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SEASONAL CHANGES OF THE MORPHO-BIOLOGICAL CHARACTERISTICS OF BLACK ROCKCOD *NOTOTHENIA CORIICEPS* (NOTOTHENIIDAE) IN THE ARGENTINE ISLANDS ARCHIPELAGO REGIONV. N. Trokhymets^{1,2}, A. V. Zinkovskiy¹

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Abstract. Black rockcod *Notothenia coriiceps* (Nototheniidae) is one of the common fish species of the Argentine Islands Archipelago region, and it is very common in the Southern Ocean waters. So, **objective** of the original research was to study the seasonal changes of biological characteristics of *N. coriiceps* individuals. The material was collected during the XII Ukrainian Antarctic Expedition in 2007-2008 using classical **methods**, specifically by the bottom gear in the ice-free water places from the boat and from the shore, and in winter also from the ice. Pieces of fresh meat and fish were used as bait for gear. The catches were carried out at the depths from 10 to 50 m (mainly at depths of 20-30 m). **Result** The majority of black rockcod has a standard length of 26,0-30,0 cm (45,3%) and the age of 4-5 full years (84,5%). During the year, the majority of individuals has II stage of development of the gonads (82,9%), however the number of individuals which have III and over stage of development has gradually increased from October to January. It was detected that the main diet components of *N. coriiceps* in the Argentine Islands Archipelago region were fish and crustaceans rarely – mollusks. Two size groups (>25 cm and <25 cm) of black rockcod had the same feeding components ratios. In the majority of individuals (67,7%), the gastrointestinal tract was filled poorly (0-1 point). Fat content during the year was predominantly 2-3 points (94,3%). The value of cardiosomatic index during the year has gradually increased from 0,181±0,008 in April to 0,283±0,005 in September and has again decreased to 0,182±0,003 in December. The value of hepatosomatic index has decreased from 2,11±0,10 in April to 1,58±0,06 in November. In December and January the index has increased to 2,66±0,57. The value of fatness by Fulton has decreased from 1,89±0,06 in April to 1,60±0,03 in September, in January it has increased to 1,86±0,52. **Conclusions:** the character of feeding and development stage of *N. coriiceps* in the region of the material collection has matched with data from the other researches of the other Antarctic Peninsula regions. In the majority of representatives (66,7%), the gastrointestinal tract was poorly filled (0-1 point), and fat content during the year was predominantly 2-3 points (94,3%). The biological features of *N. coriiceps* were characterized by the seasonal dynamics, that was associated with the feeding in summer and small amount of food in winter.

Key words: *Notothenia coriiceps*, ichthyology, Argentine Islands Archipelago, Antarctica.

СЕЗОННІ ЗМІНИ МОРФО-БІОЛОГІЧНИХ ПОКАЗНИКІВ ШИРОКОЛОБОЇ НОТОТЕНІЇ *NOTOTHENIA CORIICEPS* (NOTOTHENIIDAE) У РАЙОНІ АРХІПЕЛАГУ АРГЕНТИНСЬКІ ОСТРОВИВ. М. Трохимець^{1,2}, А. В. Зінковський¹

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Реферат. Широколоба нототенія *Notothenia coriiceps* (Nototheniidae) належить до фонових видів риб у районі архіпелагу Аргентинські острови та в цілому характеризується широким розповсюдженням у водах Південного океану. Тому **метою** оригінальної наукової роботи є дослідження сезонних змін біологічних показників в особин *N. coriiceps*. Матеріали дослідження було зібрано під час XII Української антарктичної експедиції 2007-2008 рр. Збір матеріалу проводили класичними **методами**: на відкритій від льоду воді донними гачковими знаряддями з човна та з берега, а взимку – цими ж знаряд-

дями з льоду. При цьому в якості приманки використовували шматочки свіжого м'яса і риби. Вилови проводили на глибинах від 10 до 50 м (переважно на глибині 20-30 м). **Результати** досліджень показали, що більшість екземплярів широколобої нототенії мають стандартну довжину 26,0-30,0 см (45,3%) і вік 4-5 років (84,5%). Протягом року більшість особин знаходиться на II-й стадії розвитку гонад (82,9%), хоча кількість особин, які мають III-ю і вищі стадії розвитку гонад, поступово зростає з жовтня по січень. Виявлено, що основними компонентами живлення *N. coriiceps* в районі архіпелагу Аргентинські острови є риба та ракоподібні, зрідка – моллюски. При цьому раціон двох розмірних груп (>25 см і <25 см) широколобої нототенії майже не відрізняється. У більшості особин (67,7%) шлунково-кишковий тракт характеризується низьким наповненням (0-1 бали). Жирність протягом року становить переважно 2-3 бали (94,3%). Значення кардіо-соматичного індексу поступово зростає з 0,181±0,008 в квітні до 0,283±0,005 у вересні і знижується до 0,182±0,003 у грудні. Значення гепато-соматичного індексу знижується з 2,11±0,10 в квітні до 1,58±0,06 в листопаді, а в грудні та січні знову зростає до 2,66±0,57. Вгодованість за Фультоном знижується з 1,89±0,06 у квітні до 1,60±0,03 у вересні, а в січні знову зростає до 1,86±0,52. **Висновки:** характер живлення та розвитку гонад у *N. coriiceps* в районі збору матеріалу співпадає з даними, отриманими в інших локаціях району Антарктичного півострова. У більшості представників (66,7%) шлунково-кишковий тракт наповнений слабо (0-1 бал), а жирність протягом року складає переважно 2–3 бали (94,3%). Для більшості біологічних показників *N. coriiceps* притаманна сезонна динаміка, пов'язана з нагулом у літній період і невеликою кількістю кормових об'єктів узимку.

Ключові слова: *Notothenia coriiceps*, іхтіологія, архіпелаг Аргентинські острови, Антарктика.

СЕЗОННЫЕ ИЗМЕНЕНИЯ МОРФО-БИОЛОГИЧЕСКИХ ПОКАЗАТЕЛЕЙ ШИРОКОЛОБОЙ НОТОТЕНИИ *NOTOTHENIA CORIICEPS* (NOTOTHENIIDAE) В РАЙОНЕ АРХИПЕЛАГА АРГЕНТИНСКИЕ ОСТРОВА

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Реферат. Широколобая нототения *Notothenia coriiceps* (Nototheniidae) принадлежит к фоновым видам рыб в районе архипелага Аргентинские острова, а также – характеризуется широким распространением в водах Южного океана в целом. Поэтому **целью** оригинальной научной работы является изучение сезонных изменений биологических характеристик *N. coriiceps*. Материалы исследования были собраны во время XII Украинской антарктической экспедиции 2007-2008 гг. Сбор проводили с использованием классических **методов:** на открытой ото льда воде донными крючковыми приспособлениями лова с лодки и берега, а зимой – этими же приспособлениями со льда. При этом в качестве приманки для ловли использовались кусочки свежего мяса и рыбы. Выводы проводились на глубинах от 10 до 50 м (преимущественно на глубинах 20-30 м). **Результаты** исследования показали, что большинство экземпляров широколобой нототении имеет стандартную длину 26,0-30,0 см (45,3%) и возраст 4-5 лет (84,5%). В течение года большинство особей находится на II стадии зрелости гонад (82,9%), хотя количество особей, которые имеют III и более стадии развития гонад постепенно увеличивается с октября по январь. Было обнаружено, что основными компонентами питания *N. coriiceps* в районе архипелага Аргентинские острова являются рыба и ракообразные, редко – моллюски. При этом рацион у двух размерных групп (>25 см и <25 см) широколобой нототении практически не отличается. У большинства особей (67,7%) желудочно-кишечный тракт слабо наполнен (0-1 балла). Жирность в течение года составляет преимущественно 2-3 балла (94,3%). Значение кардио-соматического индекса в течение года постепенно увеличивается с 0,181±0,008 в апреле до 0,283±0,005 в сентябре и снова уменьшается до 0,182±0,003 в декабре. Значение гепато-соматического индекса уменьшается с 2,11±0,10 в апреле до 1,58±0,06 в ноябре, а в декабре и январе показатель вновь увеличивается до 2,66±0,57. Упитанность за Фультоном уменьшается с 1,89±0,06 в апреле до 1,60±0,03 в сентябре, а в январе она снова увеличивается до 1,86±0,52. **Выводы:** характер питания и развития гонад у *N. coriiceps* в районе сбора материала совпадает с данными, которые были получены в иных локациях Антарктического полуострова. У большинства представителей (66,7%) желудочно-кишечный тракт заполнен слабо (0-1 бал), а жирность на протяжении года соответствует 2–3 баллам (94,3%). Для большинства биологических показателей *N. coriiceps* характерна сезонная динамика, вызванная нагулом в летний период и незначительным количеством кормовых объектов зимой.

Ключевые слова: *Notothenia coriiceps*, ихтіологія, архіпелаг Аргентинские острова, Антарктика.

1. Introduction

The ichthyofauna of the Argentine Islands Archipelago region includes 34 species. Black rockcod (*Notothenia coriiceps* Richardson, 1844) is the dominant species in this region (Manilo, 2006; Trokhymets, 2010). During winter 2007-08 the species reached 74% of total fish catch. Its prevalence and adaptation to the changes of their environment make black rockcod a popular study subject for scientists all around the world. A number of the researches deal with its biochemical and cytological features, as well as embryogenesis, origin, and its impact on environmental factors (Klein et al., 2017; Postlethwait et al., 2016). However, information about the biological characteristics of *N. coriiceps* is still insufficient. For example, there is no studies concerning phenological changes of biological indexes (except for sexual ones) (Manilo, 2006) in this region and in Antarctica generally. The present study provides an opportunity to expand our knowledge about this industrial fish species.

The objective of the research is to reveal the phenological changes in the biological characteristics of *N. coriiceps*.

The following tasks were set:

- to determine the size-age and sexual structures of the *N. coriiceps* populations of the investigated region;
- to determine the ratio of food components of individuals by content analysis of gastrointestinal tract;
- to study the annual changes of following biological parameters: gonado-, cardio- and hepato-somatic indexes, index of the gastrointestinal tract fullness, fatness by Fulton, degree of gastrointestinal tract fullness and fat content.

2. Materials and methods

The object of the research is the dominant fish species of the region, black rockcod (*N. coriiceps*). The materials were collected during wintering of the XII Ukrainian Antarctic expedition in 2007-2008. The collection was conducted from the Antarctic autumn (April 2007) to the summer (January 2008). Primary processing of the material was carried out directly on the spot of the catch at the Ukrainian Antarctic Akademik Vernadsky station by winterer V. Trokhymets (Trokhymets, 2010), then analysis was conducted in the laboratory of Educational and Scientific Center “Institute of Biology and Medicine” of Taras Shevchenko National University of Kyiv.

The main places of catching were the Mick-Penola Channel and the Grotto Island, where 281 representatives of the species were collected (81,9% of the catch). The samplings between the islands of Leopard, Skua and Shelter were also successful. The fishing boats also passed the Irizar, Barchans Islands and Yacht Bay several times. When bad weather or ice did not allow entering to the catching station, fishing was conducted from the shore on the water-filled post (near Prudhman Island) (Fig. 1).

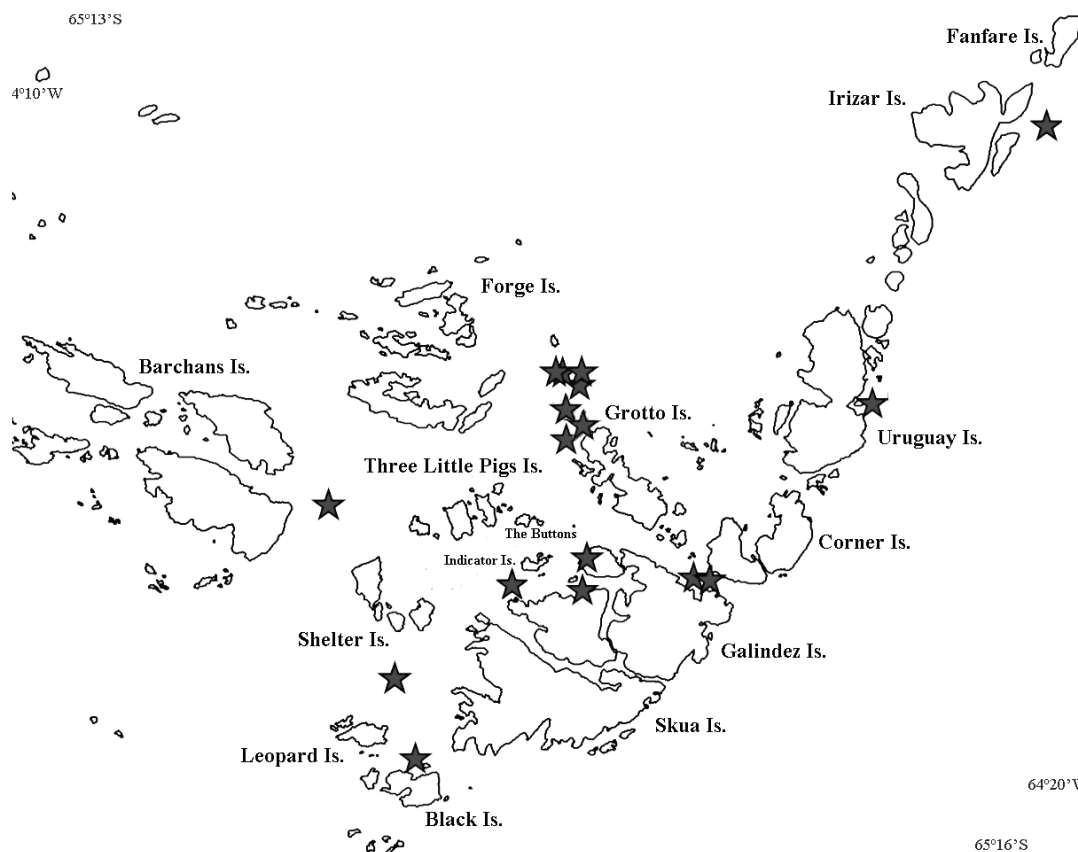


Fig 1. The places of the basic fish catching stations in the Argentine Islands Archipelago region.

The samples were collected mainly by bottom gear from the boat, shore and ice in winter. Pieces of fresh meat and fish were used as baits for spinning. Catching was carried out at the depths from 5 to 150 m, although most of them were at the depths of 10-30 m.

The collective monograph “Fishes of the Southern Ocean” (Gon, Heemstra, 1990) and the key “Southern ocean (fishing areas 48, 58, 88) (CCAMLR Convention Area)” (Fischer, Hureau, 1986) were used to identify the fish species.

Biological and morphometric analysis were performed in laboratory (Trokhymets et al., 2010) with use of conventional methods (Alexienko, Podobailo, 1998; Pravdin, 1966). Origin 8.1 program and Microsoft Office suite were used for statistical data processing with use of conventional methods (Lakin, 1990). For the study of the phenological changes, the following indexes were calculated: somatic indexes (gonado-, cardio-, hepatosomatic indexes), index and degree of gastrointestinal tract fullness, fatness by Fulton and fat content (Alexienko,

Podobailo, 1998). The content of the gastrointestinal tract was also analyzed and age of the rockcod was determined (Kafanova, 1984).

3. Results and discussion

During the wintering of 2007-08, 344 individuals of *N. coriiceps* were caught. Fishing was uneven throughout the year: most individuals were caught in May and June, and the smallest individuals were caught in August, September, December and January (Table 1). The vast majority of individuals were mature and only seven were juvenile. Male individuals were registered 1,4 times more than females.

Table 1

Seasonal changes of the mean values of somatic indexes and fatness of *Notothenia coriiceps* individuals

Month	Somatic indexes of				Stomach	Fatness	Number of individuals
	Heart	Liver	Gonads				
			♂	♀			
April	0,181±0,008	2,11±0,10	0,19±0,02	0,99±0,16	2,78±1,13	1,89±0,06	15
May	0,234±0,011	2,08±0,11	0,50±0,13	3,03±1,35	1,18±0,23	1,73±0,06	41
June	0,193±0,004	1,94±0,06	0,23±0,03	1,09±0,05	1,11±0,26	1,65±0,02	52
July	0,219±0,008	0,84±0,07	0,21±0,01	1,08±0,11	0,89±0,26	1,79±0,15	29
August	0,228±0,018	2,16±0,31	0,21	2,02	1,05±0,52	1,86±0,16	2
September	0,283±0,017	1,72±0,08	0,25±0,02	1,29±0,38	0,89±0,63	1,60±0,03	5
October	0,207±0,005	1,58±0,06	0,32±0,07	1,32±0,13	0,96±0,22	1,59±0,04	24
November	0,208±0,008	1,61±0,09	0,23±0,03	1,67±0,29	0,93±0,45	1,58±0,05	12
December	0,182±0,003	2,67±0,57	0,91	2,97±0,87	3,30±1,48	1,79±0,12	4
January	0,217±0,023	2,54±0,39	1,19±0,22	2,34±1,02	0,97±0,47	1,86±0,52	8

These individuals had a standard length from 19,3 to 41,7 cm, with average length of 28,8±0,3 cm. Most of them (45,3%) were characterized by a standard length in the range from 26,1 to 30,0 cm. 26,1% of the individuals were from 19,3 to 26,0 cm long, and 28,6% of catch were from 30,1 to 41,7 cm long (Fig. 2).

The average length of males (28,9±0,4) and females (29,1±0,5) was almost identical. Size composition for the females was characterized by a more even distribution (Fig. 3). The average body weight of individuals was 428,6±15,3 g and has varied in the range from 117 to 1242 g. Individuals of the largest size were caught in December and January. Average length of rockcod during these months was 35,8±2,8 and 34,5±1,9 cm, average weight was 864,8±183,9 and 665,3±93,1 g.

The most specimens were 4 (45,7%) or 5 (40,5%) full years old. Fewer of them were 6 years old (10,4%) and very few individuals were 3 or 7 years old (about 1,7%). The small number of the 3 year-old specimens and the absence of 1 and 2 year-old ones can be explained by the specificity of the used fishing methods (fishing hooks).

Most of the individuals, caught during the year, had gonads on the II stage of development. The specimens with III and IV stages of development of the gonads increased in number in period of October-January. V stage of development (spawning) was registered for a few individuals who were caught in May, June and January.

The average value of gonadosomatic index during the year was almost unchanged. Only at the end of the year (from November to January) it began to increase gradually from 0,32±0,07 (males) and 1,32±0,13 (females) to 1,39±0,22 and 2,97±0,87 respectively (Table 1). Unfortunately, there are no data for the period of February-April in the original work, since the seasonal work made the fishing impossible. In May, at the end of spawning, the average gonadosomatic index of males was twice as low as in January (0,50 ± 0,13 to 1,19 ± 0,22). High May figures for this index in females can be explained by the fact that few individuals completed spawning and had a value of this index up to 15,60.

According to these data, the development stage of *N. coriiceps* in this region reaches a maximum during spawning at the end of autumn (April-May). In spring the development stage of fish was low, but gradually increased in summer. Correlation of gonads weight to body weight has changed similarly – it has gradually increased since the end of spawning (June) to the beginning of a new one (April). Individuals with gonads on the V stage of development and a high value of gonadosomatic index can be observed already in the middle of the summer (end of December – January). The sex ratio during the year was 1,4:1 (♂: ♀).

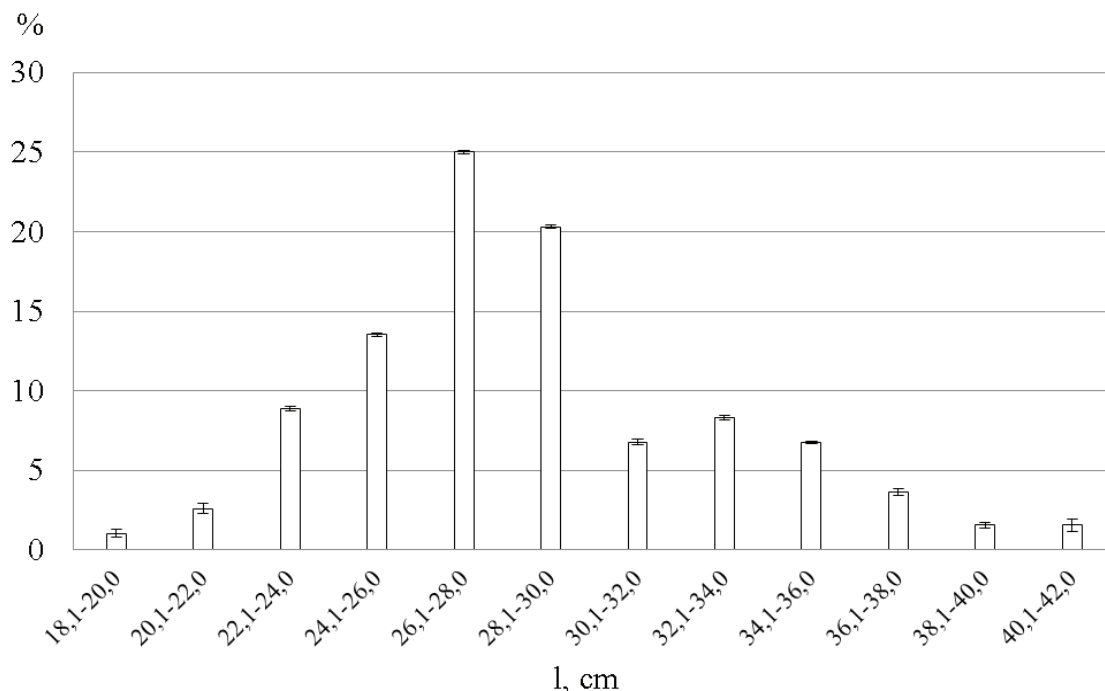


Fig. 2. Size structure of *Notothenia coriiceps* (for both sexes together) in the Argentine Islands Archipelago region.

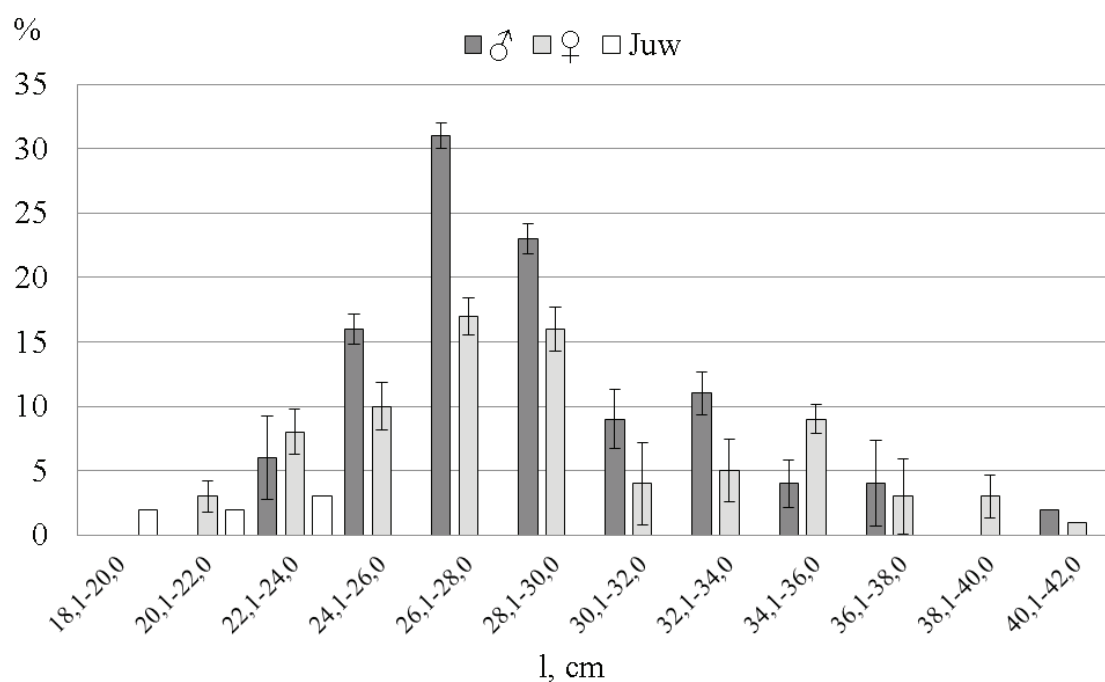


Fig. 3. Size groups and sex structure of *Notothenia coriiceps* in the Argentine Islands Archipelago.

As for the gastrointestinal tracts fullness, for the 45,3% of the caught individuals it was empty. Among the other individuals, the gastrointestinal tracts were more often filled with the fish remains (47,2%) and/or crustaceans remains (35,9%). Among the remains most frequent were observed representatives of the fishes from the genus *Trematomus* (6,6%) and *Lepidonotothen* (7,6%), remains of representatives of *Harpagifer antarcticus* and *Notothenia rossii* also were identified. Remains of mollusks were also found in the stomachs (13,2%), including octopuses. The remains of polychaetes and sea stars were found in the gastrointestinal tracts too (Fig. 4). Compared to the results of the IX Ukrainian Antarctic Expedition 2004-2005 (Manilo, 2006), the percentage of fish in the black rockcod diet has increased significantly. This could possibly occur due to the climate change and changes in the migratory routes of certain fish species in this region. 54,7% of the individuals' gastrointestinal tracts were filled with algae remains. This indicates that in this area, as well as in the South Shetland Islands, black rockcod haunts mainly in the areas that are densely overgrown with algae (Iken et al., 1997). In general, diet of *N. coriiceps* in this region is the same as in the species area total (Barrera-Oro, 2002; Casaux & Barrera-Oro, 2013). But there is distinction in the share of fish – in this region its proportion is larger than other Antarctic Peninsula sea territory (Casaux et al, 2003).

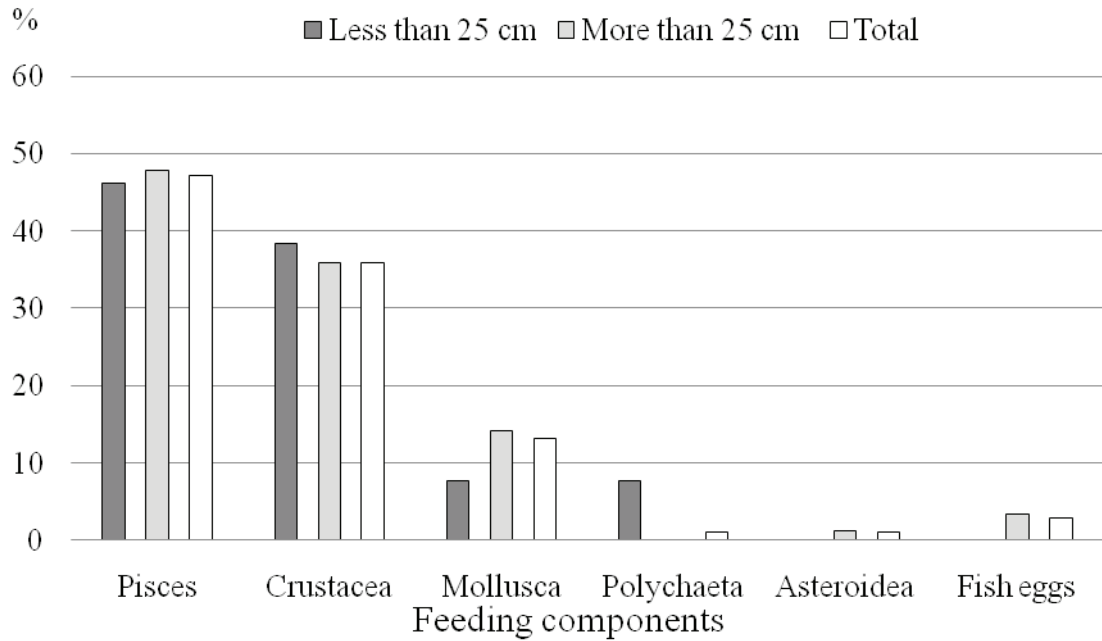


Fig. 4. Ratios of feeding components, that were found in gastrointestinal tract of *Notothenia coriiceps* individuals.

It was suggested before that when this species grown to standard length of 25 cm it changes the ratio of food components (Everson, 1970; Manilo, 2006). However, according to the original data, the main diet components for two size groups – less and more than 25 cm – are in approximately the same ratio: fish – 46,2% and 47,8%, crustaceans – 38,5% and 35,9%, mollusks – 7,7% and 14,1%. Although in the gastrointestinal tract of the larger species representatives the whole fish individuals were found among usual fillings, and those individuals have been identified later. Now the severe deformation of the remains of prey is usual for the filling of the smaller samples. In the most of the caught representatives with standard length up to 25 cm, the stomach was empty (64,5%), and for those who had a length of 25 cm or more stomachs were filled with 59,1% of samples.

During the year, the majority of individuals (66,7%) had 0-1 point of the degree of gastrointestinal tract fullness, quite often (31,2%) there were the individuals with a fullness of 2-3 points, and a few (2,1%) individuals with gastrointestinal tract fullness of 4 points. Individuals with a high degree of gastrointestinal tract fullness were registered at the end of autumn – beginning of winter and their index of gastrointestinal tract fullness was up to 14,46. The average value of gastrointestinal tract fullness during the year was $1,23 \pm 0,14$. During the year, its changes were insignificant. However, in April and December, the high values of the index were recorded: $2,78 \pm 1,13$ and $3,3 \pm 1,48$ respectively. That occurred with the individuals of rockcod with 5 or more index points.

The fat content during the year was mainly 2 and 3 points (48,9% and 45,3% respectively), for some individuals (5,8%) – 4 points. The largest number of individuals with 4 points of gastrointestinal tract fullness was observed at the end of summer – in autumn; in winter, a large number of the individuals with a degree of fat content of 2 points were noted.

It is likely that individuals with fat content of 0-1 cannot survive in natural environment (for Antarctic fish, which do not have a swimming bladder, fat plays a crucial role in maintaining buoyancy) (Gon, Heemestra, 1990). At the same time, due to their diet and rather rigid environmental conditions, the individuals had low degree of fat (2-3) in general. That is why the caught fish had a degree of fat content of 2, 3 and 4 points.

The average value of the cardiosomatic index during the year was $0,211 \pm 0,003$ (Table 2). Its value has gradually changed from $0,118 \pm 0,008$ in April to $0,283 \pm 0,005$ in September and again to $0,182 \pm 0,003$ in December. At the moment it is impossible to explain the reason for the increase of the heart weight relatively to body weight in the beginning of spring. The average index of the hepatosomatic index has decreased from $2,11 \pm 0,10$ to $1,58 \pm 0,06$. In December-January the value has increased to $2,66 \pm 0,57$. During the year, the average value was $1,94 \pm 0,04$. Fatness by Fulton during the year has changed slightly – from $1,59 \pm 0,17$ (September-November) to $1,89 \pm 0,06$ (April). The mean value was $1,69 \pm 0,03$. Hepatosomatic index and fatness have decreased from the middle of autumn to the end of spring, and then they have increased again. This can be explained by the changes of food abundance during the year. However, in August (the end of the Antarctic winter) abnormal growth of these parameters is observed, which is explained by the deficiency of the fish individuals in that month.

Table 2

Seasonal changes of the mean values of somatic indexes and fatness of *Notothenia coriiceps* male and female

Month	Somatic indexes of						Fatness	
	Heart		Liver		Stomach		♀	♂
	♀	♂	♀	♂	♀	♂		
	2	3	4	5	6	7	8	9
April	$0,171 \pm 0,006$	$0,189 \pm 0,012$	$2,30 \pm 0,19$	$1,98 \pm 0,10$	$4,98 \pm 0,89$	$5,99 \pm 1,77$	$1,95 \pm 0,08$	$1,86 \pm 0,09$

Table 2

1	2	3	4	5	6	7	8	9
May	0,238±0,021	0,232±0,012	2,46±0,29	1,91±0,06	3,95±0,32	4,31±0,31	1,89±0,16	1,65±0,05
June	0,196±0,007	0,191±0,005	2,06±0,11	1,86±0,08	4,12±0,43	3,84±0,36	1,63±0,03	1,66±0,03
July	0,212±0,008	0,222±0,011	2,04±0,12	1,75±0,07	3,39±0,26	3,83±0,38	2,12±0,45	1,63±0,03
August	0,247	0,211	2,47	1,84	4,94	3,42	2,03	1,69
September	0,303±0,019	0,253±0,015	1,74±0,13	1,69±0,09	4,25±1,31	3,78±0,51	1,64±0,09	1,53±0,08
October	0,206±0,006	0,208±0,008	1,63±0,07	1,51±0,09	3,97±0,48	3,23±0,26	1,61±0,03	1,56±0,07
November	0,201±0,013	0,211±0,009	1,96±0,13	1,43±0,05	4,75±1,37	2,81±0,21	1,69±0,09	1,52±0,05
December	0,182±0,004	0,182	3,21±0,04	1,04	7,89±1,38	2,34	1,87±0,14	1,58
January	0,237±0,044	0,198±0,015	2,26±0,61	2,81±0,53	2,98±0,35	4,34±0,83	1,51±0,10	1,55±0,09

Most of that most biological parameters of the black rockcod have changed during the year. Parameters, such as degree of gastrointestinal tract fullness, fat content, hepatosomatic index and fatness, which depend on the intensity of nutrition, have clearly decreased during winter and increased in summer. However, due to lack of relevant information it is currently not possible to indicate if such changes are typical for the whole species or only for this population. It is known that the time of spawning (autumn), and, consequently, changes of the gonadosomatic index during the year are characteristics of *N. coriiceps* populations in the Antarctic Peninsula region (Gon, Heemstra, 1990). We found significant changes in the diet of *N. coriiceps*. So, conducting similar studies and comparing their results will allow determining the existence of such changes and their reasons.

4. Conclusions

It was found that the majority of investigated specimens in catches had a standard length of 26,0-30,0 cm (45,3%) and of 4-5 years (84,5%) age. For most of the year, the examined individuals were on the 2nd stage of the maturity of the gonads (82,9%). Only at the end of spring the number of individuals with stages III and above began to grow gradually (to 66,7% in January).

It was revealed that the main components of *N. coriiceps* feeding in this area are fish (47,2%) and crustaceans (35,9%), rarely – mollusks (13,2%). There are no differences in the food components between individuals of the two size groups in the area. In the majority of representatives (66,7%) the gastrointestinal tract was filled poorly (0-1 point). Fat content during the year was predominantly 2-3 points (94,3%).

It was found that the gonado-somatic index has increased from October ($0,32 \pm 0,07$ and $1,32 \pm 0,13$) to January ($1,19 \pm 0,22$ and $2,34 \pm 1,02$) in males and females, respectively. The index of fullness of the stomach did not change significantly during the year ($1,23 \pm 0,14$). The cardio-somatic index has risen from April ($0,181 \pm 0,008$) to September ($0,283 \pm 0,017$), and then has declined ($0,182 \pm 0,003$). Hepatic-somatic index has declined from April ($2,11 \pm 0,10$) to November ($1,61 \pm 0,09$), and then has increased ($2,54 \pm 0,3$). The fertility has dropped from April ($1,89 \pm 0,06$) to September ($1,60 \pm 0,03$) and has increased from November ($1,58 \pm 0,05$) to January ($1,86 \pm 0,52$).

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6. References

- Alexienko, V.R., Podobailo, A. V. 1998. *Metodichni vkazivki do vyvchennia ikhtiologii (rozdil: «Morfometrychnyi analiz ryb»)* [Methodological guidelines for the study of ichthyology (chapter: «Morphometric analysis of fish»)]. Kiev : «Kyivskiy universytet».
- Barrera-Oro, E. 2002. The role of fish in the Antarctic marine food web: differences between inshore and off-shore waters in the southern Scotia Arc and west Antarctic Peninsula. *Antarctic Science*, 14 (4), 293–309. DOI: 10.1017/S0954102002000111.
- Casaux, R., Barrera-Oro, E., Baroni, A., Ramon, A. 2003. Ecology of inshore notothenioid fish from the Danco Coast, Antarctic Peninsula. *Polar Biol.*, 26, 157–165. DOI: 10.1007/s00300-002-0463-y.
- Casaux R., Barrera-Oro E. 2013. Dietary overlap in inshore notothenioid fish from the Danco Coast, western Antarctic Peninsula. *Polar Research*, 32 (1), 1–8. DOI: 10.3402/polar.v32i0.21319.
- Everson, I. 1970. The population dynamics and energy budget of *Notothenia neglecta* Nybelin at Singy Island, South Orkney Islands. *British Antarctic Survey Bulletin*, 23, 25–50.

6. Fischer, W., Hureau, J. 1986. *FAO species identification sheet for fishery purposes: Southern Ocean (Fishing areas 48, 58 and 88) (CCAMLR Convention Area)*. Rome: FAO.
7. Gon, O., Heemstra, P. 1990. *Fishes of the Southern Ocean*. Grahamstown: J.L.B. Smith Institute of Ichthyology.
8. Iken, K., Barrera-Oro, E. R., Quartino, M. L., Casaux, R. J., Brey, T. 1997. Grazing by the Antarctic fish *Notothenia coriiceps*: evidence for selective feeding on macroalgae. *Antarctic Science*, 9(4), 386–391. DOI: 10.1017/S0954102097000497.
9. Kafanova, V.V. 1984. *Metody opredelenia vozrasta i rosta ryb: uchebnoe posobie* [Methods for determining the age and growth of fish: tutorial]. Tomsk: Tomsk State University.
10. Klein, R. D., Borges, V.D., Rosa, C. E., Colares, E. P., Robaldo, R. B., Martinez, P.E., Bianchini, A. 2017. Effects of increasing temperature on antioxidant defense system and oxidative stress parameters in the Antarctic fish *Notothenia coriiceps* and *Notothenia rossii*. *Journal of Thermal Biology*, 68, 110–118. DOI: 10.1016/j.jtherbio.2017.02.016.
11. Lakin, G. F. 1990. *Biometria: uchebnoe posobie* [Biometric: tutorial]. Moscow: «Vysshiaia shkola».
12. Manilo, L. G. 2006. Ichthyofauna and Morphobiological Characteristic of Mass Fish Species of Coastal Waters of Argentine Islands (Antarctica). *Zbirnyk Prats` Zoologichnoho Muzeju*, 38, 5–22. [Proceedings of the Zoological Museum] 38, 5-22 Available online: http://museumkiev.org/zoo/catalog/zz_38/38_2006_All_PDF.pdf [Accessed 08 June 2017].
13. Postlethwait, J. H., Yan, Y. L., Desvignes, T., Allard, C., Titus, T., Le François, N. R., Detrich, H.W. 3rd. 2016. Embryogenesis and early skeletogenesis in the antarctic bullhead notothen, *Notothenia coriiceps*. *Developmental Dynamics*, 245(11), 1066–1080. DOI: 10.1002/dvdy.24437.
14. Pravdin, I. F. 1966. *Rukovodstvo po izucheniu ryb* [Guidelines of the study of fish]. Moscow: Pishchevaia promyshlenost.
15. Trokhymets, V.M., Tymofeyev, V.A., Perechrest J.S. 2010. The fish fauna of the Argentine Islands region (Antarctica; 12 UAE 2007–2008) and morphometrical changeability of *Notothenia coriiceps* (Richardson, 1844). *Ukrainian Antarctic Journal*, 6, 206–214. <http://dspace.nbu.gov.ua/bitstream/handle/123456789/128417/20-Trokhimets.pdf> .