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## THE FEEDING PECULIARITIES OF THE ANTARCTIC SEALS IN THE REGION OF THE ARGENTINA ISLANDS ARCHIPELAGO

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**Summary.** The detailed analysis of a food of the Antarctic species of seals around Argentine islands archipelago, that was spent through out 11 Ukrainian Antarctic expedition (2006-2007), has shown that krill (*Euphausia superba*) is the main type of food for the major species of seals in region. Krill makes 97,2 % to a diet of fur seals (*Arctocephalus gazella*) and 90 % to a diet crabeater seal (*Lobodon carcinophagus*) during the summer period. It is established rather big dimensional and weight rates to young growth in comparison with literary data according to Weddell seal (*L. weddelli*) newborns monitoring. It testifies to enough qualitative and sufficient forage reserve for pregnant Weddell seal females in archipelago water area in which diet krill prevails also (about 70 %). Considering that from 5 seals species counted within archipelago, the most numerous is the crabeater seal and a southern fur seal - these species can be used as «species indicators» of krill distribution and quantity in the given region. It is established, that the leopard seal's fodder diet is similar, to a diet of a specie around eastern Antarctic, despite an essential latitude difference of specie habitat arrangements.

The trophical researches of Weddell seal have allowed to define a new commercial specie of large squid *Psychroteuthis glacialis* for the first time in given region. These results have great value not only for a definition of an actual condition of Antarctic ecosystem and biovariety preservations in planetary scale. But also can be used for working out of the management project for future rational use of krill sea stocks and squids in the given region of Antarctic, at the state level.

**Key words:** feeding, seals, Argentina Islands, Antarctic ecosystem.

### Особливості живлення антарктичних видів тюленів у районі архіпелагу Аргентинські острови.

Дикий І.

Проведений протягом 11-ї Української антарктичної експедиції (2006-2007 рр.) ґрунтовний аналіз живлення антарктичних видів тюленів у районі архіпелагу Аргентинські острови показав, що у більшості видів тюленів регіону в раціоні переважає криль (*Euphausia superba*). Протягом літнього періоду криль складає 97,2% раціону морських котиків (*Arctocephalus gazella*) та 90% раціону крабоїда (*Lobodon carcinophagus*). Згідно з моніторингом новонароджених тюленя Уеддела (*Leptonychotes weddelli*) встановлено відносно великі розмірні та вагові показники молодняку в порівнянні з літературними даними, що свідчить про якісну й достатню кормову базу для вагітних самиць Уеддела в акваторії архіпелагу, в раціоні яких теж переважає криль (близько 70%). Враховуючи, що з п'яти видів облікованих у межах архіпелагу тюленів найбільш багаточисельними є тюлень-крабоїд та південний морський котик, ці види можуть бути використані як «види-індикатори» поширення та чисельності крилю при встановленні його запасів у даному регіоні. Встановлено, що кормовий раціон морського леопарда максимально подібний до раціону виду в районі Східної Антарктики, попри суттєву різницю широтного розташування біотопів виду.

Проведені вперше для регіону дослідження трофіки тюленя Уеддела дозволили встановити новий промисловий вид крупного кальмара *Psychroteuthis glacialis*. Ці результати мають важливе значення не лише для встановлення фактичного стану антарктичної екосистеми та збереження біорізноманіття у планетарному масштабі, а й можуть у перспективі слугувати основою для розробки на державному рівні менеджмент-плану для майбутнього раціонального використання морських запасів крилю та кальмарів у даному регіоні Антарктики.

**Ключові слова:** живлення, тюлені, Аргентинські острови, антарктична екосистема.

## Introduction

Throughout 11 Ukrainian Antarctic expedition (2006-2007) we have spent professional teriological researches of the sea mammals on territory of the Argentine islands and adjoining water areas, for the first time for 10th years of UAS "Academician Vernadsky" existence. Teriological researches were conducted on Ukrainian Antarctic station "Academician Vernadsky" during wintering on 29.01.2006-01.03.2007 according to tasks of State researches program of Ukraine in Antarctica for 2002-2010. The researches were made in two topics: "biological recourses and oceanology" and "Ecological researches and monitoring of environment". According to the main tasks those topics the project "Mammals of the Argentina islands (species list, quantity, habitat distribution, biology) and their role in the Antarctic ecosystem".

One aspect of researches included gathering and the analysis excrement of all species of seals in the given region according to standard techniques. Due to the spent analysis, trophical relations were defined and feeding competition features of sea mammals at investigated region were found out. The sea mammals of Argentine islands and adjoining territories practically remained not investigated till this time. At the same time the analysis of all existing fragmentary data which have been collected by in addition previous biologists-winterers since 3 to 9 Antarctic expeditions, in the given territory has been carried out.

## Material and technique

The Argentine islands archipelago is placed in Pacific sector of Antarctic in the western part of Antarctic peninsula between 65°13 '-65°16 ' s. and 64°10 '-64°20 ' w., in 142 km. to the north of a southern polar circle which passes on 66°33' s. The chain of islands lasts from the southeast to northwest in 5-7,5 km. from the Graham land of Antarctic peninsula. From peninsula it is separated by Penola straight. The archipelago total area occupies all nearby 3,5 km<sup>2</sup>. The archipelago serves original refugium for seals, owing to successful placing.

A total of 131 faeces of the 5 species of seals (*A. gazella* - 66; *L. weddellii* - 23; *L. carcinophagus* - 15; *H. leptonyx* - 24; *M. leonina* - 3) were collected from January 2006 to March 2007, respectively, around groups of juvenile and adult specimens of both sexes resting at beaches surrounding on archipelago of Argentina islands and Antarctic Peninsula. Given that before the collection of the samples, the beaches to be surveyed were cleaned from old faeces. All the samples analysed were produced by seals during the study periods. The samples were individually washed through sieves (minimum mesh 0.54 mm) and the prey remains were sorted to the lowest taxonomic level possible (Casaux et al. 2005). In order to estimate the approximate number of individuals of the Antarctic krill *Euphausia superba* present in each sample, we considered the number of eyes and telsons or the dry weight of the total of the carapaces present in the sample according to the technique described by Casaux et al. (1998). The highest of these three estimations was considered as the minimum number of krill specimens present per sample. The mass of the individuals was estimated by comparing with entire specimens recovered from the study area. Isopods, amphipods and decapods were represented by exoskeletons remains and their mass were estimated by comparing with entire specimens collected in the study area. Cephalopods were identified using reference materials and the illustrations «FAO species identification sheets for fishery purposes. Southern Ocean (Fishing Areas 48, 58 and 88)» (Fisher, Hureau, 1985a,b), and descriptions in Clarke (1980), Lipinski and Woyciechowski (1981), and Okutani, Clarke (1985). The number of individuals represented in the samples was estimated by the number of upper and lower beaks or eye lenses. Almost all the squids represented in the samples were tentatively identified as *Brachioteuthis picta*. The nine beaks from one sample faeces one specimen *Leptonychotes weddellii* were identified as *Psychroteuthis glacialis*. The number of gastropods and bivalves represented in the scats was estimated considering the number

of shells present in the samples and the mass was estimated by comparing with entire specimens recovered from the study area. Bones, otoliths and eye lenses indicated the presence of fish in the scat samples. The sagittal otoliths were identified to species level, where possible, using our own reference collection and illustrations and descriptions monography «Fishes of the Southern Ocean» (Gon, Heemstra, 1990) and publication Hecht (1987), Williams, McEldowney (1990) and Reid (1996). The otoliths belonging to specimens of each species were sorted into right or left and the most abundant of these was considered as the number of fish present in each sample. Since the estimates of the number and mass of prey species represented in scats usually give biased results (Clarke and MacLeod 1982; da Silva and Neilson 1985; Green and Burton 1987; Murie 1987; Casaux et al. 1997), the estimated mass of the different alimentary items does not necessarily represent their real contribution to the diet. However, these values were included because they provide information not reflected by the frequencies of occurrence.

### Results of researches

The researches have shown, that from 6 species of Antarctic seals, within Argentine islands archipelago the 5 species are extended – the family (Otariidae) is presented by one specie – a Southern fur seal (*Arctocephalus gazella* Peters, 1875). Four species of seals belongs to a family (Phocidae) from which three species belongs to subfamily (Monachinae) – Crabeater seal (*Lobodon carcinophagus* Hombron and Jacquinot, 1842), Weddell seal (*Leptonychotes weddelli* Lesson, 1826) and a Leopard seal (*Hydrurga leptonyx* Blainville, 1820). The fourth specie – a Southern elephant seal (*Mirounga leonine* Linnaeus, 1758) belongs to subfamily (Cystophorinae). The analysis of faeces is carried out has allowed to find out feeding features of the Antarctic species of seals around the Argentine islands archipelago.

**Southern fur seal.** Antarctic krill *E. superba* is the basic object of fur seal's diet within archipelago. In particular, a female after reproduction and in time of lactic period are fed exclusively by krill. Young individuals and adult males eat krill and fish. Besides molluscs (squids) are in their diet. It has been worked over fifty excrement of an animal throughout the period of researches. Seasonal researches of a fur seal excrement have shown, that in its summer diet prevails fish of family Nototheniidae, unlike autumn period. Krill together with fish are constantly presents at a diet of seals through all period of their being on archipelago (also makes 97,2 percent) (fig. 1). From 100 to 796 fragments of separate krill pieces were in one sample. On the basis of faeces analysis, it is necessary to notice, that the remains of cephalopodes in excrement of a seal were not founded. However, the specie consumes Antarctic limpet *Nacella concinna*, but not in a considerable quantity. Therefore we suppose, that seals eat limpet and mollusc shells as stones gastrolites, which animals swallow from an ocean floor in a considerable quantity. In whole, from 10 to 40 such small stones gastrolites in one sample were founded.

On literary data fur seals hunt, mainly, in the top water layer (about 50 m), young males can sometimes kill penguins, but do not eat them (Lea et al. 2002) except above listed diet. However, our observations and the analysis of an animals excrements has shown, that fur seals from territory of Galindez island and Black island consumed penguins in meal twice. Similar data results are in annual report of Manilo L., specifying that in March of 2004 and 2005 the skin and feather fragments of penguins were repeatedly founded in excrements of seals (Manilo, 2005). Possibly young and wounded penguins become victims of seals. Hence, penguins *P. papua* and *P. adeliae* also presents in a diet of a southern fur seal on territory of Argentine islands archipelago. Animals are active both in the afternoon and at night. However, food activity of animals mainly is noted on evening hours.

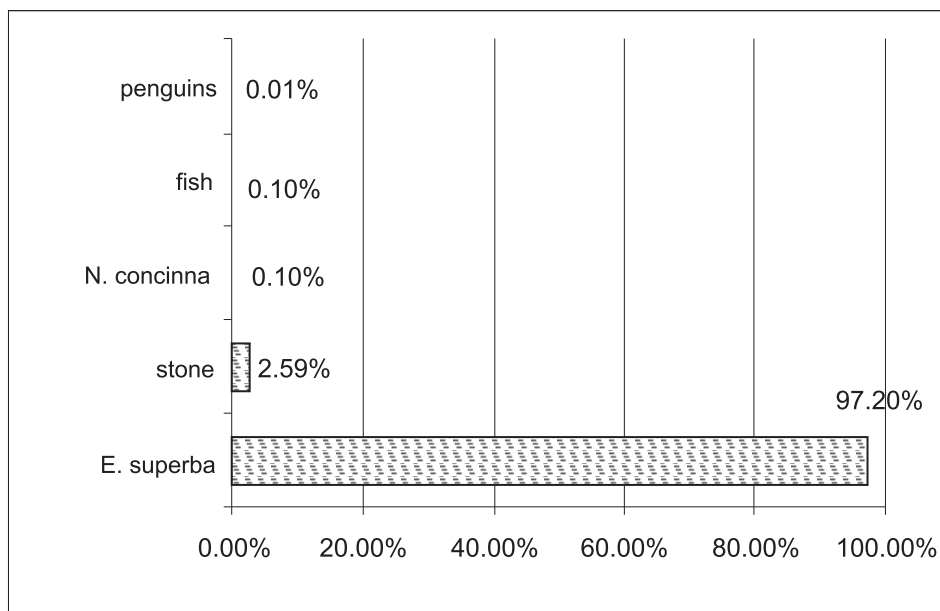


Fig. 1. Repeatability percent of forages in excrements *A. gazella* in Argentine Islands water area.

**Weddell Seal.** The analysis of Weddell seal excrement from archipelago territory has shown, that in a diet of animal the first place occupies krill *E. superba* (about 70 %), during the winter-spring period. The greatest percent of krill in investigated samples was noted in females feeding during the lactation period. Small species of fishes compound only 15-20 % of an animal diet. The seal gives advantage to Trematomus representatives. In samples prevails *Trematomus scotti* – 45 %. Also in winter there are fragments of isopodes – *Glyptonotus antarcticus* and shells of bivalves (small species) quite often. The last possibly get to a digestive path of a seal from the fishes stomachs caught by it. During the summer period in its diet prevails molluscs and fish, with a small amount of seaweed. Among cephalopodes molluscs two species of squids are in Weddell seals diet. In particular, the chitinous bills of *Brachioteuthis picta*, are in its excrement in spring-summer periods. Also bills of squid large specie (*Psychroteuthis glacialis*) has been allocated and identified from excrements of Weddell seal several individuals from Cruls Island, which is on distance of 15 km from Galindez Island, for the first time by us. This specie reaches to 44 sm of length. Its area covers Antarctic Peninsula region, and the specie gives advantage to depths from 200 to 700 m. It is a new large squid commercial specie. Its distribution has been confirmed for Argentine islands water area by analysis of faeces.

**Crabeater seal.** Antarctic krill *E. superba* compound about 90 % of a crabeater seal diet. Krill amounts the greatest percent in a seals diet in spring and summer periods around archipelago. However, fish, squids and others invertebrates are also in a diet of the given specie of seal. In particular, in winter months when the krill quantity decreases around archipelago, the seal consumes головоногих molluscs of specie *B. picta* more often. Its maintenance can reach 40 % in samples and small coastal species of fishes. Also crabeater seal food research around Antarctic Peninsula is confirmed with literary data. However, specie distribution is closely connected with krill stocks division in habitats. That's why in the winter, when *E. superba* meets sporadically around archipelago, the crabeater seals quantity decreases ten times. The detailed analysis of seasonal crabeater seal amount dynamics in the Argentine islands archipelago testifies to it.

**Leopard seal.** Leopard seal is a predator who eats warm-blooded animal (sea birds and young seals). The only natural enemy of a leopard seal is killer whale. Own observations have shown, that during the early spring period the specie gives advantage to sea birds and eats any readily available species - *Larus dominicanus*, *Catharacta maccormicki*, *Phalacrocorax atriceps*. However, the penguin *Pygoscelis papua* – 61 % — the main component of a diet around the Argentine islands during the summer period, krill is on 2nd place (fig. 2). Usually, at this time individuals of specie constantly keep closer to colonies of penguins *P. papua* and *P. adeliae* (Galindez, Petermann, Yalour islands). The successful hunting of leopard seal on young crabeater seal *L. carcinophagus* has been noted and fixed on camera, during researches in October in 2006. Thus a leopard has immobilized an animal, having had a bite a neck of victim. After that predator has hidden the undereated hulk of killed animal under a fragment of iceberg. The hunting of separate individuals of a specie for a waterfowl is often enough observed within Galindez island. It is amount, – 77 % from a diet of a specie around archipelago. Also the animal consumes large copies of Nototheniidae family fishes.

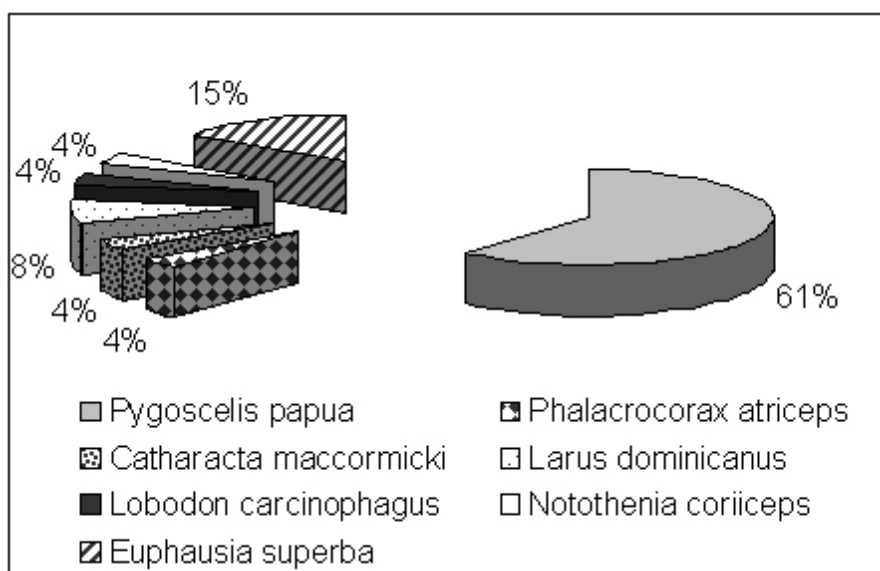


Fig. 2. Leopard seal (*H. leptonyx*) diet in Argentine Islands water area.

**Southern sea elephant.** A feeding of the given specie is poorly investigated. It is known, that the diet contents of specie depends on distribution region. The coastal species of fishes and cephalopodes compound a basis of feeding. The youth also eats large amphipodes and isopodes. According to the literature, animal of the given specie can dive to 1500 m depth, remaining under water nearly 2 hours (Fisher, Hureau, 1985b). However, usually dive to 200-400 m at a food. The excrement analysis of two young females from Rasmussen Island has shown, that cephalopodes – *Brachioteuthis picta*, small representatives of sort *Trematomus* fish, Antarctic limpet *N. concinna* and about 50 % of diet compounds the seaweed rests in investigated territory.

## Discussion

The results of krill *A. gazella* consumption being received during the summer period around Argentine Islands archipelago confirming the similar researches spent on the given specie around southern Shetland Islands. There the female together with the kid for four months of a summer season (from December on March inclusive) consumes 917 kg of krill. And consumption calculations for this period of all population in the given region make  $3,6 \times 10^6$  kg of euphausiids crude weight (Croll, Tershy 1998). All the same krill occupies a considerable particle in a feeding of fur seals during the summer period and amount from 50,2% to 97% of a diet, despite on partial geographical variability of species trophic is described in the literature (Casaux et al. 1998, 2003, Daneri et al. 2005). *A. gazella* can play a role of *E. superba* bioindicator accordingly concentrating during this period in places with the greatest congestion of second. In spite of the fact that on literary data Casaux et al. (2003), Daneri et al. (1999, 2005) during the summer-autumnal period the specie also often consumes cephalopodes, around King-George island from 12% to 14%, near Antarctic Peninsula (Cierva Point), the rest cephalopodes in excrement of a seal have not been noted within Argentine islands archipelago. However, such squid's species as *B. picta* and *P. glacialis*, that are a part of the given specie diet according to Daneri et al. (1999), extended in water area of archipelago also are in excrement of Weddell seal. Besides, the consumption of penguins by young males of seals, were noted by us. First it has been suggested that non-breeding male Antarctic fur seals frequently kill but do not eat penguins Fischer and Hureau (1985b) or that most of the penguins caught are not ingested (Bonner and Hunter 1982). Conversely, other studies reported that seals frequently kill and eat penguins (Laws 1985; Hofmeyr and Bester 1993), penguin remains being present in 23% of the samples collected at the South Orkney Islands (Daneri and Coria 1992). Based on that observation and on the occurrence of penguin remains in 45% of the scats collected at Harmony Point during the 1995/1996, 1996/1997 and 2001/2002 summer seasons, Casaux et al. (1998, 2004) also indicated that penguins are an important food item of the Antarctic fur seal.

*L. carcinophagus* is one more basic krill consumer around Argentine islands archipelago. According to the literary data, everyone crabeater seal consumes 20 kg for day (at 20-25 times more weights of a body in a year), simple calculations show, that the animal can consume nearby 10 tones of krill annually (Fisher, Hureau, 1985b). Seal crab-eater is the basic consumer of krill for given time at Southern ocean. Crabeater seals are well suited for investigations of relationships between seasonal variation in foraging behavior, habitat use, and environmental conditions. Crabeater seals are abundant, year-around residents of the Antarctic pack ice, and they forage primarily on Antarctic krill (*E. superba*) (Laws, 1985). Krill is a patchily distributed prey resource that varies in abundance and energy content due to seasonal shifts in environmental conditions (Siegel, 1988; Lascara et al., 1999). Therefore, crabeater seal behavioral strategies are likely to change seasonally in response to the same factors that influence krill populations. Previous research has indicated that crabeater seal populations are sensitive to environmental fluctuations (Testa et al., 1991) and that individuals are often found in areas where krill abundance is higher (Nordoy et al., 1995; McMahon et al., 2002). Thus, crabeater seals, like other aquatic predators appear to be selecting regions of their habitat where prey are locally concentrated (Wilson et al., 1993). Hence, *L. carcinophagus* can be used as bioindicator for *E. superba* also.

On literary data, the basic objects of *L. weddelli* feeding is coastal species of fishes Nototheniidae, Myctophidae and Channichthyidae (about 80%), cephalopodes (*P. glacialis* and *Pareledone charcoti*) and crustacea (Burns et al., 1998; Casaux et al., 1997, 2004). Last publications testify about geographical variability of specie trophic (Lake et al., 2003). The research carrying out by us confirm, that in a diet of an animal around archipelago prevails *E. superba*, instead of fish, especially at females during the bringing up period of youth. The newborn Weddell seals monitoring carried out by us has allowed to establish rather big dimensional (135–144 sm) and weight (25–28,5

kg) indicators to young growth at a birth in comparison with literary data, where the length of newborns makes 120 sm, weight – 25 kg (Fisher, Hureau, 1985b). Also it is established, the daily gain of newborns is amount 3,5 kg average. It testifies to enough qualitative and sufficient forage reserve for pregnant Weddell seals females in the archipelago water area which basis is krill.

Also on literary data the big enough percent (about 50 %) in *H. leptonyx* food occupies krill (Fisher, Hureau, 1985b). However, the excrement analysis within archipelago has not confirmed these data. The forage structure of the given specie during the summer period is similar to a population diet of leopard seals from the Southern Shetland islands area where their basis is made by penguins *Pygoscelis antarctica* and from the end of December to the beginning of February — youth of fur seals *A. gazella* (Hiruki et al., 1999). However, a food by a crabeater seal, noted by us within archipelago, is described only from area of east Antarctic (gulf Prydz) (Hall-Aspland and Rogers, 2004). Similarly with region of Argentine islands archipelago, the krill consumption in region of east Antarctic during the period since 1999 to 2002 according to Hall-Aspland and Rogers (2004) does not exceed 15,8 %, and a basis of a specie forage reserve are sea birds, in this case penguins Adelie (to 92,1 %).

It is impossible to carry out the detailed comparative analysis of *M. leonina* diet forage reserve, because of objective reason. The specie meets seldom in the Argentina islands territory. Mainly specie finds are dated for Galindez, Black, Rasmussen and Pleneau islands. First meetings of specie often happens in the summer-autumn period. Exclusively young individuals among whom females prevail are counted around archipelago in all cases. Only 12 animals have been considered during researches, and it was possible to select 3 samples of excrements. Diet of sea elephants adult individuals consists of 75 % cephalopodes and 25 % of fish, the youth prefer only amphipodes, according to Fisher, Hureau (1985b). In our case almost half of diet was made by vegetative meal (seaweed) together with squids and fish. However, it is difficult to give an objective estimation of specie trophic, because of worked samples small quantity.

### Conclusions

The faeces analysis of Antarctic seals species food around Argentine Islands archipelago, has shown that krill *E. superba* prevails in a diet of the majority seals species of region. Throughout the summer period krill amount 97,2 % to a diet of fur seals (*A. gazella*) and 90 % to a diet crabeater seal (*L. carcinophagus*). It is established rather big dimensional and weight rates to young growth in comparison with literary data according to Weddell seal (*L. weddelli*) newborns monitoring. It testifies to enough qualitative and sufficient forage reserve for pregnant Weddell seal females in archipelago water area in which diet krill prevails also (about 70 %). Considering that from 5 seals species counted within archipelago, the most numerous is the crabeater seal and a southern fur seal - these species can be used as «species indicators» of krill distribution and quantity in the given region. It is established, that the leopard seal's fodder diet is similar, to a diet of a specie around eastern Antarctic, despite an essential latitude difference of specie habitat arrangements.

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