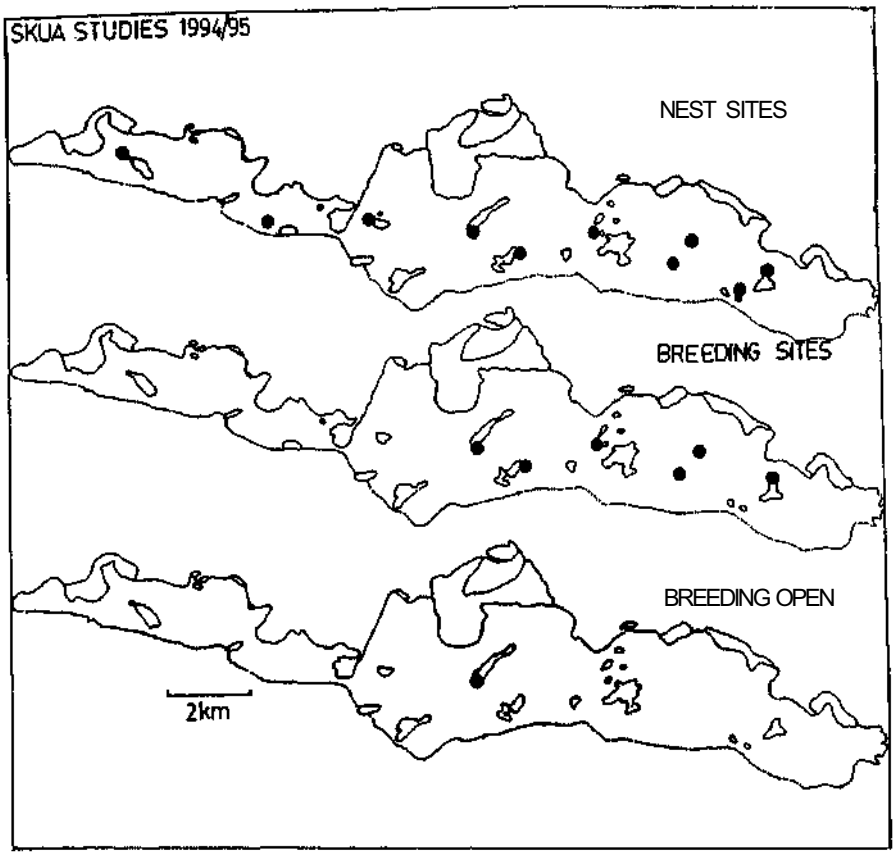

Fig. 6. Nest sites and the breeding sites of South polar skua in the Schirmacher Oasis in 1994-95 summer.

Population: Studies on skua have been conducted from 1979-80,1984-85, 1988-89,1991-92 and 1994-95 (present study). Earlier three studies have been made by George Forster, GDR and the later two by Maitri, India (Zoological Survey of India, Calcutta). A total of well confirmed 10 nests have been found by earlier studies and also by the present (Fig. 5). The number of skua nests have not been increased during the years and also the population. A total of 15 skuas were seen at Maitri during one time flight and the data on the nests shows that all 10 nesting sites can accommodate 10 pairs (20 birds). It is clear from the present studies that skua nests only near the water body and it warrants a good view of the vicinity. The number of water bodies remain same during the years as the number of nests, and the territorial behaviour of these birds also restricts the increase of nests. The fate of successful chickens are not known

clearly, after they leave Schirmacher Oasis. More ringing programmes will give us the data on the migratory pattern and nesting activities of the chickens during the adult phase.

Breeding: The number of nests seen, the number of breeding pairs and the breeding success during the present study are shown in Fig. 6. In Schirmacher Oasis the South polar skuas appear between 25- 31 October (records from winter observers) but the present observation was made from January 15 onwards. By the time we reached the oasis, already the egg-laying, hatching and feeding had started. All the nesting sites were observed with very old remnants of bones of petrels. It is well observed from their behavioural pattern that they never allow other pairs to enter into their nesting sites. This territorial behaviour mainly explains that they will not share their food and defend their clutches and chickens from the other skuas. This shows that there is always a chance for the predation of egg and chickens by other skua whenever it is warranted due to any forced conditions such as non availability of food for a number of days due to high wind velocity and blizzard. Therefore, the breeding success of skuas in Schirmacher Oasis highly depends on the feeding conditions. The reduction in number of prey such as snow petrels and Wilson's storm petrels in the Schirmacher Oasis may also affect the breeding success of skua. During the present study, only on two occasions Wilson's storm petrels were seen flying in the Oasis but no snow petrels. The skuas have to fly for a long distance for hunting. On one occasion a pair of skua with a chick was seen with the kill of a snow petrel near Indian bay i.e. about 100 km away from the Oasis. On two occasions fresh kills were observed in the nests visited. However, the rubbish from the stations Novolazarevskaya, (Soviet Union), Georg Forster (GDR) and Maitri (India) are used by most of the skuas which live nearer to these places. It is evident from the studies (Fig. 5) that most of the nests with one or two eggs and breeding success occur only around Maitri or other stations. During 1994-95 (present study) the present author had noticed many skuas visiting regularly to collect their food in turn from the meat, chicken and fish waste thrown near the garbage dump. During night (2100-0100 h during Jan-Feb) it was observed that many birds roost near Maitri station (near garbage dump and near Annapurna hut) till the morning to collect the rubbish.

Behavioural studies : A variety of studies were conducted using recorded voices of adult skuas when they visited Maitri station area. When the recorded voices of the skuas were played to the same skua pair, they showed an aggressive display. This was noticed in the case of other skuas also. When the recorded voice was played near the nest with chickens present, they started striking the tape recorder. When the voices of adelie penguin was played, they started challenging with open wings raised over the back. On one occasion a

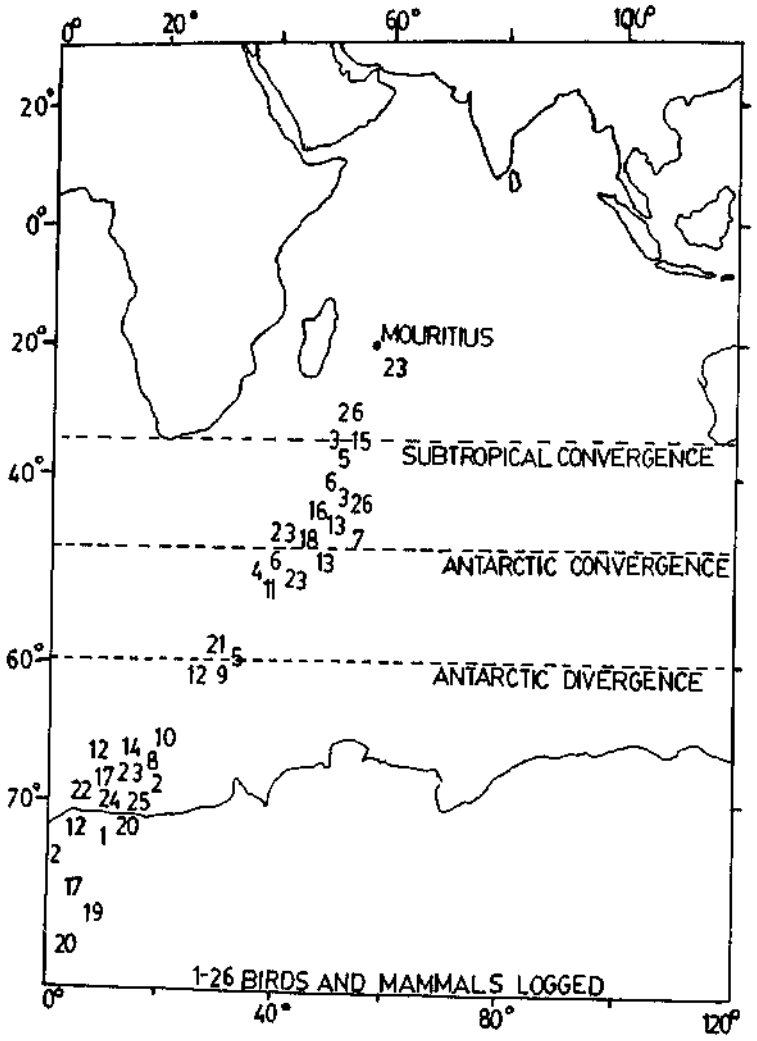

Fig. 7. Sea birds and marine mammals sighted during voyage and in Schumacher Oasis during 1994-95 summer (refer table 8 for the name of the species in serial number 1-26).

meat piece was shown to the bird and it was hidden under a stone. The meat was recovered by the same bird after a search for two hours and forty five minutes from the same place where it was hidden. Immediately after the recovery of the meat piece it was taken to the lake and was placed under water near a well marked stone. The bird was seen visiting the place where the meat was kept under water time and again to feed. The same behaviour was observed on repeated occasions. A few skuas receiving meat pieces from persons from

Table 8: Sea birds and marine mammals recorded during 1994-95 summer voyage (refer fig. 7 for location of sightings)

SI.No.	Name of the species	Date	Numbers
Pengu;ins:SPHENISCIDAE			
1.	Emperor penguin *Aptenodytes forsteri*	18.2.95 and 05.3.95	13+6
2.	Adelie penguin *Pygoscelis adeliae*	14.1.95 to 05.3.95	410
Albatrosses: DIOMEDEIDAE			
3.	Wandering albatross *Diomedea exulans*	02.1.95 to 07.1.95	8
4.	Black-Browed albatross *Diomedea melanophris*	05.1.95	2
5,	Yellow-nosed albatross *Diomedea chlororhynchos*	08.1.95	2
6.	Sooty albatross *Phoebetria fusca*	03.1.95 and 07.1.95	10
7.	Light-mantled sooty albatross *Phoebetria palpebrata*	04.1.95	3
Fulmars,Prions,Petrels and Shearwaters: PROCELLARIDAE			
8.	Southern Giant fulmar Macronecter giganteus	06.3.95 and 10.3.95	16
9.	Southern fulmar *Fulmarus glacialoides*	06.3.95 and 07.3.95	7
10.	Antarctic petrel *Thalassoica antarctica*	07.3.95	16
11.	Cape pigeon *Daption capense*	06.1.95 and 09.1.95	18
12.	Snow petrel *Pagodroma nivea*	06.3.95	12
13.	Antarctic Prion *Pachyptila desolata*	07.1.95 and 08.1.95 and 10.3.95	37
14.	White-headed Petrel *Pterodroma lessoni*	08.1.95	4
15.	Greater Sherwater *Puffinus gravis*	02.1.95	3

(Contd.)

Table 8: *Contd*

Sl.No.	Name of the species	Date	Numbers
16.	Little Sherwater *Puffinus gravis*	03.1.95	4
17.	Wilsons' Storm petrel *Oceanites oceanicus*	14.1.95 to 04.3.95	6
18.	Kerguelen petrel *Pterodroma brevirostris*	06.1.95	4
19.	Black-bellied storm petrel *Fregetta tropica*	29.1.95	1
20.	South polar skua *Catharacta maccormicki*	14.1.95 to 05.3.95	26
21.	Antarctic tern *Sterna vittata*	08.1.95	1
Marine mammals			
22.	Blue Whale *Balenoptera musculus*	16.1.95	1
23.	Humpback whale *Megaptera novacangliae*	30.12.94 07.01.95 08.01.95	7
24.	Lepord seal *Hydrurga leptonux*	06.3.95	1
25.	Crabeater seal *Labodon carcinophagus*	06.3.95 09.1.95	99
26.	Bottle nosed dolphin *Hyperoodon rostratus*	02.1.95	7?

Table 9: The number of penguins, seals and whales observed during 1994-95 summer voyage in pack ice zone

Sl.No.	Name	Inward joumey	Outward journey
1	Adelie penguin	17	393
2	Emperor penguin	1	12
3	Crabeater seal	26	73
4	Lepord seal	-	1
5	Humpback whale	7	2

Table 10 : The different birds observed between 60°S to pack ice zone during voyage

Sl.No.	Name	Inward journey	Outward journey
1	Southern Giant fulmar		8
2	Southern fulmar	-	8
3	Wandering Albatross	6	1
4	Antarctic petrel	3	16
5	Snow petrel	2	27
6	Cape pigeon	22	40

the hand was observed on many occasions. After a blizzard, for about four to five days these birds follow every person passing by to receive food.

Studies on bird and mammal logging during voyage

A total of 21 birds and five mammals were recorded in the present study (Table 8). Except dolphins, all the other mammals were seen only above 40°S latitude. Likewise, majority of the birds were recorded between 40° to 68°S and beyond the packice zone, penguins were recorded. The number of penguins and seals observed during inward and outward journey onpackice are given in Table 9. The location of different birds and mammals sighted are shown in Fig. 7. The number of bird species with increasing southern lattitude till the pack ice zone (60-65°S) and the number of species recorded was maximum (Table 10).

The extraordinary richness and great extent of Antarctic and sub-Antarctic waters support vast numbers of seabirds. In contrast to the abundance of individuals, the variety of Antarctic birds is restricted: only a few species are breeding regularly in the continent, peninsula and adjacent islands. Although the penguin is the unofficial 'national bird' of Antarctica, tube-nosed petrels constitute the majority of species that are regularly found throughout the area. Some species, most notably albatrosses and giant fulmars are wholly pelagic and depend wholly on the sea for food.

Out of the 65 species of birds reported from the Antarctic region only 12 species of birds breed in the continent (Harrison, 1989). In the present study three species such as skua, Wilson's storm petrels and snow petrels were found to breed in the Schirmacher Oasis. The number of snow petrels have reduced drastically and only on two occasions they were seen flying. The Wilson's storm petrels were seen flying on many occasions during late evening hours in February, however, no nest could be located, The depletion of the two species in the Oasis may be correlated with the abundance of south polar skua.

The rookery at the Russian dump once the breeding site for adelie penguin, was completly abandoned this year and no breeding was observed. However, about 14 penguins were seen nesting on the. Russian Bay. A group of 57 Emperor penguins with 2 chickens was observed near a rookery at Dakshin Gangothri. Yet another group with six emperor penguins (Plate 1C) was seen 50 km west of Indian bay with moulting feathers. On three occasions lonely adelie penguin visiting Schirmacher Oasis (Maitri) was observed.

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