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Bioecology of bivalve Mollusks - Anadara inaequivalvis (Bruguire, 1789) of the Black Sea Coast of Georgia

(Nominated for the degree of Doctor of Biology)
Specialty: Hydrobiology

A n n o t a t i o n

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General description of the paper

Actuality of the scientific topic. Marine organisms are of great importance in the process of self-purification of water from various contaminants. They take various elements from sea water and collect them in their body. Mollusks play a special role in the water self-cleaning system. bivalve mollusks are filters whose participation in the cleaning of reservoirs is related to their nutritional characteristicsMollusks feed on water-weighted detritus and microplankton (unicellular water-plants, bacteriums, and very small animals) by means of a complex eyelash mechanism located near the gills and mouth. They filter the mineral balance from the water and large food particles. Mollusk-filters can be used in activities related to the protection of the aquatic environment from pollution.

Mollusks are bilaterally-symmetrical animals, their bodies are non-segmented. The shape of the shell is triangular-oval. The shell, which consists of two parts, is known as the valve. Mollusks tend to be less mobile, and some are more realistic. Mollusks, as a rule, tend to have a less movable habit, and some of them are characterized with an immovable character. The soft, skeleton deprived body of most of them is placed in the shell. Mollusks are dioecious, some are hermaphroditic. Reproduction is sexual. Most mollusks breed with eggs. Some species are viviparous. Most of them live in the ocean, sea, fresh-water, relatively few - on land. Some disintegrate wood structures at the sea, while some are intermediate hosts for some parasites of domestic, wild animals, and humans. Some species inhabit at the underwater part of the ship en masse and impede the ship's movement.

Invasive species of the Black Sea - A.inaequivalvis is a bivalve mollusk, which belongs to the dimyary (Lamelabranxiata). According to the literature, in the spring the larvae hatching from eggs remain in the plankton. By the end of September, by the end of the planktonic development period, they move to the bottom and become young mollusks. They have many enemies in the form of sea fish, birds and mammals. Extremely grazed by sea plaices, cod and sturgeon. The most dangerous enemy of this mollusk in recent years has become the mollusk rapana. Mollusk populations are severely damaged by polychaetes and drilling sponges.

The bivalve mollusk A.inaequivalvis is a new opportunistic, self-acclimatized filter for the Black Sea. It is widespread in the Black Sea coast of Georgia. The reason for its widespread use is considered by scientists to be the massiveness of the shells and their ability to seal them tightly, the ability to transfer hypoxia in the event of oxygen deficiency in seabed water, which other mollusks lack. At the present stage, it is very important to solve the ecological problems of the environment. In this regard, it is also important to preserve the biodiversity sustainability of reservoir ecosystems by avoiding the impact of negative, natural or anthropogenic factors. Every day, various organisms are studied to use it as an alternative source of food.

The actuality of the issue stems from the above. The bioecology of A.inaequivalvis - a hydrobiont inhabiting in the coastal benthal zone, is still unexplored, which has aroused our interest. We think that the study of the bioecology of this hydrobiont will form the basis for its industrial cultivation, And based on the results of research on its biochemical composition, it will take proper place in increasing the diversity of the human food ration, which is very important in filling the protein deficiency. Increasing demand for food proteins has taken humanity to the level of the world ocean. The importance of the seas, including the Black Sea, plays an important role in solving this task. Not only fish but also mollusks contain protein. Notable in this regard is A. Inaequivalvis, a bivalve mollusk living in the Black Sea coastal benthal, which plays an important role in the ecosystems' bioproduction and is also considered a biosedimenter and biofiltrator

Aim and objectives of the research. Therefore, the aim of the present dissertation was to study the quantitative composition (quantities and biomass dynamics) of A. Inequivalvis in the Black Sea coast of Georgia. Its ecology - the assessment of its role and place in ecosystems and biocenoses. Relevant **tasks** were defined:

A) Seasonal dynamics of A. inaequivalvis quantity and biomass;

B) Size-weight characteristics of A. inaequivalvis;

C) Determining the biochemical composition of Anadara (Anadara inaeqiuvalvis) meat and determining its nutritional value (proteins, fats, carbohydrates);

D) Determination of the content of heavy metals (As, Zn, Pb, Cu, Cd).

As far as anadores are biofilters, Our task was also to analyze insecticides (hexachlorocyclo¬hexane α, β, γ isomers) and pesticides (DDT and its metabolites).

Object and methods of research. The object of research was A. Innaequivalvis, a bivalve mollusk living in the Black Sea coast of Georgia. For the purpose of the research, we used modern **methods** of **hydrobiological research.** In the Black Sea shelf zone of Georgia, research material was obtained at pre-planned stationary stations, In particular, in the areas of Anaklia, Poti, Kobuleti, Chakvi, Mtsvane Kontskhi, Batumi and Gonio. The survey was conducted in 2016-2018.

Material and technical base. The material was processed in the laboratory of the Department of Fisheries, Aquaculture and Aquatic Biodiversity of the LEPL National Environment Agency. Biochemical analysis was performed in the laboratory of Shota Rustaveli State University. Some important microelements in Anadara meat were identified at the Agricultural Laboratory Research Center of the Autonomous Republic of Adjara

Scientific novelty of the paper. The bioecological characteristics of A. Innaequivalvis bivalve mollusk living in the Black Sea coast of Georgia were first studied; Its quantitative composition (seasonal dynamics of quantuty and biomass) in the Black Sea coast of Georgia has been determined; Its place and role in the ecosystem were assessed; Size-weight characteristics of A.inaequivalvis and biochemical composition of meat were studied; And its nutritional value (protein, fat, carbohydrate content) was determined; Heavy metals (As, Zn, Pb, Cu, Cd) were also identified; Analysis was performed on insecticides (hexachlorocyclohexane α, β, γ isomers) and pesticides (DDT and its metabolites).

Theoretical and practical significance of the paper. A. Innaequivalvis, bivalve mollusk living in the Black Sea coastal Benthall, plays an important role in the ecosystems' bioproduction and in addition, is considered a biosedimenter and biofiltrator. Based on the above, the theoretical significance of the paper is obvious, The practical value is that the study of the bioecology of Anadara will lay the groundwork for its industrial cultivation, and based on the results of a study of its biochemical composition, it will take its proper place in increasing the diversity of the human food ration, which is very important in filling the protein deficiency.

Approval of the research results and publication. The results of the research were dedicated to scientific articles and were presented at an international conference:

1. Vadachkoria P., Tregubov A., Makharadze G., Mikashavidze E. & Varshanidze M., **Distribution and Quantitative Characteristics of Four Invasive Alien Species off the Black Sea Coast of Georgia**; Acta Zool. Bulg. 72 (4), December 2020: 539-544
2. Tregubov A., Vadachkoria P., Mikeladze R., **Determination of Size-weight percentage of Invasive Bivalve Mollusk Anadara inaequivalvis (Bruguière, 1789 in the Black Sea,** Tregubov et. al., /IJES/ 10(1) 2021 15-18
3. Tregubov A., Kamadadze E., and Kalandia A. **Biochemical Analysis of the meat of Invasive Bivalve Mollusk Anadara in the Black Sea (Anadara inaequivalvis (Bruguière, 1789))** Tregubov et. al., /IJLS/ 10(1) 2021 28-30

Also, the paper was approbated at the meeting of the Department of Biology at the Faculty of Natural Sciences and Health Care of BSU.

Structure of the dissertation. The dissertation consists of 123 printed pages and consists of an introduction, a literature review and an experimental section, which includes characterization of research materials and methods and analysis of research results. The conclusions are presented in 13 points and with a recommendation. The literature list is presented with 114 sources. The text includes 31 tables, 29 diagrams, 41 photographs.

The content of the dissertation

Literature review

The paper analyzes 115 literary sources, which review the state of knowledge on the topic of the dissertation, the main results and concepts related to the research problem.

Experimental part

Object and methodology of the research

The object of the study was A. Innaequivalvis, a bivalve mollusk living in the Black Sea coast of Georgia.

The invasive species of the Black Sea A.inaequivalvis is a bivalve dimyary mollusk (Lamelabranxiata). The larvae that hatch in the spring remain in the plankton. By the end of September, at the end of the planktonic development period, they run to the bottom and transform into young mollusks. They have many enemies in the form of sea fish, birds and mammals. Its population is harmed by sea plaice, cod and sturgeon. The most dangerous enemy of this mollusk in recent years has become the mollusk - Rapana. Mollusk populations are severely damaged by lobworm and drilling sponges.

The bivalve mollusk A.inaequivalvis is a new opportunistic, self-acclimatized filter for the Black Sea. It is widespread in the Black Sea coast of Georgia. The reason for its widespread use is considered by scientists to be the massiveness of the shells and their ability to seal them tightly, the ability to transfer hypoxia in the event of oxygen deficiency in seabed water, which other mollusks lack. No less important is its nutritional value due to its content of various useful substances, including proteins.

We used modern methods of hydrobiological research for the research (Todorova, V. and Konsulova, Ts. 2005; Жадин В.И.1960). In the Black Sea shelf zone of Georgia, research material was obtained at pre-planned stationary stations, In particular, in the areas of Anaklia, Poti, Kobuleti, Chakvi, Mtsvane Kontskhi, Batumi and Gonio. The survey was conducted in 2016-2018.

The material was processed in the laboratory of the Department of Fisheries, Aquaculture and Aquatic Biodiversity of the LEPL National Environment Agency. Biochemical analysis was performed in the laboratory of Shota Rustaveli State University. Some important microelements in Anadara meat were identified at the Agricultural Laboratory Research Center of the Autonomous Republic of Adjara

During the analysis of the bio-ecological research, the following stationary stations were selected, namely the Georgian shelf waters of Anaklia, Batumi, Supsa and Poti Black Sea.

The laboratory samples were processed as follows: Samples taken from the vessel were stored and washed again with running water in a bag made of gaseous cloth until the odor of formalin disappeared. The remaining mass was placed on a petri dish that was labeled accordingly. With the help of loupe, using Bogorov cells, organisms were collected from small portions and grouped in a typical way. A further study of benthic fauna species was carried out. Microscopic analysis and observations were additionally used at this time (Определитель фауны Черного и Азовского морей, I, II, IIIт), After which the number of individuals of the species was counted and their biomass was determined with an electronic scale of 0.001 accuracy. We calculated the quantities and biomass in the sample per $1m^2$ area. To do this, the number fixed in the sample and the biomass were multiplied by the coefficient related to the seabed area. Based on the generalization of the obtained data, tables and graphs reflecting the species composition of the benthic fauna (general list and table of diversity), as well as the species-quantity (individual / m^2) and their biomass (g/m^2) were compiled. The size and weight of the animal were determined by appropriate methods (В.И. Жадин – М.:1960; В.Н. Полупанов, М.Н. Мисарь, 2015.), using an electronic scale (total mass) with an analytical accuracy of 0.001 g. For all further calculations we used the mean length and weight. We grouped mollusks according to size classes. The following components were identified: a) total weight; B) the weight of the shell; C) Raw and dry weight of meat. We placed the raw and dry meat material in a drying cupboard at 500^C. We dried it to a constant weight and processed the obtained data statistically.

In the biochemical study of A. inaequivalvis we used the kjeldahl method.

The study material was collected at seven stations on the Georgian shelf, namely: Anaklia, Batumi, Gonio, Poti, Chakvi, Kobuleti and Mtsvane Kontskhi. A bottom dredger was used to take zoobenthos samples. We were diving under the visually favorable transparency of the water. We processed the collected material, weighed it and determined the number dynamics (В.И. Жадин – М.: 1960; В.Н. Полупанов, М.Н. Мисарь, 2015.). Relevant graphs of the latest information were drawn up.

1. The number of copies was determined per square meter from samples taken from different stations. The average value of the number was calculated by the formula: $X = \frac{X_1 + \ldots + X_n}{n}$, Where X is the arithmetic mean, X^1, X^2 and etc. - the meaning of quantities, n - number of benchmark.
2. The water content was determined by drying the sample at a temperature of plus 50-60°C (arbitration method). This method is used to determine the content of fish, marine mammals, invertebrates, algae, as well as the water produced in them ГОСТ 7636-85 (https://docs.cntd.ru/document/1200022224?marker =7D20K3).
3. Embersing was made by dry method - + 550-600°C in a muffle oven. The percentage of ash was determined by weight method.
4. Fat was determined by the soxlet method, we used chloroform as a solvent, The duration of extraction was 24 hours. The amount of fat was determined by the weight method (J. Chem. Educ. 2007. Vol. 84, no. 12. P. 1913 - 1914).
5. Protein was determined by the kjeldahl method. Quantity was determined by the titration method (Ю. А. Золотова. 2004. Т. 2. 503 с.).
6. Determine the total sugar content of carbohydrates by the caliper-cyanide method, which determines free carbohydrates in meat.
7. Lead was determined by electrometric atomic absorption spectrometry, using appropriate methodology (МУК 4.1.986-00) Pb 0,10 Mg/kg ±U0,03 Mg/kg "Z.D.N." Not more than 0.3 mg/kg.
8. Arsenic was determined by the graphical cuvette of an atomic absorption spectrometry (argon-gas) by using ГОСТ Р 51766 - 2001 method As 0.2705 ∂ Mg/kg "Z.D.N." X = 5,0 mg/kg.
9. Cadmium was determined by an atomic absorption spectrometry using МЧК 4.1.986-00 method Cd 0,5779 Mg/kg "Z.D.N." X = 1,0 mg/kg.
10. Copper content was studied in the laboratory by atomic absorption spectrometry МЧК 4.1.991-00, Cu 1,1685 ∂ Mg/kg "Z.D.N." X = 10,0 mg/kg.

11. Hexachlorocyclohexane - according to the Thermo Fisher scientific method 63899 methodology < 0,002 Mg/kg “Z.D.N.” < 0,002 mg/kg.

12. DDT and its metabolites - Thermo Fisher scientific method 63899 - < 0,007 mg/kg, Where the value <0.002 mg / kg is the maximum allowable concentration and < rate means less than allowed.

Analysis of research results

Quantitative composition and biomass research results of Anadara in the waterfront of the Black Sea coast of Georgia (Batumi-Anaklia)

It is well known that it is important to determine the quantity and biomass of a reservoir per square meter in order to estimate the reserve of industrial hydrobionts in reservoirs.

In the process of our research, one of the goals was to determine the quantuty and biomass of the mollusk - Anadara, which is widespread in the Georgian coastline of the Black Sea (Batumi-Anaklia).

Appropriate materials were collected in pre-selected stationary areas: Gonio, Batumi, Chakvi, Mtsvane Kontskhi, Kobuleti, Poti, Anaklia sea coasts according to different depths and seasons.

The results of the research are presented in detail in the relevant tables and graphs according to the individual districts (Table 1-8), where it is clear that the rates of Anadara (pieces / m^2) and biomass (g / m^2) are somewhat different according to the individual district and the corresponding depths. The difference is also noted at different times - 2016, 2017, 2018 - according to the materials obtained and the season.

For example, in the samples taken in May 2016 in Anaklia district (Table 1), the number of Anadara at a depth of 20-30 meters was observed 15 pieces / m^2; Biomass amounted to - 1.85 g/m^2; At a depth of 30-40 meters was observed 15-22-104 pieces/$m^{2;}$ Biomass amounted to 8.1-17.4-137 pieces/m^2; At a depth of 40-50 meters was observed 7-59 pieces/m^2, Biomass amounted to 0.7-16,5 g/m^2. n the materials of February 2017, 11 pieces/m^2 were observed at a depth of 10 meters, Biomass was 2,5 g/m^2; In April, at a depth of 7 meters, 31 pieces/m^2 were recorded, biomass was

1.95 g/m^2; In May 2018, at a depth of 20 meters, 24-39 pieces/m^2 were recorded, biomass amounted to 3.25-38.7 g/m^2.

Based on the ***Vanveen*** model of the bottom dredger used, the dredge area is ***0,135*** cm^2 and therefore K=7,4. The calculation coefficient is also shown in Table (1) and Figure (1), respectively. Quantity (ind./m^2) and biomass (g/m^2) of A.inaquelvalvis in Anaklia district at different seasons and depths.

Table 1

Quantity (ind./m^2) and biomass (g/m^2) of A.inaquelvalvis in Anaklia district

test *N*	*May, 2016*				
	Depth, m	Ind., piece	g	Ind./ m^2	g/m^2
I	20-30	2	0.025	15	1.85
II		2	0.03	15	0.22
I	30-40	14	18.5	104	137
II		2	1.1	15	8.1
III		3	2.3	22	17.4
I	40-50	1	0.005	7	0.37
	Depth, m	Ind., piece	g	Ind./ m^2	g/m^2
I	20-30	2	0.025	15	1.85
II		2	0.03	15	0.22
I	30-40	14	18.5	104	137
II		2	1.1	15	8.1
III		3	2.3	22	17.4
I	40-50	1	0.005	7	0.37
II		8	2.2	59	16.5
III		6	0.5	44	3.61
IV		6	0.3	44	2.14
	February, 2017				
I	10	1	0.2	11	2.5
	April, 2017				
I	7	2	0.12	31	1.95
	May, 2018				
I	20	5	0.41	24	3.25
II	20	5	4.9	39	38.7

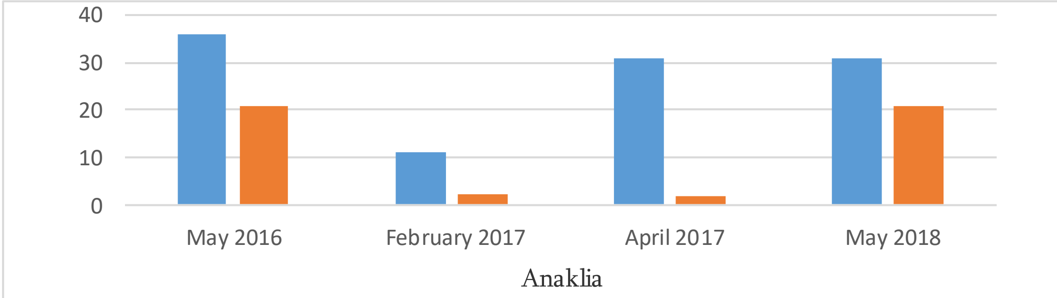


Figure 1. Ratio of A. inaquelvalvis's quantity (pieces / m^2) and biomass (g / m^2) at different seasons and depths in Anaklia district

Relatively high rates were observed in Mtsvane Konstkhi district (Table 2). The quantitative rate is especially high in the materials of October 2017 for a depth of 3-5 meters, where the density of Anadara settlement was 100-600 pieces/m^2, and biomass - 0.04-84 g/m^2. The situation was similar in the materials of June and September 2018 at a depth of 2-3 meters, namely, the settlement of Anadara was 104-346 pieces/m^2, and biomass - 0.24-34 g/m^2.

Table 2

Quantity (ind./m^2) and biomass (g/m^2) of A.inaquelvalvis in Mtsvane Kontskhi district at different seasons and depths

test N	June, 2016				
	Depth, m	Ind., piece	g	Ind. / m^2	g/m^2
I	5	1	0.02	11	2.5
	October 2017				
I	5	3	0.0001	120	0.04
II	3	1	0.145	100	14.5
III	5	6	0.841	600	84
IV	5	4	0.001	120	0.04
	June 2018				
I	2-3	10	0.99	34.6	34
II	2-3	3	0.4	104	13.6
	September 2018				
I	2-3	3	0.007	104	0.24

Figure 2 shows quantity (ind./m^2) and biomass (g/m^2) of A.inaquelvalvis in Mtsvane Kontskhi district at different seasons and depths

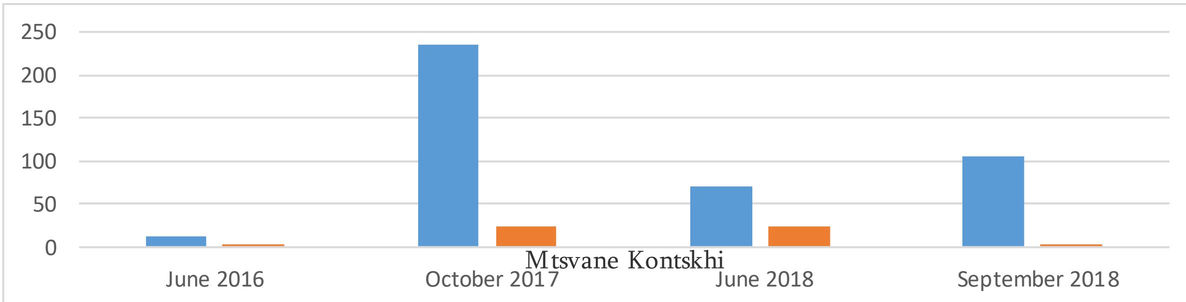


Figure 2. Quantity (ind./m^2) and biomass (g/m^2) of A.inaquelvalvis in Mtsvane Kontskhi district at different seasons and depths

Mean numerical values were observed in the Chakvi district at different depths (Table 3). At a depth of 10 meters, 24 pieces/m^2 were observed, and the biomass was 3.25 g/m^2; At a depth of 20 meters, 31 pieces/m^2 were recorded, biomass was 7.3 g/m^2; At a depth of 40 meters, 8-31 pieces/m^2 were recorded, biomass was 1.9-7.7 g/m^2, At a depth of 55 meters, 16-39 pieces/m^2 were recorded, biomass was 25.7 - 56.5 g/m^2.

Table 3

Quantity (ind./m^2) and biomass (g/m^2) of A.inaquelvalvis in Chakvi district at different seasons and depths

Depth, m	May, 2018			
	Ind., piece	g	piece/ m^2	g/m^2
10	3	0.41	24	3.25
20	4	0.9	31	7.3
40	1	0.23	8	1.9
40	4	0.97	31	7.7
55	5	7.17	39	56.5
55	2	3.3	16	25.7

Tables 4, 6, 7 and 8 show quantity (ind./m2) and biomass (g/m2) of A.inaquelvalvis in Kobuleti, Gonio, Batumi and Supsa districts at different seasons and depths.

Table 4

A. Quantity (ind./m²) and biomass (g/m²) of A.inaquelvalvis in kobuleti district

April, 2016				
Depth, m	Ind., piece	g	piece/ m²	g/m²
20	3	0.25	3	2.5
May, 2018				*k=7,87*
10	1	34.9	8	274.5
20	4	0.09	40	0.5
40	51	0.3	401	2.3
40	34	0.1	268	1

Table 5

Quantity (ind./m²) and biomass (g/m²) of A.inaquelvalvis in Gonio district

April, 2016				
Depth, m	Ind., piece	g	piece/ m²	g/m²
20	7	0.49	55	3.9
October, 2017				
20	1	0.148	10	1.48
May, 2018				
10	8	1.34	63	10.5
40	17	15.8	134	124.2
40	19	0.29	150	2.26
60	1	1.5	8	11.9
September, 2018				
7-8	10	0.1	346	66.6

Table 6

Quantity (ind./m²) and biomass (g/m²) of A.inaquelvalvis in Batumi district

February 2016				
Depth, m	Ind., piece	g	piece/ m^2	g/m^2
20	2	0.004	20	0.04
April, 2016				*k=20*
6-7	1	0.013	20	0.25
May, 2018				*k=7.87*
10	3	2.32	24	18.3
44	1	2.48	8	19.5
20	1	1.9	8	15
10	4	3.1	31	24.5

Table 7

Quantity (ind./m^2) and biomass (g/m^2) of A.inaquelvalvis in Supsa district

April, 2016				
Depth, m	Ind., piece	g	piece/ m^2	g/m^2
	3	0.207	24	1.6
	2	0.0001	200	0.01

Table 8

Quantity (ind./m^2) and biomass (g/m^2) of A.inaquelvalvis in Poti district

February, 2016				
Depth, m	Ind., piece	g	piece/ m^2	g/m^2
20	1	1.5	10	14.9
May, 2018				
40	1	0.02	8	0.16
40	84	0.3	661	2.17
60	7	0.15	55	1.19

Figure 3 shows Quantity (ind./m²) of A.inaquelvalvis in different areas and depths of the Georgian shelf.

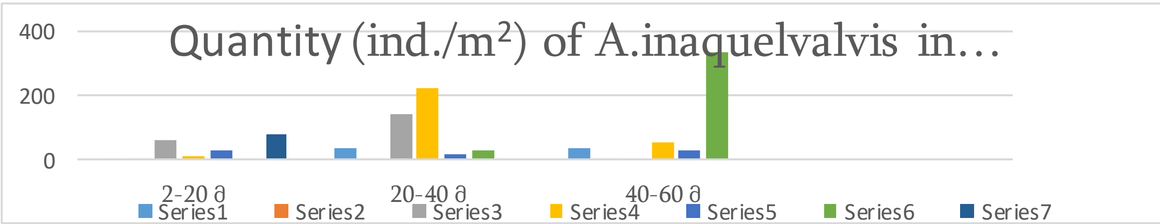


Figure 3. Quantity (ind./m²) of A.inaquelvalvis in different areas and depths of the Georgian shelf.

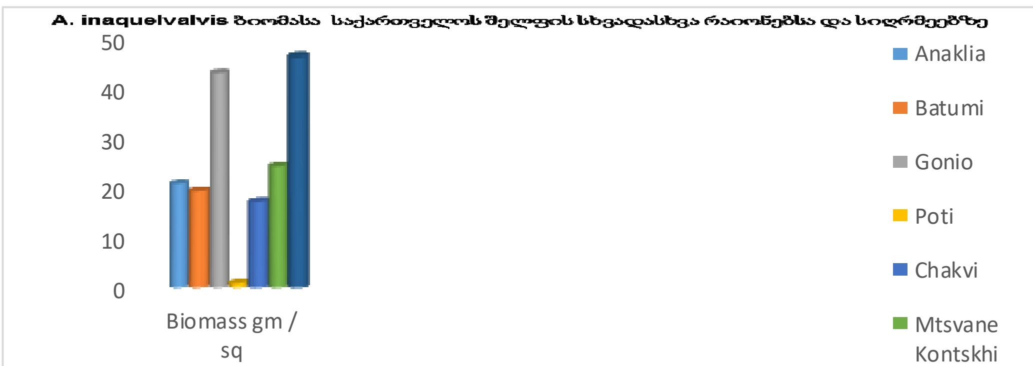


Figure 4. biomass (g/m2) of A.inaquelvalvis in Poti district in different areas and depths of the Georgian shelf.

Based on the analysis of the results of the presented study, it should be noted that in comparison with the quantitative composition of mollusk Anadara, high rates were observed in the deep waters of Mtsvane Kontskhi, Gonio, Kobuleti and Poti shelf (Tables 2, 4, 5, 8). In particular, 100-600 pieces/m² were recorded at a depth of 3-5 meters in the Mtsvane Kontskhi water area; In Kobuleti water area at a depth of 20-40 meters - 31-401 pieces/m²; 134-346 pieces/m² were observed at a depth of 7-8-40 meters in Gonio district; In Poti water area at a depth of 40 meters - 661 pieces/m².

The results obtained should be explained by the fact that the salinity of sea water in these areas is relatively stable and it is 14-18 per mille.

Dynamics were observed according to depth and salinity. We can outline Anadara distribution levels by shelf and region. Based on the results of the existing study, we found that the distribution of Anadara in the Black Sea depends primarily on the salinity of the water. In particular, where there is less influence of the rivers, there were more specimens of Anadara. Relatively low rates were observed in Anaklia, Batumi and Chakvi districts (Tables 1, 3, 6). This result should be due to the reduction of seawater salinity, which is caused by the influence of freshwater from the Chorokhi, Chakvistskali and Enguri rivers.

It is known that the mollusk Anadara is highly sensitive to the variability of salinity in seawater and is quite resistant to the variability of the oxygen content in the water. Anadara, as a filtrate, is also resistant to contamination of water by organic matter. Thus, it can be considered as a certain indicator for determining water quality, It should also be noted that it is, to some extent, involved in the natural self-cleaning process of water pollution.

Thus, based on the given quantitative composition of Anadara, despite the different situation in a particular district, we can conclude that Anadara is characterized by some stability within the Black Sea coastal area and its sufficient stock provides an opportunity to think about the introduction of its production-aquaculture.

Biometric Analysis of Anadara

Today, humanity is studying different organisms every day to use it as an alternative source of food. The biochemistry of this hydrobiont inhabiting Anadara (A. Inaquelvalvis) on the Georgian coastline is still unexplored, which has evoked our interest. Based on the above, we aimed biometric analysis of Anadara's body to determine its weight value. We think that in this regard, it will provide us with useful information and in the growth of human food base diversity, Anadara will establish its place in the food ration in Georgia as a delicacy.

A massive amount of material was collected on the Batumi beach in November 2018 during a 4-5 magnitude sea turbulence. At this time, about 10 kilograms of material of different sizes were isolated and collected, which enabled us to conduct significant research.

The size and weight of the animal were determined by appropriate methods (В.И. Жадин – М.: 1960) Using an electronic scale (total mass) with an analytical accuracy of 0.001 g. For all further calculations we used the mean length and weight. We grouped mollusks according to size classes. The following components were identified: a) total weight; B) The weight of the shell.

The figures and tables below discuss the relationship of raw weight (mollusk weight with shell) to body length. In particular, the percentage ratio between them was determined. (В.Н. Полупанов, М.Н. Мисарь, 2015; Todorova, V. and Konsulova, Ts. 2005.) According to the relevant methods, we took 10 specimen of approximately the same size, with an average length of 52-75 mm. Which averaged 48.4 mm per specimen. We measured the length of each copy using a caliper and weighed it on an electronic scale (weighing up to 500 grams).

Also, the relationship of meat weight (mollusk without shell) to the length of the shell was studied. The flesh of each specimen was removed from the sink and weighed separately, on the basis of which a dependency table and figure were compiled showing the size-weight dependence of Anadara (Anadara inaeqiuvalvis) (Table 9; Figure 5.6).

Table 9

The relationship of A. inaquelvalvis body length to raw body weight and meat weight

Length, mm	Raw weight, g	Meat weight, g
54	43.6	18.2
59	45.2	15.6
53	41.2	17
52	43	16
58	51.1	22.9
49	32.6	13
51	27.4	8.5
75	35.7	13.5
75	40	16.4
55	44.6	15.3

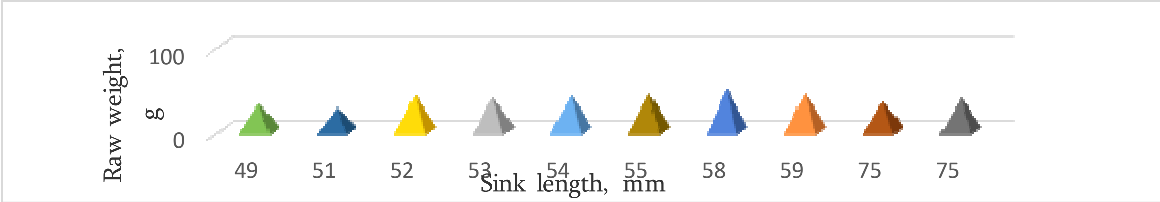


Figure 5. Ratio of crude weight to shell length of A. inaquelvalvis

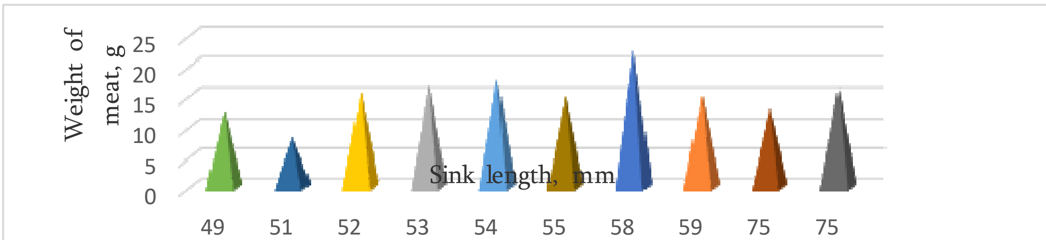


Figure 6. The ratio of the weight of the meat to the length of the shell of A. inaquelvalvis

There was a certain peculiarity, namely that the weight of the meat is about three times less than the size of the body (Table 1; Figure 5,6). For example, the total (Raw, whole) weight of a 54 mm individual's shell was 43.6 g and the weight of a meat (muscular without shell) was 18.2 g.

Another important parameter was studied on the samples at our disposal - the relationship between raw weight and meat weight (Table 9, Figure 7).

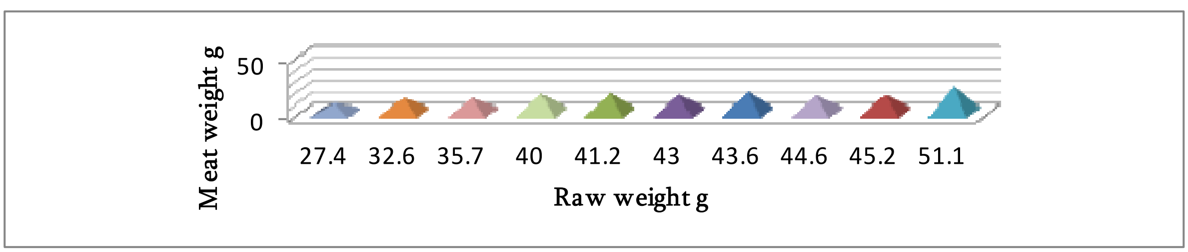


Figure 7. Ratio of raw body weight to meat weight of A. inaquelvalvis

As the analysis of the obtained results shows, on average, 40.14 g of raw mollusk weighs 15.6 g of meat weight, the rest is the shell. Analysis of the samples taken shows that the weight of fresh meat averaged 39% of the total body mass, which is a very significant value for this adult size category.

In order to confirm the results of our research, we studied the same parameters in another category – in small specimens. In this case, the average size of the mollusks was 35.3 mm, the body weight of the shell was 11.64 g, and the weight of the meat was 4.62 g. Analysis of this size-weight relationship revealed that the specimens studied were characterized by a smaller size and a relatively thinner shell. The result was different. If the size / weight ratio on the example of large size was 5/4, in this case the figure was 3/1, ie in the first case it was 83%, and in the second - 32.3% (Table 10; Figure 8.9).

Table 10.

Relation of body length of A. inaquelvalvis to raw (gross) weight and meat weight (in small specimens)

Length, mm	Raw weight, g	Meat weight, g
32	11.3	5,1
34	10.6	4.4
35	12.8	6
35	8.7	2.5
36	11.7	5.4
36	12.3	4.6
36	9.1	2.7
36	14	4.9
36.5	11.4	5,1
36.5	14.5	4.4

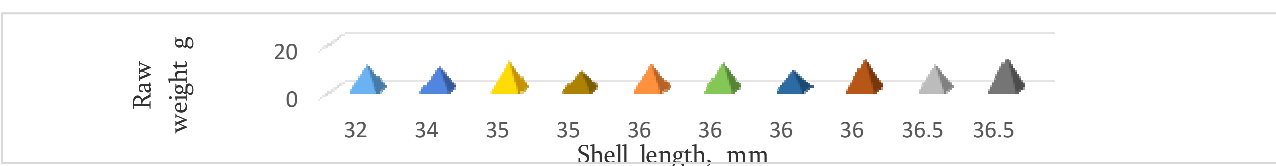


Figure 8. Ratio of body length of A.inaquelvalvis to raw weight (in small specimens)

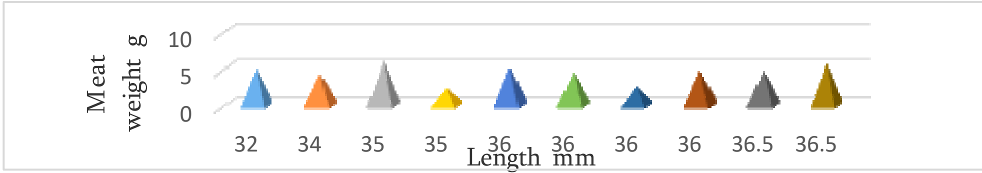


Figure 9. Ratio of body length of A.inaquelvalvis to meat weight (in small specimens)

Some peculiarities were revealed. In particular, in this case the weight of the meat depends on the size. If 54 mm specimens weigh about 18 grams of meat, the weight of 30-35 mm is only 5 grams.

The ratio of raw weight to meat weight of A.inaquelvalvis was also analyzed in small samples, as shown in the table and figure (Table 12; Figure 10). The analysis of the obtained results reveals that 11.6 g of average raw weight of mollusk comes from 4.6 g of meat weight, which means that 39% of the raw weight falls on the mass of meat.

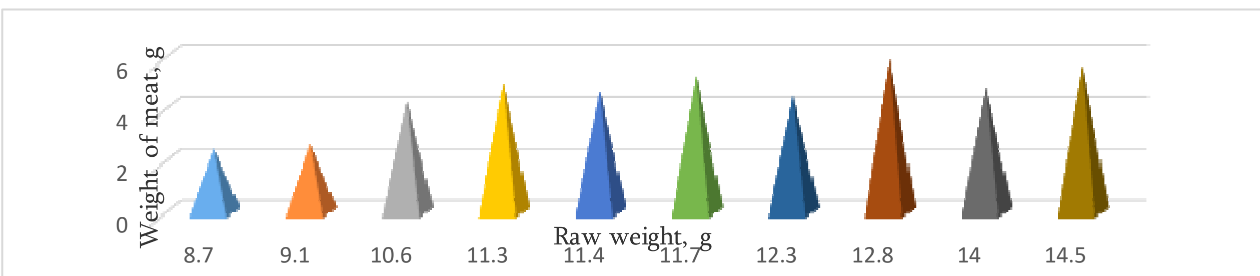


Figure 10. The ratio of raw weight to meat weight of A.inaquelvalvis in small specimens

An analysis of the results of a size-weight study to assess the nutritional value of Anadara in the Black Sea revealed the ratio of body length to total (raw) weight, meat weight, as well as raw body weight and meat weight of Anadara inaequivalvis. Based on the information obtained from the study, a useful percentage coefficient was determined from the total mass of the caught sample. It was found that on average 39% of body weight comes from meat, which is quite a high figure.

Results from Bioecological Research of Anadara

Part of the Georgian shelf of the Black Sea is inhabited by quite rich and diverse benthic organisms, the constituent species of which have different dependencies on the ecological conditions of the environment. Particularly important in this regard are their attitudes towards a particular habitat, the different soil structure of the seabed, and they form several different ecological groupings; Whose constituent species of hydrobiotics are biologically interconnected and form a single whole, the biocenosis of the so-called reservoir benthal or benthofauna. Species of all ecological groups of water reservoirs are more or less involved in the formation of the structure of biocenoses and play a role in the ongoing bioprocesses in it.

One of the biocomponents of this biocenosis is the bivalve mollusk Anadara. That is why we aimed to find out what place it occupies and what role it plays in creating the structure of these biocenoses. It turned out that the mollusk Anadara is quite widespread in the Black Sea shelf area of Georgia (Table 11). Based on the generalization of the obtained material, tables of benthic fauna species composition (general list of diversity) as well as the number of species (pieces/m^2) and their biomass (g/m^2) were compiled. According to the materials obtained by us, in the study areas: Batumi, Supsa, Poti and Anaklia, at different depths of the shelf (5-50 m), mollusk anadara, unlike other hydrobionts, is widespread. It is often in a dominant position with members of his group. Anadara is especially widespread along with other hydrobionts in the Anaklia area at different depths (10–50 m) of the sea benthsl (Table 12). Its wide distribution in this area should be explained by the fact that the soil structure of Anaklia is very peculiar compared to other areas. It is represented by sustainable silt-sand and silty soils, making it the best habitat for Anadara, where it inhabits a partially submerged condition. Depending on the soil (habitat), they form specific ecological groups together with other hydrobionts – psalmophile or pelophile zoocenosis. Thus occupying a special place in the formation of the Benthal biocenosis structure. Also noteworthy is the fact that Anadara, as a filter and sedimenter, feeds on biogenic substances that are abundant in the composition of things brought down by rivers and together with other filtrators participate in the process of biological self-purification of contaminated water in the reservoir. Thus, Anadara also plays a role in maintaining the state of the reservoir biocenosis structure in this regard.

In order to determine the role and portion of Anadara in the creation of the common bioproduct of this biocenosis, a number of studies were carried out in different areas of the shelf, at appropriate depths, as well as at different ground conditions. Their quantitative composition was determined together with different hydrobionts - settlement, density (pieces/m^2) and biomass (gr/m^2). The results are presented in the relevant tables, which clearly show the share of Anadara with other hydrobionts in case of common and separate biocenosis. It turned out that their share is quite visible. In the case of a number of cenoses it occupies a leading-dominant position with a high quantity of biomass. Thus, Anadara plays an important role in marine biocenosis and plays an essential role in creating a common bioproduct. It also participates in the process of natural self-purification of water in polluted reservoirs. In addition, Anadara provides food for various animals. In addition to the above, due to its rich content of nutrients, Anadara can also be used for human food.

To illustrate the general assessment of the bio-ecological status of the mollusk-Anadara in the Georgian Black Sea shelf area, consider the results of the study, which are shown in the tables, which present quantitative values of hydrobionts at different depths and ground conditions.

Table 11

Species composition of benthofauna in study areas

species	Research districts			
	Batumi 10-20m	Supsa 17-22m	Poti 5-16m	Anaklia 10-50m
NEMERTINI				
1. Cephalothrix sp	0	0	0	+
ANNELIDAE				
Polyhaeta				
1. Aricidae cerrutii Laubier, 1965	0	0	0	+
2. Anicistrosyllis tentaculata Treadwell, 1941	+	+	0	+
3. Amphitritegracilis (Grube 1860)	0	0	0	+

4. Exzogene gemmifera Pegenstecheri, 1884	0	+	0	+
7. Harmothoe reticulata Claparede, 1870	0	0	+	0
8. Heteromastus filiformis (Claparede 1864)	+	+	0	+
9. Micronephtys staumeri Augener, 1932	0	+	0	+
10. Mysitides limbata (Saint-losiph, 1888)	0	0	0	+
11. Mellenna parmata Grube, 1869	+	0	0	+
12. Magelona pailicornis O. F.Muller, 1858	0	0	0	+
13. Magelona minuta Eliason, 1962	0	0	0	+
14. Nereis zonata Malmgren, 1867	0	0	0	+
15. Nereis succinea Leuckart, 1847	0	0	0	+
16. Notomastus lineatus Claparede, 1863	0	0	0	+
17. Nephthys cirrosa Ehlers, 1868	+	0	+	+
18. Nephthys hombergii Audouin et M.-Edwards, 1834	+	+	+	+
23. Paraonis gracilis Tauber, 1909	0	0	0	+
24. Paranois fuigens Lebinsen,1883	0	0	+	+
25.Polydora ciliata Iohnston, 1838	+	0	0	+
26. Prionospio cirrifera Wiren, 1883	+	0	0	+
27. Olygoaeta sp.	0	0	0	+

TENTACULATA

Bryozoa				
1. Membranipora denticulata Busk, 1884	0	0	0	+
Phoronidae				
1. Phoronis euxinicola S-long, 1907	+	0	0	+

ARTHROPODA

Crustacea				
1. Ampelisca diadema A. Costa, 1853	0	0	0	+
2. Athanas nitescens Leach,1814	0	0	0	+
3. Balanus inprovisus Darvin, 1854	0	+	+	+
4. Brachinotus sexdentatus Risso, 1827	+	0	0	0
5. Callianassa pestai De-Mann	0	+	0	0
6. Callianassa truncata Giard et Bonnier	0	+	0	0
7. Cumella pugmae euxinica Bacescdu, 1950	0	0	+	+

8. Clibanarius erythropus Latzeilla, 1818	0	0	0	+
9. Diogenes pugilator Roux,1828	+	0	+	+
10. Gammaridae sp.	0	0	0	+
11. Upogebia pusilla Petagna, 1792	0	0	0	+

MOLLUSCA

Gastropoda				
1. Cylichina variabilis Milachevitch, 1909	0	0	0	+
2. Cylichina strigella Loven, 1846	+	0	+	+
3. Cylichina robogliana Fischer, 1867	0	0	0	+
4. Citharella costata Pennant, 1767	0	0	0	+
5. Ciclope donovani Risso, 1826	+	+	+	+
6. Odostomia pallida Montagu	0	0	0	+
7. Parthenina intarstincta Montagu, 1803	+	0	0	+
8. Proneritula westerlundi Brusina, 1900	0	0	0	+
9. Retusa truncatella Locard, 1892	+	0	+	+
10. Tritia reticulata Linne, 1758	0	0	0	+
Lamellibranchiata, S.Bivalvia				
1.Arca tetragona Poli, 1795	+	0	+	+
2. Cerastodermaglaucum Poiret, 1789	0	0	0	+
3. Anadara inaequivalvis	+	+	+	+
4. Chamelea gallina Linne, 1758	+	+	+	+
5. Lentidium mediterraneum Costa, 1829	+	+	+	+
6. Lucinella divaricata Linne, 1758	+	+	0	+
7. Mactra corallina Lnne, 1758	0	0	0	+
8. Metilaster lineatus Gmelin, 1790	0	0	0	+
9. Metilus galloprovincialis Lamark, 1819	0	0	0	+
10. Pitar rudis Poli, 1791	+	+	+	+
11. Spisula triangula Reniari, 1804	+	+	+	+
12. Thracia papyracea Poli, 1791	+	0	0	0

Table 11 provides a general list of benthofauna species compositions, which are presented in considerable diversity. A total of 58 species were registered. Among them are 23 species of palolo Polychaetes worms (Polichaeta), as well as mollusks (Molusca - 22 species, followed by crustaceans (Crustacea) - 11 species. As can be seen from the table, the mentioned species of hydrobionts are more or less common in the areas of Batumi, Supsa and Poti. In the case of Anaklia (at a depth of 10-50 m) almost all species of Benthal are registered. As for Mollusk Anadara, it is spread everywhere - in all the indicated depths of Batumi, Supsa, Poti and Anaklia districts.

5 samples were taken from different depths at Anaklia research station; From a substrate of silt, silty sand and shell-containing. After processing of the material, the quantity and biomass of the sample macrozoobenthos were (Table 12) 16255 individual/m^2 and 2911,127 g/m^2.

Table 12

Quantity (ind/m^2) and biomass (g/m^2) of A.inaquelvalvis in Anaklia district
Year: 2016-17-18

Depth	substrate	Macrobenthos		Bivalvia		A.inaquelvalvis	
		piece/ m^2	g/m^2	piece/ m^2	g/m^2	piece/ m^2	g/m^2
14 m	silty sand	220	63,115	120	60,345	10	0,005
17 m	silt	3120	1143,55	2590	1089,71	180	261.0
18 m	silt	200	3,735	50	1.618	20	0,681
19 m	shell-containing	7320	828,985	7150	812,85	170	297,5
20 m	silty sand	5395	871,742	5065	840,36	40	386,3
	total	16255	2911,127	14975	2804.883	420	945.486

At a depth of 14 m the silty sand substrate, quantity and biomass were 220 pcs/m^2 and 63,115 g/m^2. Of these, pcs/m^2 and 60,345 g/m^2 fall on two-headed mollusks (55% and 96%). The number of Anadara and biomass in the settlement of the mentioned substrate was 10 pcs/m^2 and 0.005 g/m^2, which was 8% of the bivalve individuals and 24% of the biomass.

At a depth of 17 m, a silty substrate was observed, the number of macrofauna and biomass amounting to 3120 pcs/m^2 and 1143.55 g/m^2, of which 2590 pcs/m^2 and 1089.71 g/m^2 fall on bivalve mollusks (83% and 95.3%). Among the bivalve mollusks, Anadara owns almost 7% of individuals and 23% of biomass.

In the sample taken from a depth of 18 m, where the substrate silt was fixed, the number of biocenosis macrozoobenthos and biomass were 200 pieces/m^2 and 3,735 g/m^2. Of these, 50 pieces/m^2 and 1,618 g/m^2 fall on bivalve mollusks, which accounted for 25% of the quantuty and 43.3% of biomass. Of the bivalve mollusks, Anadara contains almost 40% (0.681 pieces/m^2) in individuals and 42% (0.681 g/m^2) in biomass. In the sample taken from a depth of 19 m (shell substrate) the quantity and biomass of the biocenosis' macrozoobenthos were 7320 pieces/m^2 and 828,985 g/m^2. Of these, 7150 individual/m^2 and 812.85 g/m^2 fall on bivalve mollusks, which accounted for 98% of the quantuty and 98% of biomass. The number of bivalve mollusks belonging to Anadara was 2% (170 pieces/m^2) and 37% (297.5 g/m^2) biomass.

In the sample taken from a depth of 20 m, where the substrate silt was fixed, the number of biocenosis macrozoobenthos and biomass were 5395 pieces/m^2 and 871,742 g/m^2, Of these, 5065 pieces/m^2 and 840,36 g/m^2 fall on bivalve mollusks, which accounted for 94% and 96,4%. The number of bivalve mollusks belonging to Anadara was 1% (40 pieces/m^2) and 46% (297.5 g/m^2) biomass.

We believe that a basis for very important reasoning is given by the aggregate data at different depths and ground type conditions. The total number of biocenosis and biomass of the research station - Anaklia was 16255 pieces/m^2 and 2911.127 g/m^2, of which 14975 pieces/m^2 and 2804.883 g/m^2 (92% and 96%) are bivalve molluscs. 3% -34% of them come from Anadara (420 pieces/m^2 and 945,486 g/m^2).

As for the qualitative and quantitative share of mollusk anadara in general and specific biocenoses, it is quite important, which is due to the fact that it is quite resistant to positive or negative bio-ecological factors. For him, the positive living environment is a silty, silty-sand habitat (biotope). It is quite resistant to variability in the concentration of oxygen dissolved in water. May exist for a short time during hypoxia. As a filtrate, it is also resistant to contamination of the reservoir with organic matter, which has led to its widespread use in the waters of the Georgian Black Sea shelf.

Table 13

Quantity (ind/m²) and biomass (g/m²) of A.inaquelvalvis in Batumi district year: 2016-18

Depth	substrate	Macrobenthos		Bivalvia		A.inaquelvalvis	
		piece/ m²	g/m²	piece/ m²	g/m²	piece/ m²	g/m²
14m	sand	730	103,595	560	98,6	10	1,85
11m	silty sand	470	163,277	370	160,303	30	97,2
	Total	1200	266.872	390	258.903	40	99.05

The total number of biocenosis and biomass of the research station - Batumi was 1200 pieces/m^2 and 266,872 g/m^2, of which 390 pieces/m^2 and 258,903 g/m^2 (33% and 97%) are bivalve mollusks. 10% -38% of them come from Anadara (40 pieces/m^2 and 99.05 g/m^2) (Table 13).

Sand and silty sand substrate are fixed in Batumi biocenosis. The substrate is known to determine the biodiversity of benthic fauna. In the case of Batumi, sand and silty sand are mainly formed by mollusks, dominated by *Lamelabranchiata* or *Bivalvia*. The biocenosis of sand is dominated by bivalves, the number of which is equal to 560 pieces/m^2 , and biomass 98.6 g/m^2. The silty sand substrate gives a similar picture: the dominant is again bivalves 370 pieces/m^2, and biomass - 160,303 g/m^2.

In the biocenosis of Supsa a substrate of sand and silt is observed. In the case of Supsa, silt and sand are mainly formed by bivalve mollusks and crustaceans. The biocenosis of silt is again dominated by bivalves with a number equal to 140 pieces/m^2. Their biomass was 5.701 g/m^2. The next position in the biocenosis of the silt substrate is occupied by crustaceans with biomass of 6.623 g/m^2 (40 pieces/m^2). The sand substrate gives a different picture. Here, too, the dominant is still bivalves in number - 2110 pieces/m^2, and with biomass 261.64 g/m^2 (Table 14).

Table 14

Quantity (ind/m²) and biomass (g/m²) of A.inaquelvalvis in Supsa district
Year: 2016-17-18

Depth	substrate	Macrobenthos		Bivalvia		A.inaquelvalvis	
		piece/ m^2	g/m^2	piece/ m^2	g/m^2	piece/ m^2	g/m^2
22m	sand	2200	269,459	2110	261,64	30	134,807
17m	silt	210	12,364	140	5,701	10	2,3
	Total	2410	281,823	2250	267,341	40	137,107

The sample and biomass of biocenosis macroeobenthos in the sample taken from the depth of 22 m at Supsa station were 2200 pieces/m^2 and 269,459 g/m^2. Of these, 2110 pieces/m^2 and 261.64 g/m^2 fall on bivalve mollusks, which accounted for 96% of the number and 97% of biomass. From bivalve mollusks Annadara accounts for 1% (30 pieces/m^2) and 52% of biomass (134,807 g/m^2).

In the sample taken at a depth of 17 m at the Supsa station, where the substrate silt was fixed, the number of macrozoobenthos and biomass in the biocenosis amounted to 210 pieces/m^2 and 12,364 g/m^2, respectively. Of these, 140 pieces/m^2 and 5,701 g/m^2 fall on bivalve mollusks, which accounted for 67% and 46%, respectively. Bivalve mollusks accounted for 7% (10 pieces/m^2) and 40% (2.3 g/m^2) for biomass (Table 14).

Table 15 shows the quantitative index of species of benthic organisms in the materials obtained under different depths (16 m, 15 m) and in different soil (silt, sand/silt) conditions within the Poti water area.

Table 15

Quantity (ind/m²) and biomass (g/m²) of A.inaquelvalvis in Poti district
Year: 2016-18

Depth	substrate	Macrobenthos		Bivalvia		A.inaquelvalvis	
		piece/ m^2	g/m^2	piece/ m^2	g/m^2	piece/ m^2	g/m^2
15m	silty sand	410	74,646	350	67,766	10	20,01

16m	silt	90	3,4403	80	3,44	20	0,81
	Total	500	78,0863	430	71,206	30	20,82

At almost equal depths, where the difference was only 1 m (Table 15), the species diversity of biocenosis changes dramatically in the case of different substrates (silt substrate, silty sand). The amount of 90 piece/$m^2$was observed in the silt substrate, with biomass 3.4403 g/m^2, where mainly bivalve mollusks dominate 3.44 g/m^2.

In the sample taken at a depth of 15 m at the Poti station, where the substrate silty sand was fixed, the number of macrozoobenthos and biomass in the biocenosis amounted to 410 pieces/m^2 and 74,646 g/m^2. Of these, 350 pieces/m^2 and 67,766 g/m^2 fall on bivalve mollusks, which accounted for 85% of the total and 91% of the biomass. Among the bivalve mollusks Anadara accounted for 3% (10 pieces/m^2) and 30% (20,01 g/m^2) for biomass.

In the sample taken at a depth of 16 m at the Poti station, where the substrate silt was fixed, the number of macrozoobenthos and biomass in the biocenosis amounted to 90 pieces/m^2 and 3,4403 g/m^2. Of these, 80 pieces/m^2 and 3,44 g/m^2 fall on bivalve mollusks, which accounted for 89% and 99%. Among the bivalve mollusks Anadara accounted for 25% (20 pieces/m^2) and 24% (0,81 g/m^2) for biomass

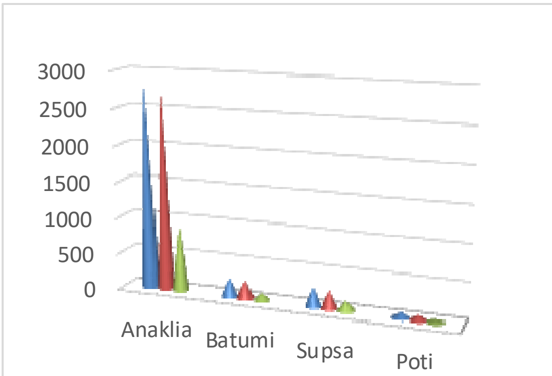
The total number of biocenosis and biomass of Poti research station was 500 pieces/m^2 and 78,0863 g/m^2. Of these, 430 pieces/m^2 (86%) and 71,206 g/m^2 (91%) are bivalve mollusks, of which 7% and 29% (30 pieces/$m^2$and 20.82 g/m^2) come from Anadara.

Table 16

Total quantity (ind/m^2) and biomass (g/m^2) of A.inaquelvalvis at Anaklia, Batumi, Supsa and Poti stationary stations
Year: 2016-17-18

Depth		Macrobenthos		Bivalvia		A.inaquelvalvis	
		piece/ m^2	g/m^2	piece/ m^2	g/m^2	piece/ m^2	g/m^2
1	Anaklia	16255	2911,127	14975	2804.883	420	945.486

2	Batumi	1200	266,872	390	258,903	40	99,05
3	Supsa	2410	281,823	2250	267,341	40	137,107
4	Poti	500	78,0863	430	71,206	30	20,82
	Total	20365	3537,9083	18045	3402,333	530	1202,463



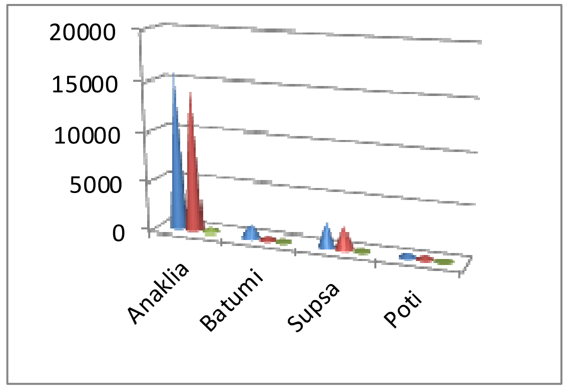


Figure 11 and 12. Total quantity (ind/m2) and biomass (g/m2) of A.inaquelvalvis at Anaklia, Batumi, Supsa and Poti stationary stations. Year: 2016-17-18

Based on the final analysis of the materials obtained from different stationary stations (Anaklia, Batumi, Supsa, Poti) (Table 16; Figure 11,12) we can conclude that the number of biocenosis and biomass amounted to 20365 piece/m^2 and 3537,9083 g/m^2, of which 18045 piece/m^2 and 3402,333 g/m^2 (89% and 96%) are bivalve mollusks, of which 3% and 35% come from Anadara (530 piece/ m^2 and 1202.463 g/m^2).

According to the table and figure data, the number of individuals in biocenosis and biomass may be expressed as a percentage:

- Anaklia - 80% of the total number of individuals in Macrobenthos, 82% in biomass, 83% and 82% in bivalves, 79% and 79% in Anadara.
- Batumi - amount of macrobenthos 6%, biomass 8%; Among them, bivalves 2% and 8%, A.inaquelvalvis 8% and 8%.
- Supsa - Macrobenthos - 12%, Biomass - 8%, including bivalves 12% and 8%, A.inaquelvalvis - 8% and 11%.

- Poti - in Macrobenthos the number of individuals is 2%, biomass - 2%, including 2% and 2% for bivalves, and A.inaquelvalvis - 6% and 2%.

Thus, the mollusk Anadara, which is distributed in the Georgian shelf of the Black Sea, is widespread everywhere.

Results of Mollusk Anadara Biochemical Research

Determination of protein, fat, carbohydrates,

Constant weight, embers

In July 2019, 2 kg raw samples of Anadara in a frozen condition were transferred to the biochemistry laboratory of Batumi Shota Rustaveli State University. Based on biochemical research, the percentage composition of moisture, embers, fat, carbohydrates and protein in mollusk meat was studied.

Table 17

The result of biochemical research of Anadara inaequivalvis

Sample №	Mass fraction of moisture%	Dry matter by drying%	Embers %		Fat, %		Carbohydrates, %		Protein,%	
			Raw	Dry	Raw	Dry	Raw	Dry	Raw	Dry
1	80,14	19,86	1,04	5,26	1,22	6,17	2,5	12,64	14,1	71,28
2	80,30	19,70	1,16	5,86	1,17	5,92	2,4	12,13	13,5	68,25
Average	80,22	19,78	1,1	5,56	1,20	6,04	2,45	12,39	13,8	69,77

In Table 17, the first and second lines show the results of the parallel analysis of the two samples, and the third line shows the arithmetic mean.

The data obtained based on the analysis of the research results are presented in Table (Table 17), where a detailed analysis of mollusk meat (sample) was performed simultaneously. The percentage ratio of dry to raw weight of the substance was determined.

Determination of moisture. The water content was determined by drying the sample at + 50-60 ° C (arbitration method). This method is used to determine the content of fish, marine mammals, invertebrates, algae, as well as the water produced in them. The mollusk meat was weighed and placed in a BioBase sublimation laboratory drying cabinet, where it was reduced to a constant weight at a temperature of +50 - +60°C. As a result of the arbitration method, it was found that the mass fraction of moisture per 100 g of product in the material taken from both samples was 80.22% on average, therefore, 19.78% of the dry matter.

Embersing was made by dry method - + 550-600°C in a muffle oven; The percentage of ash was determined on dry and raw material by dry weight method. The average for both samples was 1.1% for the raw sample and 5.56% for the dry sample.

Fat was determined by the soxlet method. We used chloroform as a diluent. Sample extraction took approximately 24. The amount of fat was determined by the weight method (J.Chem.Educ. 2007. Vol. 84, no.12. P.1913-1914). We poured 200 ml of diluent into the prepared soxlet, placed the pre-made sample in the capsule, checked the apparatus for hermetic seal and connected the cooling pipes (necessary to create condensate). We put it on the stove. We used chloroform as a diluent. Sample extraction took approximately 24 hours until the liquid inside was discolored. Then we placed "Biuks" with the extract in a water bath until diluent evaporation – until smell disappearing which is characterised for diluent, then we placed it in a preheated dryer at + 100°C for 10 minutes, cooled in a desiccator and weighed the obtained fat on a laboratory scaleAs a result, the average fat content was 1.20% for raw materials and 6.04% for dry matter.

In order to study **carbohydrates,** the total sugar content was determined by the caliperi-cyanide method, free carbohydrates were defined in the meat, to which belongs sugar. As a result, the average carbohydrate content was 2.45% for raw weight and 12.39% for dry matter.

The **protein** content in mollusk meat was determined by the Keldal method. While the titration method determined a specific quantity. As a result, the average amount of protein was 13.8% from the raw material and 69.77% from the dry matter.

Analysis results of trace elements (Zn, Pb, As, Cd, Cu), hexachlorocyclohexane, DDT and its metabolites

Zink. The bivalve mollusk Anadara is known as a filter-sedimenter, and based on this important information, we aim to test Anadara's meat in the appropriate laboratory, where a sample of 1 kg mollusks with the shell was sent as a result of electrometric atomic absorption spectrometry. Using the appropriate method (МУК 4.1.991-00) the zinc content in meat was 13,370 mg / kg. If we compare it with other seafood, for example: oysters - 40 mg, anchovy - 1.72 mg, octopus - 1.68 mg, carp - 1.48 mg, caviar - 1 mg, herring - 0.99 mg, mussels - 21 mg (Table 18).

Table 18

Zinc content in aquatic organisms

	oyster	anchovy	octopus	carp	caviar	herring	mussel	anadara
Zn mg / kg	40	1,72	1,68	1,48	1	0,99	21	13,3

Lead. Using the appropriate electrometric atomic absorption spectrometry method (МУК 4.1.986-00) determined that the lead (Pb) content in Anadara meat was 0.10 mg / kg ± U0.03 mg / kg. According to the maximum permissible concentration obtained in Georgia, as the norm is 0.3 mg / kg, based on the obtained result, we can conclude that the lead in the mentioned hydrobiont does not exceed the norms set by the standard, therefore, according to this parameter, Anadara is acceptable for use.

Arsenic. Using the graphite cuvette for atomic absorption spectrometer method (argon gas) GOST R 51766 - 2001 the content of arsenic (As) in the mollusk meat sample was determined - 0.2705 mg / kg, which does not even reach the allowed norm X = 5.0 mg / kg.

Cadmium. The goal was to test the cadmium content of Anadara mollusk meat as well. Anadara meat was tested for cadmium content in the laboratory using atomic absorption spectrometer МЧК 4.1.986-00. The sample showed 0.5779 mg / kg of cadmium (Cd), which does not reach the allowed norms X = 1.0 mg / kg.

Copper. Anadara meat was tested using the atomic absorption spectrometer МЧК 4.1.991-00. The sample showed copper (Cu) content - 1.1685 mg / kg, which does not reach the allowed norms X = 10.0 mg / kg. In view of the above, according to this parameter, its meat is acceptable for consumption.

Hexachlorocyclohexane. Since Anadara is a filter-sedimenter and often its place of extraction and habitat is the area of rivers flowing into the sea, we were interested in determining the content of hexachlorocyclohexane in it. The content of hexachlorocyclohexane (α, β and γ isomers) was studied in the laboratory using the appropriate method (Thermo Fisher scientific method 63899), which turned out to be <0.002 mg / kg. This value is a limit of <0.002 mg / kg. As long as this dose is not dangerous for humans, we can say with certainty that Anadara's meat is safe in this regard.

DDT and its metabolites. As mentioned, Anadara is a filter and often its extraction and habitat is in the vicinity of rivers and canals flowing into the sea. Thus, we conducted the study according to this parameter as well (Thermo Fisher scientific method 63899). Anadara's meat analysis showed that DDT and its metabolites is <0.007 mg / kg. The maximum allowable concentration is <0.002 mg / kg. The result obtained is less than the allowable value. Thus, we can confirm that the object of study – Anadara's meat is not a threat to humans.

Conclusions:

1. Quantitative (piece/m^2) and biomass (g/m^2) indicators of Anadara (Anadara inaeqiuvalvis) according to different depths and seasons in the Black Sea coastal area of Georgia (Batumi-

Anaklia), in pre-selected stationary areas (Gonio, Batumi, Chakvi , Mtsvane Kontskhi, Kobuleti, Poti, Anaklia) were found to be somewhat different from the studies conducted.

2. It has been established that Anadara has a special attitude towards the condition of the seabed. It prefers silty, sandy and solid ground habitats. It creates a special ecological biocenosis, such as: psammophile, pelophile or psalm-pelophile zoocenosis.
3. 3. It has been established that in the study region (Batumi-Anaklia) at different depths of the sea benthic (5–50 m), in different soil conditions (silt, silty sand and shell soil) mollusk anadara, unlike other hydrobionts, is widespread wherever it Often occupies a dominant position. It is especially widespread in the Anaklia area, which should be explained by the fact that the structure of Anaklia soil is very peculiar compared to other districts. It is represented by sustainable silt-sand and silty soils, making it the best habitat for Anadara, where it lives in a partially hidden state.
4. Dynamics according to depth and salinity were studied. We can outline Anadara distribution levels by shelf and region. Based on the results of a case study, we found that the distribution of Anadara in the Black Sea depends primarily on the salinity of the water. In particular, where there is less influence of the rivers, there were more specimens of Anadara.
5. Based on the quantitative study of Anadara, it was found that the rates were relatively high in the deep waters of Mtsvane Kontskhi, Gonio, Kobuleti and Poti shelf waters. In particular, 100-600 piece/m^2 were recorded at a depth of 3-5 meters in the Mtsvae Kontskhi water area; In Kobuleti water area at a depth of 20-40 meters - 31-401 pieces/m^2; 134-346 pieces/m^2 were observed at a depth of 7-8-40 meters in Gonio district; In Poti water area at a depth of 40 meters - 661 pieces/m^2. The results obtained should be explained by the fact that the salinity of seawater in these areas is relatively stable and it is 14-18 per mille. Relatively low rates were observed in Anaklia, Batumi and Chakvi districts. This result should be due to the reduction of seawater salinity caused by the influence of freshwater from the Chorokhi, Chakvistskali and Enguri rivers.

6. It has been established that Anadara is quite resistant to water oxygen variability. As a filtrate, is also resistant to contamination of water by organic matter. Thus, it can be considered as a certain indicator for determining water quality, It should also be noted that it is, to some extent, involved in the natural self-cleaning process of water pollution.

7. Despite the different situation in a particular area, it can be concluded that Anadara is characterized by some stability within the waters of the Black Sea coast and its considerable reserves allow for its industrial cultivation.

8. An analysis of the results of a size-weight study to assess the nutritional value of Anadara in the Black Sea revealed the ratio of body length to total (raw) weight, meat weight, as well as raw body weight and meat weight of Anadara inaequivalvis. In particular, it was revealed that he size / weight ratio was 83% for large specimens (49-75 mm) and 32.3% for small specimens (27.4-51.1 mm). As for the ratio of raw body weight to meat weight, there is a certain regularity - the weight of meat is about three times less than the size of the body.
9. Based on the study of the biological status of Anadara, it was determined that it is actively involved in the formation of the overall biocenosis structure of the benthic fauna in the reservoir ecosystem, where it is one of the biocomponents. However, the mass fraction in determining the quantitative composition of the benthic fauna is important. Sometimes it is dominant with high quantitative composition.
10. Based on biochemical research, the content of energy substances: proteins, fats, carbohydrates in the muscular part of Anadara was determined, which determines the suitability of meat as one of the food objects in the human ration. In this regard, it is particularly important in filling the deficiency of protein and natural amino acids, which is several times higher than in other marine hydrobiotics.

11. Important trace elements were identified in Anadara meat, such as: iron, zinc, calcium, sodium and kalium, which were found to be much higher in Anadara than in sea fish meat.

12. The content of toxic substances, - heavy metals (lead, cadmium, arsenic, copper, hexachlorocyclohexane, DDT and its metabolites) in Anadara's body was also determined. It was found that their number in Anadara's body is very small, does not exceed the norms allowed by the standard and it is acceptable to be used for food.

13. The qualitative and quantitative share of mollusk anadara in common and private biocenoses is quite important, which is due to the fact that it is quite resistant to positive or negative bio-ecological factors. For him, the positive living environment is a silty, silty-sand habitat. It is quite resistant to variability in the concentration of oxygen dissolved in water. May exist for a short time during hypoxia. As a filtrate, it is also resistant to contamination of the reservoir with organic matter, thus it is fed and, together with other filtrates, participates in the self-cleaning process of the reservoir. Thus, Anadara plays a role in maintaining the biocenosis structure of the reservoir and contributes to its widespread distribution in the Georgian Black Sea shelf area.

Recommendation

The results of the bioecological study of the bivalve mollusk - Anadara inaequivalvis of the Black Sea coast of Georgia provide the basis for its industrial cultivation. According to the results of the study of the biochemical composition of Anadara, it is an important product for increasing the diversity of the human ration in order to fill the protein deficiency.

Anadara is characterized by some stability within the waters of the Black Sea coast of Georgia (despite the different conditions in some parts of its distribution) and its considerable share provides an opportunity for industrial cultivation, in particular, to think about its introduction into aquaculture.

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