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Stanisław RAKUSA-SUSZCZEWSKI

Department of Polar Research, Institute of Ecology,
Polish Academy of Sciences, Dziekanów Leśny

Environmental conditions and the functioning of Admiralty Bay (South Shetland Islands) as part of the near shore Antarctic ecosystem*)

ABSTRACT: Multidisciplinary research was carried on in 1978/79 in the region of Admiralty Bay and Arctowski Station. This area is representative of the near-shore Antarctic ecosystem. It is characterized by a number of local traits such as climate, ice conditions, hydrology, hydrochemistry and hydrodynamics. Estimates were made of primary production and abundance of zooplankton in Admiralty Bay and of the biomass and quantity of food taken by avi-fauna and pinnipeds. Main routes and directions of transport of mineral and organic matter are shown; some of them have been estimated quantitatively. A continuous inflow of organic matter from Bransfield Strait is necessary for the summer functionning of Admiralty Bay.

Key words: Antarctic, environmental conditions

1. Introduction

The setting up in 1977 of Polish Arctowski Station on King George Island in the region of Admiralty Bay (62°09′8″S, 58°28′6″W) has created conditions for a multidisciplinary research in this area (Rakusa-Suszczewski 1977). Only this type of research allows the understanding of the functioning of the whole ecosystem. Inshore areas play a special role in the energy flow and circulation of matter because of the concentration of organisms of the whole trophic web of the ecosystem (Rakusa-Suszczewski 1980).

Overfishing of whales during the last 50 years has caused an increased production of krill, which is estimated to reach 147–200 million tons annualy (Everson 1977). As a result new quantitative and qualitative relations ocour and visible changes take place in the Antarctic ecosystem. There is an increase in the numbers of penguins and seals (Conroy 1975, Laws 1977). New powerful processes of decomposition of the "surplus" krill have been set in motion (Rakusa-Suszczewski and Zdanowski

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1980). At present commercial exploitation of Antarctic fishes and krill has started and we know little about their stocks. This causes further changes. In this situation the recognition of the ways of energy and matter flow, the estimation of the abundance of consumers of krill, fish and cephalopods and the monitoring of their numerical abundance has not only scientific meaning. The practical purposes are to observe the changes occurring in the ecosystem and to define the limits of a safe exploitation of the living resources. The research carried on at Arctowski Station surves, among other things, this purpose.

2. Research area

King George is the largest island of South Shetlands and has an area of 1338 km^2. Higest elevation of the island is 675 m above sea level. The island is covered by ice. Maximal thickness of the ice cover is 326 m, the average about 100 m (Simonov 1975). Only a small percent of the land is free from ice.

Admiralty Bay together with adjacent land (Fig. 1) are the areas of ecological investigations. Dimensions of the research grounds are shown in Table I. The area of research covers 388 km^2; the surface area of the bay alone is 131 km^2 (33%). The land (257 km^2) is covered with ice in 93%. The coastal line is diversified; rocky and sandy-gravel shores domi-

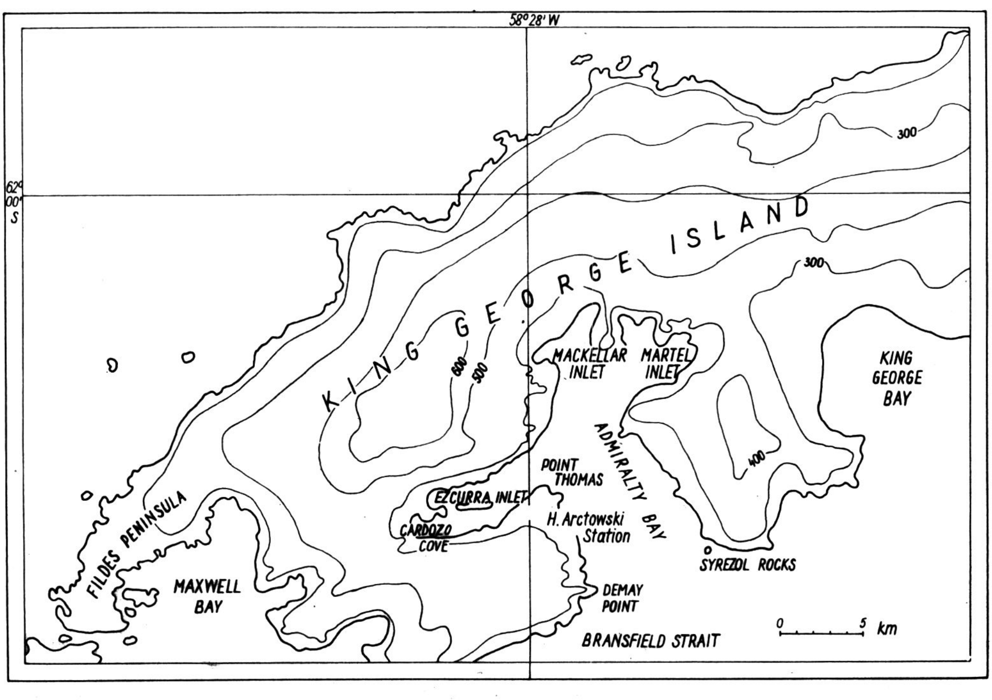

Fig. 1. Research area of Admiralty Bay (King Georg Island, South Shetlands, Antarctica)

Table I.
Geographical features of Admiralty Bay and of the surrounding research area
(Preliminary results)

Specification	Surface		Volume	Length	
	km^2	%	km^3	km	%
Research area	388.3	100	—	—	—
Admiralty Bay	131.3	100	17.9	—	—
Admiralty — central part	98.8	75.4	13.5	—	—
Martel. MacKellar Inlet	22.8	17.4	3.1	—	—
Ezcurra Inlet	9.7	7.4	1.3	—	—
Land	257.0	100	—	—	—
Land covered with ice	238.0	92.6	—	—	—
Land free from ice	19.0	7.4	—	—	—
Coastal line of Admiralty Bay	—	—	—	84.8	100
Ice shores	—	—	—	39.4	46.4
Rock and cliff-shore	—	—	—	26.3	31.0
Sand and gravel shores	—	—	—	19.2	22.6

nate in the western part of the bay, while glacial shores prevail in the north and east. The presence of glaciers, their seasonal dynamics and long-term changes in the mariginal zone have an essential influence on the hydrological conditions of the bay and on the development of both marine and land communites of the coastal area.

According to preliminary calculations based on the comperison of a British map of this region from 1956/57 and Polish photographs taken in summer 1979, it has been estimated (Furmańczyk, unpublished data, Fig. 2) that the coastal line of the glaciers in the region of Admiralty Bay has receded about 2 km^2 during the last 22 years.

The greatest area of land free from ice and easily accessible from the water side lines on the western shore of Admiralty Bay, between Point Thomes and Demay Point. This area is of special importance since most species of birds, including all penguins, make their rookeries there. Main lairs of sea elephants and fur seals are also located on the western side of the bay. One can find there most diversified communities of land flora. Aquatic flora occurs in numerous shallow water reservoirs.

2.1. Admiralty Bay

It is largest bay of the South Shetlands archipelago. It has a character of a fiord with a braching system of bays. The southern limit of Admiralty Bay is a line between Demay Point and Syrezol Rocks (The Antarctic Pilot 1974). In the nothern part of Admiralty Bay there are three branches: Ezcurra Inlet in SW, and MacKeller and Martel Inlet, N and NE.

Basen of Admiralty Bay has a shape of the letter "U", which cuts into a wider, more open part of the basin. Such a configuration makes a "micro-shell" with depths reaching a few tens of meters. Bottom of the central part of the bay is smoothed; in the longitudinal section it

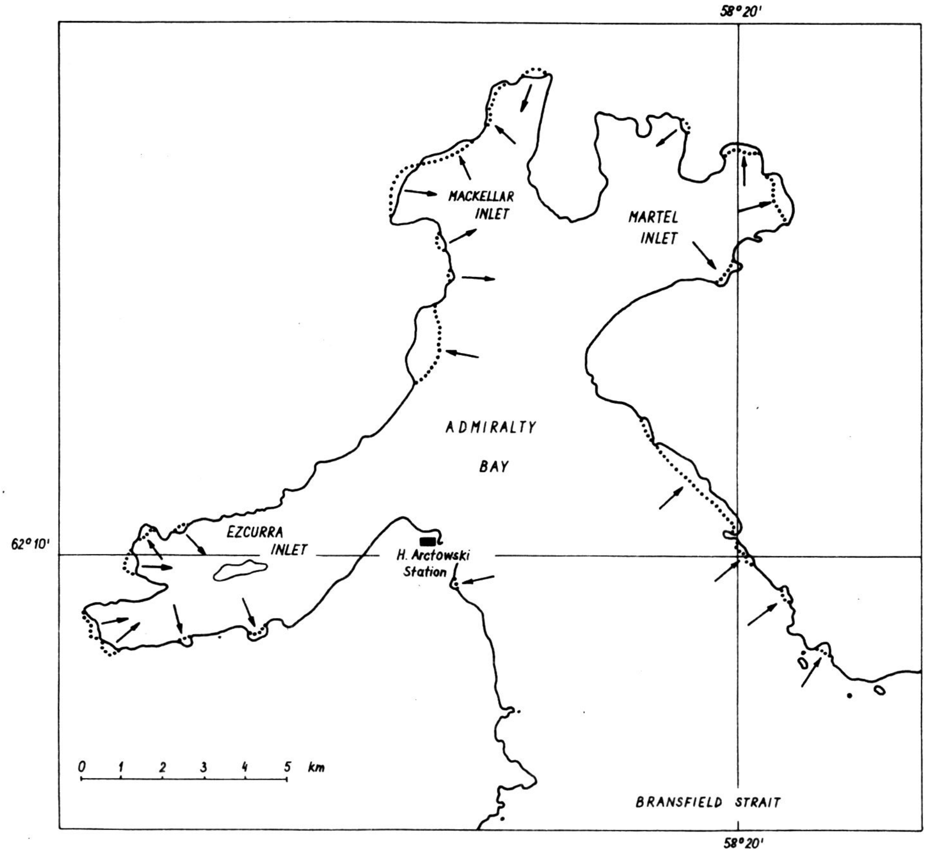

Fig. 2. Glacier margins, comparison of positions in 1956/57 and 1978/79 based on British maps and Polish photographs
General balance of surface changes after 22 years is: $-2.3\ km^2 + 0.5\ km^2 = -1.8\ km^2$

slightly slents towards S. Maximum depth of the bay is 530 m (Fig. 3). Admiralty Bay opens broadly towards S. At the exit of the bay the depths reach the border of the shelf, and farther in Bransfield Strait the bottom falls steeply to about 2000 m.

The basin of Ezcurra Inlet makes a valley located above the basin of Admiralty Bay (Fig. 3). Greatest depths reach 270 m in the east and 80 m in the west. In the central part, east from Dufayel Island, the bottom rises abruptly to 75 m below surface.

The basins of MacKellar Inlet and Martel Inlet have very much diversified depths and the bottoms have been strongly modified through the processes of erosin and glacial accumulation (Marsz, in prep.). Characteristic sills and elevations of the bottom (Fig. 3) make important morphological features of the whole basin of Admiralty Bay. More important: one of them, 50 m high, lies at the outlet of the bay to Bransfield Strait, another separates Ezcurra Inlet from Admiralty Bay, the third is situated in the centre of Ezcurra Inlet. The presence of sills and bottom elevations causes eddies of water masses which enter Admiralty Bay from Bransfield Strait. It creates good upwelling conditions.

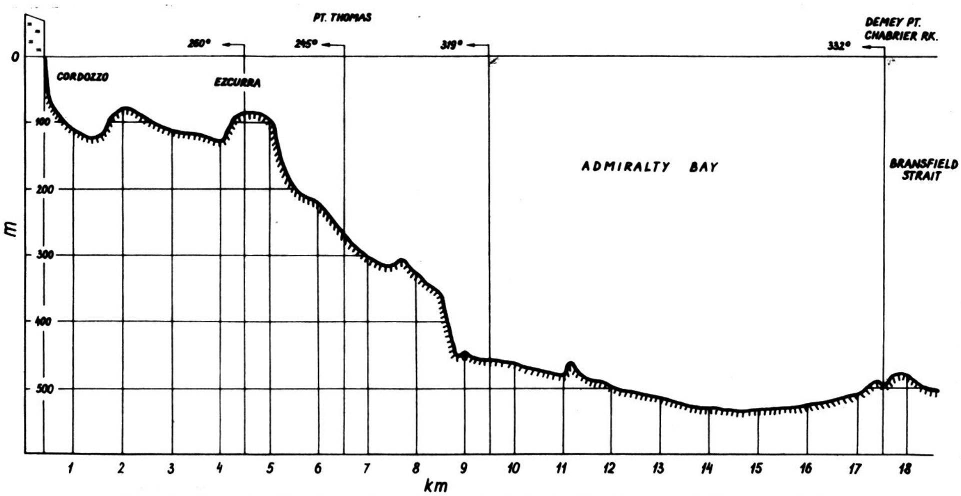

Fig. 3. Longitudinal section through Admiralty Bay and Ezcurra Inlet
Elevations of the bottom are shown at 5.8 and 18 km

3. Climatic conditions

King George Island is located in the zone of marine Antarctic climate, in a region of deep atmospheric lows moving from west towards east (Moczydłowski 1978). As a consequence winds in Admiralty Bay blow from SW through W to N, with WSW direction dominating (Fig. 4). Average

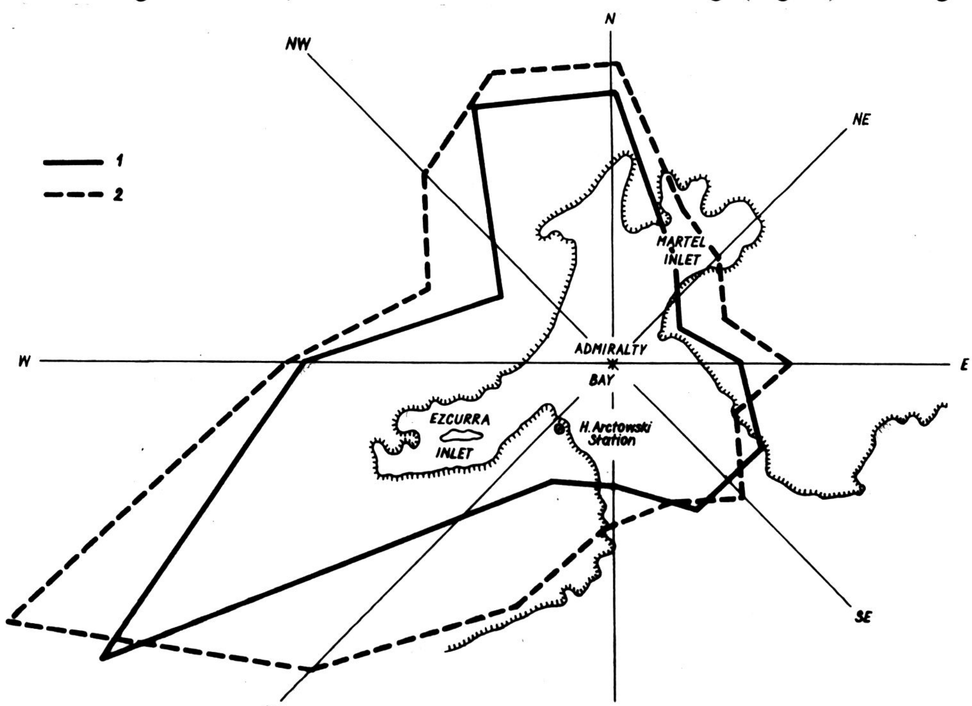

Fig. 4. Wind rose from the area of Arctowski Station *1* — in 1977, *2* — in 1978

annual wind velocity at Arctowski Station in 1978 was 7.0 m/s. Wind velocities of 15 m/s were noted during 69 days, and above 25 m/s during 95 days (Nowosielski 1980).

Wind is the main meteorological phenomenon in this region; its action is decisive about the course of a great number of processes going on in water and on land. Wind causes local upwellings in Ezcurra Inlet. Wind and waves cause the movement of mineral substances and nutriens from sea to land. Strong eolic erosion and the spreading of sand and gravel over the glaciers speed up glacier ablation. Eolic cooling is a decisive factor in the production of land vegetation. Wind carries fragments of plants to the areas of land uncovered as a result of glacial recession.

Air temperatures in the area of Admiralty Bay oscillate during the year around 0°C (273°K) and in all months reach values above 0°C (Fig. 5). Greater

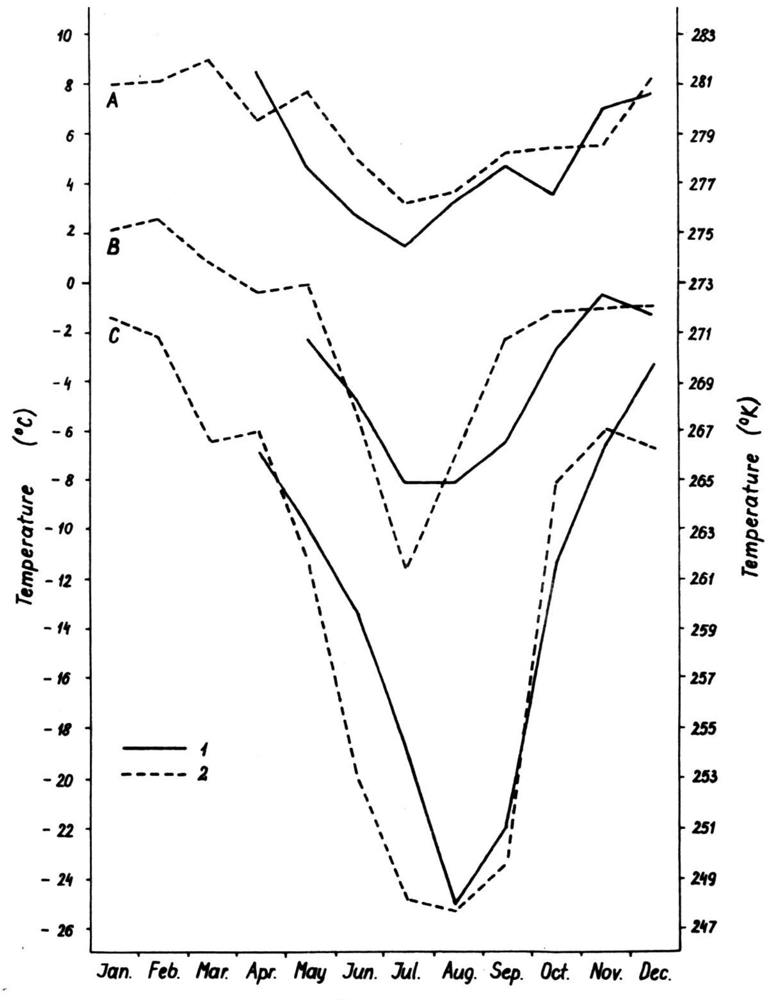

Fig. 5. Annual changes of the maximum *(A)*, average *(B)* and minimum *(C)* air temperature at Arctowski Station *1* — in 1977, *2* — in 1978

temperature ranges may be observed in winter months (Zubek 1980) when the bay is covered by ice during three months.

Cloud cover in this area is high with an annual average of 6/8. Admiralty Bay region is privileged in this respect. Orography and fen effect cause, that cloud cover in the region Arctowski is lower compare to the rest of King George Island. As a result a greater amount of incident solar energy reaches the area (Kumoch, unpublished data). There are distinct differences in the microclimate in the area of Admiralty Bay. The western shore receives a greater average insolation and lesser cooling during the year than Keller peninsula (Zubek 1980) since it is situated on the lee side, relative to the prevailing wind directions, and it is open to solar radiation.

Precipitation in the region of Arctowski Station in 1977 and 1978 was 198—554,8 mm (Zubek 1980, Nowosielski 1980). Snow cover lasts here more than 200 days over an area greater than a half of the surface (Nowosielski 1980).

The region of Admiralty Bay does not differ in climatic conditions from the region of South Shetlands. It shows, however, a number of characteristic features of the microclimate. These differences in microclimate occurring in the area of Admiralty Bay may be decisive in the distribution of bird rookeries and breeding places of seals and in the development of land communities as well.

4. Conditions of hydrology and hydrodynamics

Hydrology and hydrodynamics in Admiralty Bay are influenced by an exchange of waters with Bransfield Strait, by the inflow of fresh waters from the land and by local processes characteristic for fiords (Wright 1971). Ranges of basic hydrochemical parameters of the environment of Admiralty Bay in the summer of 1978/79 are shown in Table II. At the bottom of Admiralty Bay there is an inflow of cold waters of high

Table II.

Environmental conditions ranges in Admiralty Bay
December — February 1978/79

Compared elements	Surface	Above bottom
Water temperature (°C)	0.19 — 2.82	−0.24 — 0.9
Near-shore water temperature (°C)	−1.60 — 5.30	—
Salinity (‰)	16.4 — 34.1	33.67 — 34.26
pH (in situ)	8.10 — 8.22	—
Chlorophyll (mg/m³)	0.26 — 4.43	—
PO_4 (μgat/dm³)	1.474 — 3.669	
NO_3 (μgat/dm³)	4.171 — 30.619	
NO_2 (μgat/dm³)	0.003 — 0.553	
Si (μgat/dm³)	77.4 — 84.4	
O_2 (ml/dm³)	5.46 — 9.22	

salinity from Bransfield Strait. Maximal salinity of these waters (34.2°/₀₀) indicates their origin in the Weddell sea (Charitonov 1976). At the time of prevailing westerly winds part of these waters enters Ezcurra Inlet, where they upwell at the surface in the region of a central sill (Fig. 6). As a consequence surface strata have a high nutrient content, higher salinity and lower temperatures. Because of upwellings in Ezcurra Inlet the content of chlorophyll in the water is low; it rises towards the exit from Admiralty Bay, where the value is 4.43 mg/m³ (Lipski, unpublished data). Eastern part of Bransfield Strait is very rich in phytoplankton. The chlorophyll content in the surface stratum here reaches 5.6 mg/m³, with an average 2.41 mg/m³ (El-Sayed, Mandelli and Sigumura 1964).

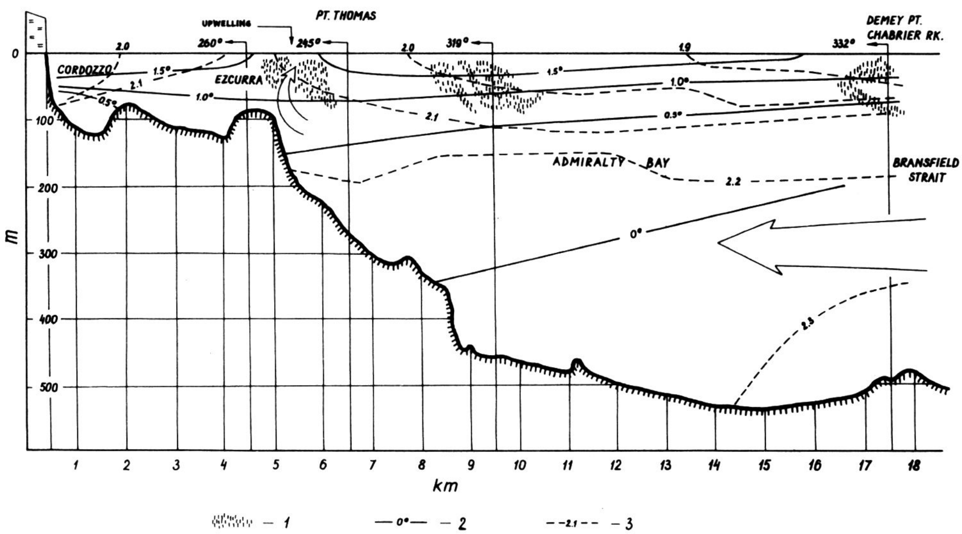

Fig. 6. Main directions of currents and locations of eddies on longitudinal section of Admiralty Bay and Ezcurra Inlet
1 — areas of krill swarms, *2* — temperature (°C), *3* — concentration of phosphates (μgat/dm³)

Frequent and strong winds blowing in this area cause intensive mixing of surface waters. Thermal stratifications in the bay occur rarely, in periods of calm weather. At that time strong solar radiation and steep shores rise the temperatures of nearshore, surface waters (cf. Table II) to higs which are not recorded at these latitudes in the region of the open ocean (Chłapowski and Grelowski 1978).

Frequent and fast changes in salinity and temperature, especially in the inshore area are the result of thawing of ice broken off from glaciers surrounding the bay.

Considerable, although of varying intensity in summer inflow of waters from the glaciers and streamlets of the watershed also causes large changes in salinity of the surface stratum. Streams and rivulets flowing into Admiralty Bay bring considerable amounts of terrogenic material; this increases turbidity of water, and is limiting penetration of light and primary production. The value of suspended matter in the inshore water may exceed 180 mg/l (Pęcherzewski 1980).

High pH of the water indicate a good oxygenation. Slight lowering of pH walues in the inshore area results from an inflow of fresh waters from the land with a low pH (5.2—7.3) (Lipski, unpublished data). The whole body of water of Admiralty Bay does not differ considerably from the waters of Bransfield Strait in hydrochemical conditions, however, it has a number of features typical for a fiord. These are the characteristic circulation, upwelling, considerable variation of conditions in the surface stratum and a relatively high changeabity of conditions which is not known for such small areas in the open ocean.

4.1. Currents and exchange of water

So far, recogniction of currents in Admiralty Bay is fragmentary, however, the general picture of water movements in this basin seems to be clear. The main cause of circulation of waters in the bay and of their mixing with the waters from Bransfield Strait are tides. Since tides in this region are irregular (Wróbel 1977), the directions of water movements in the bay also change irregularly every 5 to 14 hours (Pruszak 1980). Waters from Bransfield Strait enter the basin of Admiralty at the bottom and move first NW towards Ezcurra Inlet. This can be also observed from the movements of icebergs: even at winds blowing from WSW and W icebergs entering Admiralty Bay from S are being transported with currents in the region of Ezcurra Inlet.

Waters leaving Admiralty Bay for Bransfield Strait flow at the surface, mainly on the eastern side of the bay.

In the central basin of the bay down to 100 m current velocities vary from 30 cm/s at the bottom to 50 cm/s at 50 m depth (Pruszak 1980). In the central part of Ezcurra Inlet velocities of under-surface currents are samewhat lower and range from 20 cm/s to 45 cm/s. Surface currents generated by winds are considerably more variable and their velocities at the shores are 20 cm/s–30 cm/s, in the centre of the bay 30–60 cm/s, with the maximum reaching 100 cm/s.

According to preliminary estimates the exchange of waters in the surface stratum down to 100 m depth in Admiralty Bay occurs in the period of one-two weeks (Pruszak 1980).

5. Pelagial resources and their consumers

Average value of primary production in waters of the Antarctic Peninsula area is 0.89 g C/m^2/day (El-Sayed 1968), and for the whole Antarctic it is 0.134 g C/m^2/day (El-Sayed 1978).

In Ezcurra Inlet primary production values range 0.4–0.9 g C/m^2/day (Dera et al., unpublished data). Assuming the average value as 0.65 g

C/m^2/day and the ratio of carbon to wet biomass of phytoplankton as 1:10 (El-Sayed 1978) one can estimate the primary production of phytoplankton in Admiralty Bay as 6.5 g C/m^2/day × 131 km^2 = 851.5 ton/day. With the conversion ratio of 1 : 10 the production of zooplankton would be 85.15 ton/day. Since krill makes 50% to 10% of zooplankton biomass (Everson 1977), it would indicate that krill production in this area is 42.57 to 8.51 tons. The remaining 76.64 to 42.57 tons is the production of other zooplankton, especially of the dominating in this region *Copepoda*. According to Gulland (1970) and Hempel (1970) the production to biomass ratio for *Euphausia superba* Dana is 1 : 1. With this assumption the quantity of krill in Admiralty Bay would range between 0.329 g/m^2 and 0.065 g/m^2. According to Pomeranz (pers. communic.) the average biomass of krill in the area of Scotia Sea is 0.83 g/m^2. Considering that value, the biomass of krill in Admiralty Bay area may be estimated at 108.7 tones.

In summer there are three species of krill in Admiralty Bay: *E. superba*, *E. crystallorophias* Holt et Tattersall and *Thysanoessa macrura* Sars. *E. superba* makes the greatest biomass (Fig. 7). It is followed by *E. crystallorophias*.

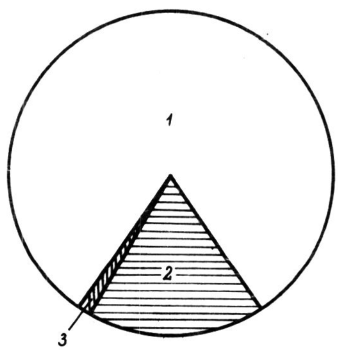

Fig. 7. Biomass proportions for *Euphausia superba* (*1*), *Euphausia crystallorophias* (*2*) and *Thysanoessa macrura* (*3*) caught in Admiralty Bay area in summer 1978/79

E. superba occurs most often in the area of Point Thomas — Langer Glacier and at the entrance to Admiralty Bay, where it makes swarms (Fig. 6). In both areas strong eddies occur which are the result of bottom configuration and of tidal currents. This kind of distribution of *E. superba* swarms in Admiralty Bay proves the important role of the hydrodynamical factors in the formation of such swarms. Hydrochemical conditions do not play a direct role in the formation of swarms: they might, however, be indicative of some defined hydrodynamic situations permitting their formation (Rakusa-Suszczewski 1963).

E. crystallorophias occurs mainly in Ezcurra Inlet and it appears to be a local population. This species only rarely is found in Bransfield Strait (John 1936).

It is difficult to estimate right now the size of the fish stock in Admiralty Bay. So far, 20 species of fishes belonging to eight families have been identified. The family *Notothenidae* is richest in species; four genera and ten species have been recognized (Rembiszewski, unpublished data). On February 25, 1979 m/t Taurus made a two hours haul with a commercial drag along the central part of Admiralty Bay. The ship brought back 1.5 tons of fish from the depth of 420–540. The materials are being analysed.

In the second half of December 1978 the biomass of penguins and flying birds occurring in Admiralty Bay area was estimated at 365.676 tons (Jabłoński, in prep.).

In relating this figure to the unit of surface area of Admiralty Bay, it might be expressed as 2.8 g/m^2. The average biomass of avifauna in the Antarctic has been estimated at 0.12 mg/m^2 to 30 mg/m^2 per ocean surface (Holdgate 1967, Everson 1977).

The biomass of food, mainly of krill consumed by birds inhabiting Admiralty Bay, is estimated to be 52 tons/day (Fig. 8). This figure may double in January and February after the hatching of chicks. The stocks of krill in Admiralty estimated at 8.5–108 tons are not sufficient for the subsistance of avifauna. Observations of penguins showed, that most of them feed beyond Admiralty Bay.

In summer there are five species of pinnipeds in the area of Admiralty Bay. Most numerous among them are elephant seals. In the summer of

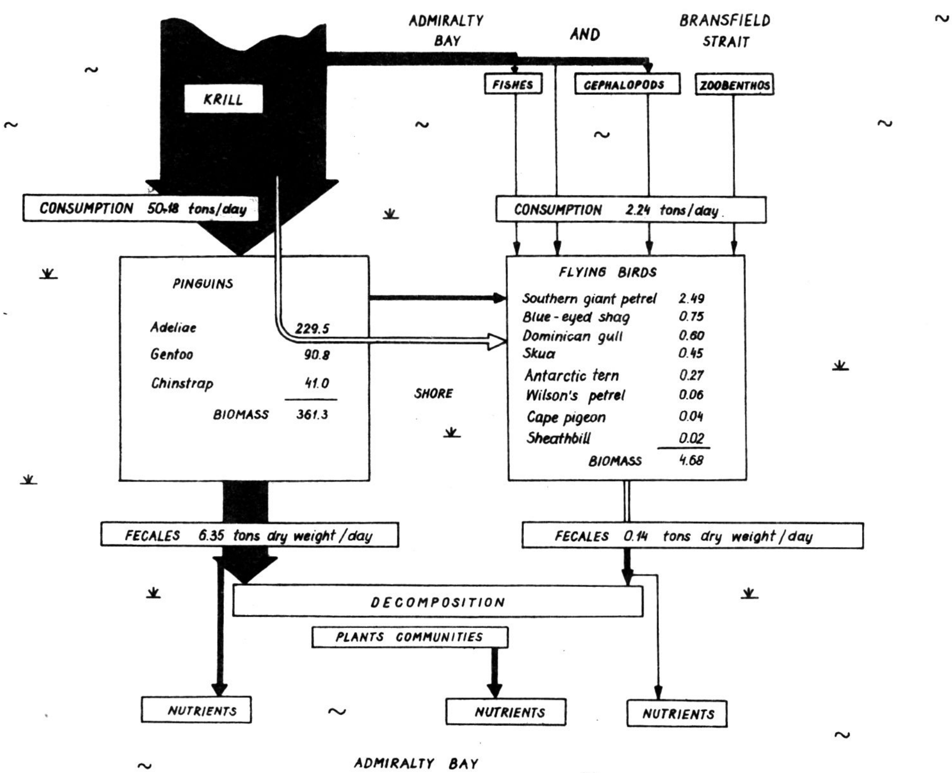

Fig. 8. Biomass, consumption and size of production of fecals by avifauna in Admiralty Bay, second half of December 1979

1978/79 their numbers ranged between 600 and 960 individuals (Krzemiński, unpublished data). The main food of elephant seals are fishes and cephalopods. Daily food ration for an elephant seal of an average weight 500 kg is 27,4 kg (Everson 1977). In the summer, however, elephant seals do not eat much.

According to Woyciechowski (unpublished data) there are about 100 representatives of the Weddell's seals in Admiralty Bay. If we assume the average weight of the seal to be 246 kg and the average daily food portion, consisting mainly of fish and cephalopods, as 5.8 kg (Everson 1977), we find that the daily consumption of the whole population in this area would be about 0.58 ton.

In the second half of the summer fur seal occur in Admiralty Bay. In the season of 1978/79 their numbers were estimated at 220 individuals (Krzemiński, unpublished data). Average weight of one individual is 50 kg, daily food portion is 2.2 kg (Everson 1977). Krill makes 50% of the food, the rest are cephalopods and fish. The biomass of krill consumed by fur seal in that area might be estimated at 0.242 tons/day. The same amount pertains to fish and cephalopods. The numbers of the remaining species of pinnipeds, such as the crabeater seals and sea leopards, which are the main consumers of krill, are so small during the summer, that they have not been considered in the calculations.

The above data show, that penguins with the dominant species *Pygoscelis adeliae* (Hombron et Jacquinot) are the main consumers of krill in the summer in the area of Admiralty Bay and Bransfield Strait. Penguins are the main competitors for food with the fur seals, whose population is gradually increasing after their almost complete decimation in the 19th century.

Many times whales have been observed entering Admiralty Bay; they appeared to feed on krill in the vicinity of Point Thomas and Ezcurra Inlet, however, we are not in the position of giving any estimates of the size of their food rations.

The sum of daily food portions of pinnipeds (excluding elephant seals) in Admiralty Bay, who feed on fish and cephalopods is estimated at 1 ton/day. It seems that this quantity of food may be provided by Admiralty Bay alone. However, if the consumption of elephant seals (21.4 tons/day) is added, the stocks of fish and cephalopods may not be sufficient, and pinnipeds may have to feed beyond Admiralty Bay.

It is clear that the area of Admiralty Bay together with its avifauna and pinnipeds makes during the summer a part of a much greater fragment of a near-shore ecosystem, and it is an area which depends on production in pelagial. Admiralty Bay within its geografical boundries is not self-sufficient.

An inflow of a befined amount of organic matter and nutrients from the sea is indispensable also for the land plant and animal communities which inhabit this region. It pertains to the summer season. The whole functioning fragment of the near-shore ecosystem is subject to considerable seasonal changes, which will be observed in the course of future investigations.

6. Ways and directions of matter transport

In the research area of Admiralty Bay the transport of mineral and organic matter and of nutrients is one of the most characteristic processes. The ways of this transport may be shown schematically (Fig. 9).

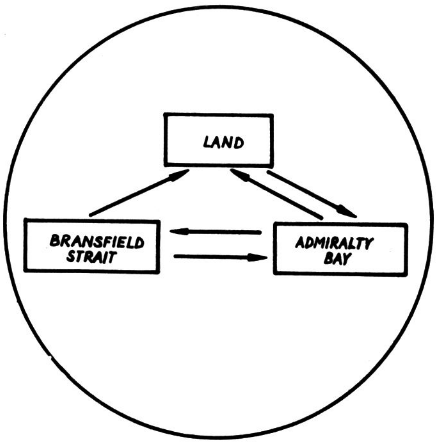

Fig. 9. Main routes of matter transport in Admiralty Bay area in summer

The amounts of water and ice flowing into Admiralty Bay have not been estimated so far. The quantity of terrogenic materials in the form of suspended matter brought into the bay by inflowing, streams has been estimated at 200 tons/24 hours (Pęcherzewski 1980). With frequent changes of currents directions, the suspended matter spreads over the bay area and carried by surface waters it partly outflows into the Bransfield Strait. Wind and thawing icebergs and groulers provide other ways of transport for terrogenic materials (Znachko-Yavorsky and Ravich 1966). These processes are especially intensive in the second half of summer after the thawing of snow cover. The size of this transport has not been estimated as yet. Wind transports also considerable quantities of salts and nutrients from Admiralty Bay on land (Holdgate 1967), especially in the areas open to the wind. This causes an increase in salinity and changes in ionic ratios in fresh water reservoirs and streamlets (Rakusa-Suszczewski 1963). Remnants of marine macro-algae brought by waves on shore are an important source of organic matter on land. This process is irregular and much depends on wind direction, waves and tides. According to preliminary estimates more than 376 tons of wet algal weight may be deposited on shores of Admiralty Bay following a strong storm (Zieliński, unpublished data). These algal remnants decompose on contact with air and within 20 days more than 50% of organic matter (or 18 tons of dry weight) finds its way back into the shore and waters of the bay.

Transport of organic matter from Bransfield Strait on land surrounding Admiralty Bay is accomplished via birds and pinnipeds. The amount of dry weight of fecals excreted in the area of penguin rockeries in the second half of December has been estimated as 6.4 tons/day. This figure may double in January. Fecals of penguins are the main source of nutrients inflowing into Admiralty Bay and those which are utilized by plant communities on land. The following concentrations of nutrients and chlorophyll *a* have been found (Lipski, unpublished data) in one of the lakes located south from Arctowski Station in the vicinity of penguin rockeries: Si — 164.0 μgat/dm³, P — 41.6 μgat/dm³, NO_3 — 118.0 μgat/dm³, NO_2 — 7.1 μgat/dm³, chlorophyll *a* — 1–70 mg/m³. These values are much greater than those found in Admiralty Bay (Table II).

There is a continuous exchange of waters between Bransfield Strait and Admiralty Bay. Since production in the bay area is smaller than in Bransfield Strait, considerable amounts of live organic matter are being transported by waters inflowing to Admiralty Bay. The dimensions of these processes are difficult to estimate at the present stage of our research.

The figures cited above, although only approximate, give an idea of the scale of the processes taking place in the research area.

7. Summary

Admiralty Bay area is a region of multi disciplinary research. It is a representative part of the near-shore Antarctic ecosystem. The Bay is fiord — like in character, with a branching system of inlets. It covers an area of 131 km² (Table I, Fig. 1). The volume of water is about 18 km³, depth 530 m. The shore line is broken by beaches and rocks (45,4 km) and ice cliffs (39.4 km) (Fig. 2, 3).

The area is located in a zone of oceanic climate. Westerly winds are prevailing (Fig. 4). Temperatures (Fig. 5) oscillate around 0°C (273 K). Snow cover lasts for more than 200 days during a year. There are differences in microclimate resulting from orography. Hydrology and hydrochemical conditions in Admiralty Bay are influenced by exchange of waters with Bransfield Strait. Tides are the main cause of water movements. Water run-off from land into the bay causes considerable fluctuations of temperature and salinity and brings terrogenious materials in the amount of about 200 tons/day (Table II). There is no permanent stratification of waters. Strong wind and configuration of the basin are main causes of upwellings in Ezcurra Inlet (Fig. 6). Waves deposit about 376 tons of broken makro-algae on shore. This is an irregular process.

Primary production in the bay is low, it increases towards Bransfield Strait. Its average value has been estimated at 851 tons/day. Maximal stocks of krill in Admiralty Bay has been estimated at more than 100 tons (Fig. 7), and the amount of food, mainly krill, consumed by avifauna at more than 50 tons/day (Fig. 8). Amount of fecals deposited on land is about 6.4 tons/day. These figures may double in the second half of summer (Fig. 9).

Quantities of fish and cephalopods eaten by pinnipeds which inhabit Admiralty Bay are estimated at about 1 ton/day.

A continuous inflow of organic matter from Bransfield Strait is necessary for the summer functioning of the part of near-shore ecosystem such as the Admiralty Bay area together with the fauna and flora.

8. Резюме

Район Залива Адмиральты является полигоном многодисциплинарных исследований. Он становит представительную часть экосистемы прибрежной зоны Антарктики. Залив Адмиральты можно охарактеризовать как фиорд с распространённой системой заливов. Он занимает поверхность 131 км^2 (табл. I, рис. 1). Объём выносит 18 км^3, максимальная глубина достигает 530 м. Береговую линию (рис. 2, 3) образуют пляжи и скалы (45,4 км), а также береговые обрывы (39,4 км).

Район расположен в зоне морского климата. Преобладают западные ветры (рис. 4). Температуры (рис. 5) колеблются около 0°C (273 K). Снежный покров удерживается свыше 200 дней в год. В исследованном районе выступают микроклиматические разницы, вытекающие из орографии. Гидрологично-гидрохимические условия в Заливе Адмиральты образует обмен вод с Проливом Брансфильда, которого главной причиной являются приливы и отливы. Сток воды из суши в залив вызывает значительное колебание температуры и солённость, а также приток террегенического материала в количестве 200 т в день (табл. II). Нет постоянной стратыфикации. Сильные ветры и форма бассейна являются причиной подъёма в Заливе Эзкурра (рис. 6). Процессы волнования вызывают выбрасыване останков макроводорослей на берег, в количестве 376 т. Этот процесс происходит нерегулярно.

Первичное производство в заливе небольшое, растёт по направлению к Проливу Брансфильда. В среднем его оценивается на 851 т в день. Запасы криля в Заливе Адмиральты оценивается максимально на свыше 100 т (рис. 7). Количество пищи, особенно криля, съедаемого авифауной, оценивается на свыше 50 т в день (рис. 8). Количество фекальной массы, выбрасываемой на сушу равняется 6,4 т в день. Эти числа могут дважды увеличиться во второй половине лета (рис. 9).

Количество рыб и головоногих съедаемых ластоногими, выступающими в районе Залива Адмиральты, оценивается на 1 т в день.

Для функционирования летом части экосистемы, каким является район Залива Адмиральты, вместе с выступающей фауной и флёрой, необходимым является постоянный приток органической материи с Пролива Брансфильда.

9. Streszczenie

Rejon Zatoki Admiralicji jest poligonem badań wielodyscyplinarnych. Stanowi on reprezentatywną część ekosystemu strefy przybrzeżnej Antarktyki. Zatoka Admiralicji ma charakter fiordu o rozbudowanym systemie zatok. Zajmuje powierzchnię 131 km (tabela I, rys. 1). Objętość wody wynosi około 18 km^3, maksymalna głębokość sięga 530 m. Linię brzegową (rys. 2, 3) tworzą plaże i skały (45,4 km) oraz klify lodowe (39,4 km).

Obszar leży w strefie klimatu morskiego. Dominują wiatry zachodnie (rys. 4). Temperatury (rys. 5) wahają się wokół 0°C (273 K). Pokrywa śnieżna utrzymuje się w ciągu ponad 200 dni w roku. W badanym rejonie występują różnice mikroklimatyczne, wynikające z orografii. Warunki hydrologiczno-hydrochemiczne w Zatoce Admiralicji kształtuje wymiana wód z Cieśniną Bransfielda, której główną przyczyną są pływy. Spływ wód z lądu do zatoki powoduje znaczne wahania temperatury i zasolenia oraz dopływ materiału terrygenicznego w ilości około 200 ton/dzień (tabela II). Brak trwałej stratyfikacji. Silne wiatry i kształt basenu jest przyczyną powstawania upwellingu w fiordzie Ezcurra (rys. 6). Procesy falowania powodują wynoszenie szczątków makroglonów na brzeg w ilości 376 ton. Proces ten zachodzi nieregularnie.

Produkcja pierwotna w zatoce jest mała, wzrasta w stronę Cieśniny Bransfielda. Średnio oszacowano ją na 851 ton/dzień. Zasoby kryla w Zatoce Admiralicji oszacowano maksymalnie na ponad 100 ton (rys. 7). Ilość pokarmu, głównie kryla, zjadanego przez avi-

faunę oszacowano na ponad 50 ton/dzień (rys. 8). Ilość masy fekalnej wynoszonej na ląd wynosi około 6,4 ton/dzień. Liczby te mogą ulec podwojeniu w drugiej połowie lata (rys. 9). Ilość ryb i głowonogów zjadanych przez płetwonogie, występujące w rejonie Zatoki Admiralicji oszacowano na około 1 ton/dzień.

Dla funkcjonowania w okresie letnim fragmentu ekosystemu, jaki stanowi rejon Zatoki Admiralicji wraz z występującą tu fauną i florą, konieczny jest stały dopływ materii organicznej z Cieśniny Bransfielda.

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AUTHOR'S ADDRESS:

Doc. dr Stanisław Rakusa-Suszczewski
Zakład Badań Polarnych
Instytut Ekologii PAN
Dziekanów Leśny
05-150 Łomianki
Poland