CEPHALOPODS IN THE DIET OF KEYSTONE-SPECIES ANIMALS IN THE REGION OF THE ARGENTINE ISLANDS ARCHIPELAGO (WEST ANTARCTICA)

ABSTRACT. Objective. The study of diet of keystone-species vertebrates (Nothotenia coriiceps, Phalacrocorax bransfieldensis, Leptonychotes weddellii) in the ecosystem of the Argentine Islands Archipelago. Methods. Biological researches were conducted on Akademik Vernadsky station during wintering in 2006—2007, 2009—2010, 2011—2012, 2019 accordance with tasks of the State Special-Purpose Research Program in Antarctica for 2011–2020. In total, the content of 30 faeces of the L. weddellii, 64 pellets and three stomachs of the Ph. bransfieldensis and 40 stomachs of the N. coriiceps were analyzed. Material was collected at all seasons. Results. The L. weddellii diet is dominated by three squid species Galiteuthis glacialis (39,5%), Brachiotheutis picta (21%) and the fishery species Psychroteuthis glacialis (15.8%). In the diet of Ph. bransfieldensis were found the main four Octopus species such as Adelieledone polymorpha — 20%, Pareledone turqueti — 20%, and Graneledone sp. — 24% and Benthoctopus sp. — 16%, who owns the highest proportion of hits. In the nutrition of N. coriiceps, cephalopods are rarely recorded. Only one species of Octopus has been registered and has been identified only to the Cirroteuthidae family. Conclusions. Found that in the diet of keystone-species vertebrates (N. coriiceps, Ph. bransfieldensis, L. weddellii) in the ecosystem of the Argentine Islands Archipelago there are 13 species of Cephalopods, of which 4 species belong to squid Decapoda and 9 species to octopuses Octopoda (3 species are identified to the genus and one to the family). The findings are important not only to establish the actual status of the Antarctic ecosystem and to conserve biodiversity in the Antarctic region.

Keywords: Cephalopoda, Antarctica, Argentine Islands Archipelago, keystone-species, feeding.

INTRODUCTION

The material was collected during Ukrainian Antarctic expeditions in 2006—2007; 2009—2010, 2011—2012, 2019 in the Argentine Islands Archipelago (West Antarctica). The Argentine Islands Archipelago is located in the Pacific Antarctic in the western part of the Antarctic Peninsula between 65°13’—65°16’ S and 64°10’—64°20’ W, 142 km north of the Polar Circle, which extends 66°33’ S. The island chain stretches from southeast to northwest 5—7.5 km from the land of Graham Antarctic Peninsula. From the peninsula it is separated by the Penola Strait. The total area of the archipelago is only about 3.5 km². Due to its successful location, the archipelago serves as a kind of refugium for marine invertebrates and vertebrates.

For the comprehensive analysis of the trophic chains of the Antarctic ecosystem, was selected three key species of vertebrates: fish — Yellowbelly rockcod Nothotenia coriiceps J. Richardson; bird — Antarctic shag Phalacrocorax bransfieldensis King and marine mammal — Weddell seal Leptonychotes weddellii (Lesson). The purpose of this work was to study the diet...
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of keystone-species vertebrates (N. coriiceps, Ph. bransfieldensis, L. weddellii) in the ecosystem of the Argentine Islands Archipelago. To identify the species composition and estimate the percentage of cephalopods in their diet was the task. Results of this study will be used in the program for monitoring and forecasting the density of the Cephalopoda population (CCAMLR Ecosystem Monitoring Program CEMP) of the Commission on Conservation Marina Living Resources (CCAMLR). The provision of research results in the CCAMLR allows us to really assess the species composition and presence of Cephalopoda species in this CCAMLR Subarea 48.1. and use the results to develop a strategy for the management and rational use of the natural resources. The studies were conducted in accordance with the objectives of the State Special-Purpose Research Program in Antarctica for 2011—2020.

METHODS

In total, the content of 30 faeces of the L. weddellii, 64 pellets and three stomachs of the Ph. bransfieldensis and 40 stomachs of the N. coriiceps were analyzed.

**Fig. 1.** Cephalopod-beaks from the pellets of Antarctic shag (Ph. bransfieldensis)

**Fig. 2.** Frequency of occurrence of different species of cephalopods in Weddell seal (L. weddellii) feces from the Argentine Islands Archipelago

**Fig. 3.** The number of exemplars of cephalopods in the pellets Antarctic shag (Ph. bransfieldensis) from the Argentine Islands Archipelago
Material was collected at all seasons. The samples were washed separately with a sieve (minimum mesh 0.54 mm) (Casaux et al. 2005; Daneri et al., 1999). Cephalopods were identified using chitins cephalopod-beaks (upper and lower jaws) (Fig. 1) according to the Cephalopod Beak Guide for the Southern Ocean (Xavier, Cherel, 2009) and Identification key and species description for Antarctic squids (Okutani T., Clarke M., 1985; www.antarctica.ac.uk/about_antarctica/wildlife/index.php; www.marinespecies.org/photogallery.php?album=668).

RESULTS

**Leptonychotes weddellii.** Previously, Xavier J.C., Cherel Y. (2009) examined the feeding of Weddell seals by four species of cephalopods in the western Antarctic region, and in particular in the South Shetland Islands and near the Antarctic Peninsula. In particular, the diet of the seal included such cephalopods as *Gonatus antarcticus* Lönnberg, *Kondakovia longimanus* Filippova, *Moroteuthis kniopivitchi* Filippova and *Psychroteuthis glacialis* Thiele (Clarke, Mac-Leod, 1982; Lipinski, Woyciechowski, 1981). A scatological analysis of *L. weddellii* showed that cephalopods predominate in the sealfeeding area of the Argentine Islands Archipelago after the fish (Dykky, 2009; 2012). Among the cephalopods in *L. weddellii* diet are four squid species, three of which have been identified. In particular, *Brachioteuthis picta* Chun, whose chitinous beaks often occur in its excrement (Fig. 2). Also in the excrement of several individuals of the Weddell seal from Cruls Islands and Forge Islands (near French Strait) found large squid beaks of *P. glacialis*, measuring up to 44 cm in size. The squid habitat captures the Antarctic Peninsula, and the species favors depths of 200 to 700 m and according to literary data is included in the diet, sperm whale, Weddell and elephant seals (Fisher, Hureau, 1985; Clarke, 1980).

Two new squid species, such as *Histiooteuthis macrohista* Voss and *Galiteuthis glacialis* Chun, have also been identified (Fig. 2). The excrement analysis also revealed two antarctic Octopus species — *Graneledone antarctica* Voss and *Pareledone sp.*, which were first identified in the diet of this species in the Argentine Islands Archipelago.

**Phalacrocorax bransfieldensis.** Analysis of pellets *Ph. bransfieldensis* showed that fish predominate in bird diet (54%), including the remains of 407 exemplars of fish of 19 species (734 otoliths) (Zahorodnyi, Dykky, 2017). Found that in second place in diet *Ph. bransfieldensis*, after fish, is dominated by Cephalopods (36%). The pellets revealed 25 upper and 10 lower cephalopod-beaks belonging to 25 individuals of Cephalopods. In particular, it was found that the diet of *Ph. bransfieldensis* includes six species of Cephalopods, namely Octopus representatives. Four of them were identified. In particular, *Adelieledone polimorpha* Robson – 20% and *Pareledone turqueti* Joubin – 20%, whose chitins-beaks are most commonly found in *Ph. bransfieldensis*. Also isolated from the pellets of octopus beaks *Stauroteuthis giglhrishi* Robson – 16% and *Graneledone macrotyla* Voss – 4%, which occur less frequently. The largest proportion of Cephalopods is from the genera *Graneledone* – 24% and *Benthoteuthus* – 16% which we were not able to identify to the species level (Fig. 3).

**Nothotenia coriiceps.** An analysis of 40 stomachs of *N. coriiceps* shows that sometimes Cephalopods also become prey to large fish specimens. Only in one stomach were registered three fragments of the mandible of one octopus, species from the family Cirroteuthidae.

CONCLUSIONS

The diet of keystone-species vertebrates (*N. coriiceps*, *Ph. bransfieldensis*, *L. weddellii*) in the ecosystem of the archipelago of the Argentine Islands Archipelago includes 13 species of Cephalopods, of which 4 species belong to squid Decapoda and 9 species to Octopuses Octopoda (3 species are identified to the genus and one to the family). The *L. weddellii* diet is dominated by three squid species *G. glacialis* (39.5%), *Brachioteuthis picta* (21%) and the fishery species *P. glacialis* (15.8%). The diet of *Ph. bransfieldensis* is dominated by the main four Octopus species such as *A. polimorpha* – 20%, *P. turqueti* – 20%, and *Granele-
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 done sp. — 24% and Benthoctopus sp. — 16%. In the diet of N. coriiceps, Cephalopods are rarely recorded. Only one species of octopus has been registered by belongin to the Cirroteuthidae family. The findings are important not only to establish the actual status of the Antarctic ecosystem and to conserve biodiversity in the Antarctic region.

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промисловий вид Psychroteuthis glacialis (15,8%). В раціоні Ph. bransfieldensis домінують основні чотири види восьминогів такі як Adelieledone polimorpha – 20%, Pareledone turqueti – 20%, та Graneledone sp. – 24% і Benthoctopus sp. – 16 %, яким належить найбільша частина трапляння. В живленні N. coriiceps головоногі молюски трапляються досить рідко. Зареєстровано лише один вид восьминога, який вдалося ідентифікували лише до родини Cirroteuthidae. Висновки. З'ясовано, що до спектра живлення ключових видів хребетних тварин екосистеми Аргентинські острови входить 13 видів головоногих молюсків, з яких 4 види належать до кальмарів Decapoda і 9 видів (три види ідентифіковано лише до роду і один до родини) належать до восьминогів Octopoda. Отримані результати мають важливе значення не лише для встановлення фактичного стану антарктичної екосистеми та збереження біорізноманіття в регіоні Антарктики. Ключові слова: Cephalopoda, Антарктика, Аргентинські острови, ключові види, живлення.