

Current status and prospects of Ukrainian biological exploration in Antarctica: long-term ecological monitoring

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Introduction

Biological investigations of Ukraine in Antarctica were started at the base Academic Vernadsky in 1997th. Main activity was devoted to birds populations (penguins, skuas, etc) and was concerned with dynamics of migration, estimation of parameters of populations, biology of reproduction and demography.

Nowadays the set of species consists of penguins, skuas, shags and other birds, krill, fishes, invertebrate, mammals (observation only), plants (algae, mosses, lichen and other) and microorganisms. The methods used include observations, morphological measurements, individual marking, ringing, and a set of contemporary protocols of biochemistry, genetics, microbiology and other laboratory methods.

The more intensive become international cooperation. It includes bilateral and multilateral interaction.

Since 2002 Ukraine started program of long-termed observations of gentoo colony of the Petermann Island, one of the most visited site of Antarctica. The colony of gentoo at this island is the most south one and its changes (gene pool and population number) may be a good indicator of environmental impact and changes of ecosystem.

These works and data obtained underlie the development of the program of long-termed ecological monitoring (LTEM). The main aim of this program is tracking of simultaneous changes of climate and living beings (species composition, gene pool of indicator species) for prediction of possible changes of ecosystem.

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Current status and prospects

Biology and Ecology

Research of the adaptation features of separate species is carried out. The research objectives area: (1) determination specifically and quantitative structure nested and migratory birds, phenology of the basic biological objects; (2) study of the population characteristic distinctions and nested life observation to determine features between species and inside species relations using the birds ringing.

Research and monitoring of the marine mammals and birds population condition in region of the Vernadsky station are fulfilled, an estimation of number of the basic groups of the species in dynamics and account of volume of consumption by them a krill in region of archipelago the Argentina Islands, study seasonal, in-between-seasonal population with the purpose of making a databank morphological and phenotypic signs.

We provide the seasonal estimation of population of Antarctic krill in the Argentina Islands region, krill population genetic monitoring, analysis of krill population genetic structure and their dynamics. The genetic basis of stability of the krill development and adaptation and research of genetic structure of krill population using methods of biochemical genetics for an estimation of dynamics of their gene pool and forming of the units of a stock are provided in collaboration with Kiev National Taras Shevchenko University (Bezrukov, 1998, 2002).

In the framework of the project "Fauna of parasites of the Antarctic fishes (taxonomy, phylogeny, and seasonal dynamics)" the research Antarctic fish peculiarities are provided in the current winter (Utevsky, 1996; Epshtein, 1996, 1996a). The species composition, taxonomy, and host-parasite relationships of Antarctic leeches are important biological issues both in fundamental and in commercial concern. Results of the study will include the list of species of Antarctic leeches and other parasites, revision of the taxonomic positions of a series of species and genera, discovery of the phylogeny of fish leeches and determination of ecological factors that caused the evolution of this group.

The marine expéditions onboard R/V Ernst Krenkel and R/V Gorizont have been organized by the UAC in 1997, 1998, 2000 and 2002 yrs. The study of state and changes West Antarctica, Antarctic Peninsula seasid region, the study of Antarctic krill population (*Euphausia superba* Dana) and other main pelagic component of South-Orkney sub-region Scotia Sea and Bransfield Strait (Bezrukov, 1998; Samychev, 2001, 2002) are made during expéditions.

Research in genetics has been made in the fields: (1) the analysis of krill population genetic structure and their dynamics based on the methods biochemical genetics; (2) genetic basis of stability development and krill adaptation.

During the 2001/2002 season it was established that krill stock in the region of traditional fishery Scotia Sea (nearby Coronation Is.) reduced (in comparison to 1998 season research) in 6 times (Samychev, 2002). The ecosystem state evaluation was received from simultaneous biology and oceanography observations in Bransfield Strait. The seasonal estimation of population of Antarctic krill in the Argentina islands region is carried out. Scientific purposes of research are: studying of composition distribution and productivity of phytoplankton, visual calculation of bird and mammal quantity that are fed the krill, selection of phyto- and bacterio- planktons samples zoo flagellates and infusorians, and their composition study, observations of forms and quantity of birds and mammals (whale, seals) in the Antarctic Peninsula region.

The complex of experimental works in the fields of marina biology, oceanology, hydro-chemistry, industrial and acoustic oceanography were proposed. Most interesting directions of explorations are: krill, salpas, zooplankton and other factor of environment in the zones of high biological activity (the Patagonia shelf and shelf of the East Cost of Argentina, Scotia Sea. The research topics are: estimation of krill capacity in regions of industrial fishing, dynamics and structure of waters in that regions, explorations of the fronts and large-scale sea currents as factors of creation of the fields increased biological activity, the investigation of typical season changes of wind field over South-West Atlantic and correspondent changes in circulation of the waters for different seasons, investigation of acoustic properties of polar marina media (Artamonov, 1998).

The monitoring of Galindez Island ecosystem has been installed in the purpose of estimation of Antarctic station activity influence on environment pollution. Selection and conservation the moss and lichen samples have been made to the purpose of researching contaminants in them. Collection of samples for definition of quantity concentration the oil-products and toxically substances in seawater near the station has been realized as well.

It is discussed the study of the influence of growing tourists activity on the Vernadsky station region and adjacent territory of islands.

The new project "The ecology - geochemical monitoring of the Vernadsky station region" was recently started in 2003 (Andreev, 2003). Environmental monitoring of the Vernadsky area gives a special approach, which is to provide for finding low technogenic anomalies and for their effective identification in a background of mostly lithologic natural geochemical anomalies. It is suggested to apply research (exploration) methodology for low technogenic geochemical anomalies in the conditions of changed lithologic origin of sediments (soil) composition (Shnyukov, 2001; Andreev, 1992).

The moss, lichen, penguin guano and feather, algae, peat samples, eggshells have been chosen for the environment monitoring at Vernadsky station. The samples for the eco-geochemical monitoring (joint project of UAC and KNU) have been collected in Antarctica. The Cu, Zn, Pb content data using XRF-analysis of samples after preparation and pre-treatment was obtained. The data are variable in wide range and can't be used for the regional environmental condition evaluation and tracking dynamics. Therefore the environmental monitoring of the man-caused geochemical anomalies has to consider mineral contamination of biogenic samples. Lithologic factor influence on the level of geochemical background should be eliminated by instrumental quantitative determination of micro- and macro elements in the sediments (Andreev, 2003).

LTEM site: Petermann Island

Principal biome: Coastal and open ocean pelagic communities; seabird nesting areas. Most abundant species are penguins gentoo and Adelie, occasionally chinstraps. There is also a small colony of cormorants; in the south part of island the nests of skua are located.

Research topics: Population genetics of gentoo, breeding colony size and breeding success of gentoo and blue-eyed shags, impact of tourism on population demography (UAC, KNU, Oceanites, Inc.).

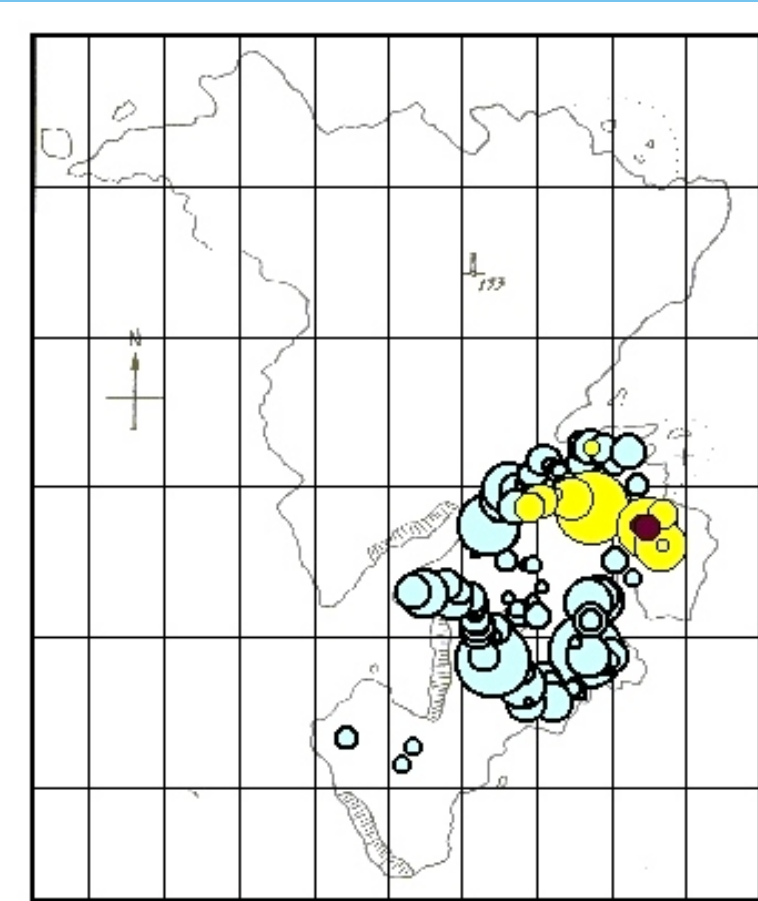
Site Coordinates: -65°10'S, 64°10'W

Site description:

Petermann Island is located close to Vernadsky station. It was first discovered by a German expedition in 1873-74 and is named for the German geographer August Petermann. It is a snow-covered and domed island that rises moderately steeply to a rocky summit. At a cove on the southwest side of Petermann, the French explorer, Jean-Baptiste Charcot, and his vessel, *Pouquoi Pas?*, overwintered in 1909. Charcot named this cove Port Circumcision, for the holy day (January 1) on which it was discovered. There is an abandoned *refugio* at Port Circumcision. The island is one of the most tourist visited sites (by zodiacs with landing) in Antarctica.

The activity planned for the site maintenance:

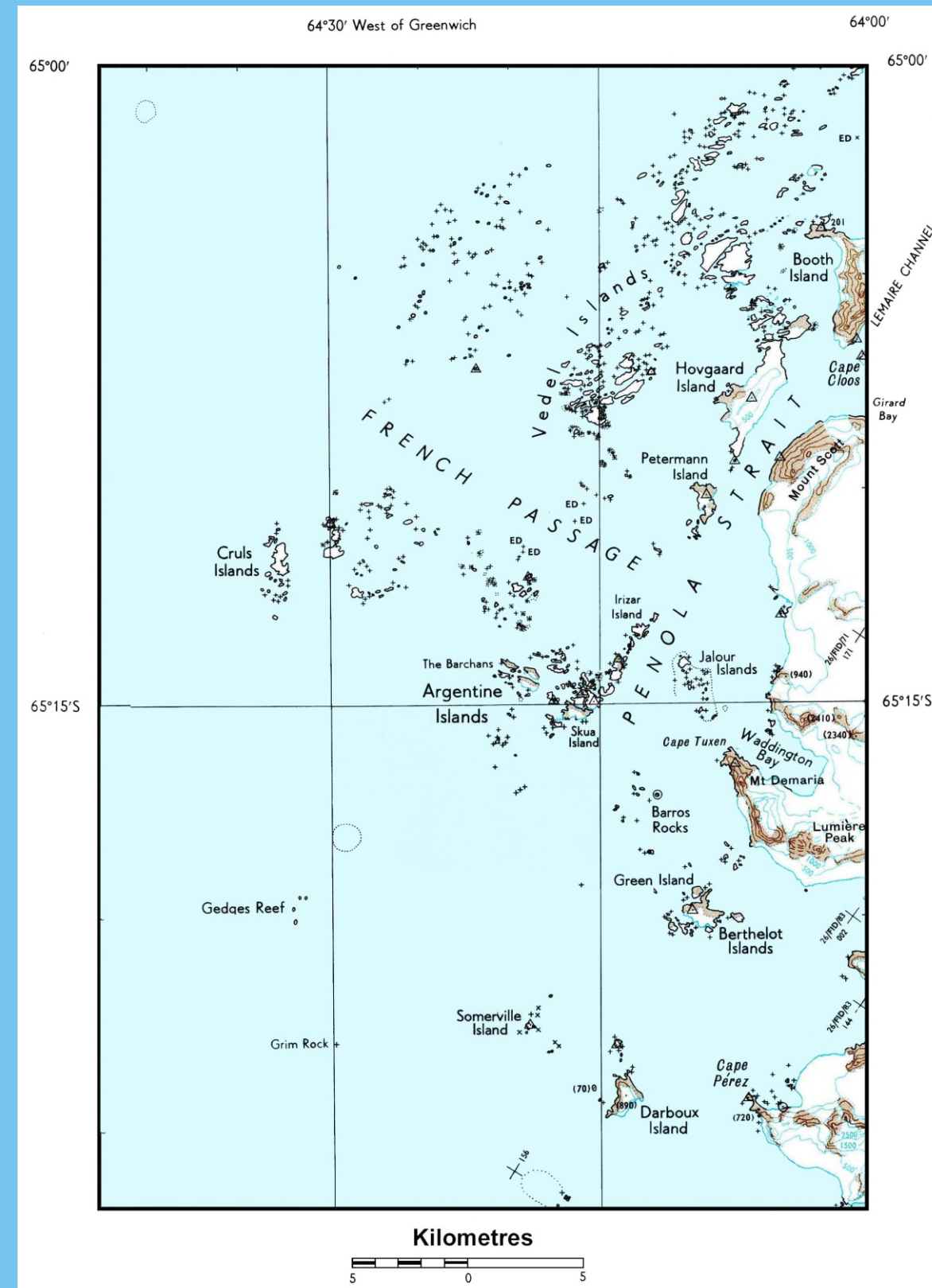
- To invent the birds' colonies structure, the emergency hut conditions and tourist activity at the Island
- Tourist activity improving:
 - to call to SCAR for the status of "site of special management" for the Petermann Island
 - to share the territory into the parts allowable and restricted for tourists' visits
 - to build up the convenient places for zodiacs landing at Port Circumcision
 - to prepare the educational data for tourists about history and nature of Petermann Island.
- Building works:
 - Reparation of the emergency hut in its initial form as historical part of the Petermann
 - Creation and equipping the facilities for scientific work and living during summer season expéditions.



Nestings of gentoo (blue), adelies (yellow) and shags (violet) at Petermann Island in December, 2002

LTEM

Area: the three triangles



Three defined area were chosen for the LTEM program:

Little triangle Islands: Galindes - Winter - Skua Meek and Cornice Channels, Black Island, Skua Island, Stella Creek, Penola Strait; sites of special interest: Vernadsky and Wordie House

Middle triangle Islands: Barchans (all of Argentina Islands), Yalour Petermann; French Passage and Penola Strait; additional site of special interest: Emergency hut at the Petermann Island

Large triangle Islands: Cruls Berthelot Hovgaard (including Vedel Islands), Waddington Bay and two important passages: French Passage and Penola Strait; additional site of special interest: Emergency hut at the Rasmussen Island

These areas differ for intensity of monitoring: for frequency of data gaining, samples collection, set of collecting samples, set of inspecting indicator species and environmental parameters that will be checked

The Little Triangle is the area of the intense monitoring during all the year with the widest set of monitored parameters. List of indicator species includes birds, mammals, fishes, sea invertebrates and plants (mosses, lichens and algae).

The Middle Triangle is the area of less intensive monitoring. The sites of this area will be visited during the summer season (with zodiacs), when the situation will allow it. List of indicator species includes some birds, mammals, sea invertebrates and plants (mosses, lichens and algae).

The Large Triangle is the periodically visited area of monitoring. The sites of this area will be visited several times during the summer season (with zodiacs). List of indicator species includes some birds, mammals and plants (mosses, lichens and algae).

Integration with external initiatives

Aim - integration into international programs and cooperation with other countries

The following initiatives are considered for LTEM integration:

Programs of SCAR:

CEMP (CCAMLR Ecosystem Monitoring Program)
The CEMP is a scientific program aimed at detecting changes in the condition, abundance and distribution of the animals within the Convention Area.

RiSCC (Regional Sensitivity to Climate Change in Antarctic Terrestrial Ecosystems)
An International Research Program on Antarctic and Peri-Antarctic Terrestrial and Limnetic Organisms and Ecosystems

EASIZ (Ecology of the Antarctic Sea Ice Zone)
The EASIZ program aimed to study the seasonal, inter-annual and long-term changes in coastal and pack-ice zone ecosystems, their associated links to climate fluctuations, and the ecosystems controls on biogeochemical.

EVOLANTA (Evolution in the Antarctic)
Evolanta will examine genetic variation in terrestrial and limnetic organisms.

ITASE (International Trans-Antarctic Scientific Expedition) (GLOCHANT)
ITASE focusses on climate and environmental history covering the last 200 - 500 years. The output of this program is directly relevant as climatic background information on species distributions.

New SCAR's Scientific Research Programmes

Antarctic Climate and the Global System (ACGS)

Evolutionary Biology of Antarctica (EBA)

Inter-hemispheric Conjugacy on Environmental, Solar-Terrestrial and Atmospheric Research (ICESTAR)

Non-SCAR programs:

GCTE (Global Change and Terrestrial Ecosystems)
GCTE aims to predict the effects of changes in climate, and atmospheric composition and on terrestrial ecosystems.

I-LTER (International Long-Term Ecological Research)
The I-LTER Network is a collaborative effort promoting synthesis and comparative research across sites and ecosystems and among related research programs.

DIVERSITAS (International Programme of Biodiversity Science)
The program is aimed to promote integrative biodiversity science, linking biological, ecological and social disciplines, and to provide the scientific basis for an understanding of biodiversity loss, and to draw out the implications for the policies for conservation and sustainable use of biodiversity

The Antarctic site inventory (Oceanites, Inc)
Population studies of indicator species in the LTEM area (demography, gene pool, impact of tourism)

IAATO - involving in data collection and education

Aims

Area

Activities

Monitoring

Abiotic parameters

Biotic parameters

Environmental pollution

Supervision and inspection

New technologies of wastes processing

Data bases maintenance

Site-specific activity

Petermann

Rasmussen

Wordie-house

Berthelot

Interaction with tourist expeditions and scientific programs

Integration with other initiatives

AIMS

The main cause for the LTEM establishing consists in idea that Antarctic ecosystem is relatively simple, fragile and easy may be destroyed with growing human activity. From the other side, Antarctic region is large and require international cooperation for control and management by ecological researches of different countries. First of all this cooperation have to deal with data exchange. Then, long-term monitoring for main parameters of ecosystem let to predict its' possible changes in the nearest and more distant future.

Ukrainian scientists have already sufficient experience in their studies of Antarctic biota as well as abiotic factors of Antarctic ecosystem To put their activity in order so that it could be integrated into international programs of ecological monitoring, Ukrainian Antarctic Center and Kyiv National Taras Shevchenko University here propose for discussion and improving the Program of Long-Term Ecological Monitoring (LTEM) with the following aims:

- design and coordination of the program of monitoring and the analysis and interpretation of the data arising from it
- to monitor changes of important components of the Antarctic ecosystem,
- to develop basis for the conservation of Antarctic living resources;
- to check all kinds of environmental pollution in the area of LTEM
- to integrate national ecological programs into already existing and new international programs

Aside of above aims, in the frames of LTEM the activity on regulation of tourist activities and maintenance of historical sites are planed, also. Among them: looking after Wordie House (1), renewal and maintenance of emergency hut at the Petermann Is. (2) and emergency hut at Rasmussen (3).

Activities

All kind of activity of in the area of LTEM Program ought to be reviewed and authorized by national committee before performing activity. It have to respect the requests of the Protocol on Environmental Protection to the Antarctic Treaty.

Monitoring

Abiotic parameters

- meteorological observations
- the ice characteristics changes
- hydrological researches
- ozone layer and UV registration
- glaciology observations

Biotic parameters

- Species abundance
- Gene pool
- Population structure
- Level of phenotypic plasticity and genetic variaton
- Growth and developmental stability
- Reproduction and reproductive success
- Molecular and genetic basis of adaptation
- Feeding ecology and behavior

Methods

To ensure comparability of data from different sites, different researchers and different seasons the methods used will be (if available) standard methods for monitoring of CCAMLR Ecosystem Monitoring Program (CEMP)

Environmental pollution inspection in the area of LTEM

Creation of National Antarctic Environmental Data Centre

The NAEDC will be responsible for interaction with the Ukraine NADC

Data bases development and maintenance

Site-specific activity

Peterman Island emergency hut repair and maintaining

Rasmussen Island emergency hut maintaining

Wordy-housemaintaining and environmental pollution inspection

Berthelot Islands environmental pollution inspection

Interaction with tourist expeditions and scientific initiatives