N E W S
OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN
SERIES OF BIOLOGICAL AND MEDICAL
ISSN 2224-5308
Volume 4, Number 340 (2020), 52 – 61 **https://doi.org/10.32014/2020.2519-1629.32**

UDC 504.05:62/69
IRSTI 87.15.91

A. Kenzhegaliyev[1], A. A. Abilgaziyeva[1], A. K. Shakhmanova[1], A. Sh. Kanbetov[1], D. K. Kulbatyrov[1], V. F. Zaitsev[2], M. K. Urazgaliyeva[1]

[1]Non-profit JSC «Atyrau Oil and Gas University named after S. Utebayev», Atyrau, Kazakhstan;
[2]Astrakhan State Technical University, Astrakhan, Russia.
E-mail: akimgali_k@mail.ru; aaaina77@mail.ru; ashk.69@mail.ru; a.kanbetov@mail.ru; dkkd@mail.ru; viacheslav-zaitsev@yandex.ru; mira_090578@mail.ru

THE CONDITION OF HYDROBIONTS NEAR KASHAGAN FIELD AREA

Abstract. The study results of the condition of hydrobionts near the artificial islands, where oil and gas fields of "Kashagan" are under development and which was conducted during spring and autumn periods of 2018, showed that 173 species of algae were found in spring as part of phytoplankton and 19 species less, i.e. 154 in autumn. The cyanobacteria outnumbered other species with 51.68%, whereas, diatomic algae predominated in biomass with 80.1%. In 2017 blue-green algae was the largest in number, diatomic algae predominated in biomass in 2017, as well as in 2018.

As a part of zooplankton presence of 24 taxons in spring and 23 species in autumn was detected. During study period the other species of zooplankton predominated with 67.79% in number and 95.1% in biomass. The seasonal dynamics of zooplankton described above generally repeated that of 2017, when from spring to autumn there was also a decrease in diversity and a growth in the number of zooplankton.

It was found 50 taxons in zoobenthos during both spring and autumn studies. Basically, this number was formed by worms - 72.54%, whereas biomass was predominated by mollusks - 40.26% of the total biomass.

The number and biomass of bottom invertebrates were higher in spring 2017 and lower in autumn than in the corresponding seasons of 2018.

Key words: NCOC, «Kashagan» field, artificial islands, phytoplankton, zooplankton, zoobenthos.

Introduction. Offshore oil production is an essential component of the world's energy supply [1,2]. It requires the use of increasingly sophisticated technologies and increasing attention due to its harmful effects on the environment. The Kashagan field is one of the largest fields in the world discovered in the last 40 years, as well as the largest oil field at sea [3].

Development of the deposit is carried out under difficult conditions: shelf zone, unfavorable combination of shallow water conditions and ice formation (about 5 months per year), eco-sensitive zone, large depths of deposit occurrence (up to 4800 m), high formation pressure (80 MPa), high content of hydrogen sulfide (up to 19%) from artificial islands [4,5].

Considering that the area of deposit location is productive of not only hydrocarbon fuel, but also biodiversity of the sea, i.e. there is a reproduction process of semi-passing ichthyofauna and their feed capacity, it becomes significantly important to monitor them. This work is devoted to the study of the latter.

Researches on the condition of hydrobionts (phytoplankton, zooplankton and zoobenthos) in this area began from the moment of oil exploration [6-11].

The development of phytoplankton depends on many factors, the author of the work [4] has established a close relation with the volume of the Ural River, as well as salinity of water for diatomic algae. Research [9] reports that it depends primarily on the temperature and presence of biogens (silicon and phosphorus). In recent decades, phytoplankton dynamics have been influenced by rising sea levels.

The author of the work [7] studied seasonal dynamics and established the following: from spring to summer the number of cladocera crustaceances increased 12.7 times, biomass increased 8.8 times and the reduction of the number and biomass from summer to autumn. It is reported in the research work [10] that the monitoring did not reveal significantly negative changes in the composition, distribution and productivity of zooplankton in the North-East Caspian Sea. The dynamics of zooplankton biomass reflected the natural processes, which are typical for inter-annual changes in the abundance of plankton invertebrate animals.

The results of long-term research of bottom organisms of the north-eastern part of the sea make it possible to do the following: it states in [8] that the distribution of benthos is determined primarily by the type of soils, salinity and gas regime of the bottom layer. During whole period of study, the "Kashagan" structure was predominated by worms on average by 60% and crustaceans by 38% in number and mollusks on average by 50% in biomass.

As a result of the conducted research, it was revealed that the largest biomass was observed in the spring period. There was a decrease in the mass of bottom organisms from spring to summer. According to the data of multi-year observations in work [11] the species composition of bottom fauna is relatively stable. Seasonal and multi-year dynamics of zoobenthos number are mainly due to natural factors.

The condition of the bottom population of invertebrate animals at the fields, in general, is comparable to its condition at the control stations. Local changes in the composition of bottom sediments, for example, an increase in the share of fine fractions in the construction area of artificial islands leads to a decrease in the share of large forms of benthos (shellfish) and, in some cases, to a decrease in the overall abundance of the bottom population of organisms. Generally, exposed area is small, being limited to a radius of up to 700 meters. After completion of the construction, the composition and abundance of bottom communities are restored quite quickly - within 1-2 years.

The authors of the research works [12,13] revealed that the summer distribution of phytoplankton in the area of artificial island D at the Kashagan field is subjected to general patterns of the Northern Caspian Sea. From year to year, there may be differences in its composition, which mainly depends on the inter-annual variability of the hydrological and hydrochemical regime of water. Among all the members of zooplankton species in this part of the sea, copepoda crustaceans are turned out to be the largest mass group. Variation of taxonomic composition of zoobenthos and its quantitative characteristics, predominance of certain groups in biomass and number in its composition on observation stations of the water area of Kashagan field's Island D were primarily related to hydrological and hydrochemical conditions of habitat (among which salinity is on the first place) and type of soil.

The study [14] states that the structure of phytoplankton depended on a number of natural and anthropogenic factors. The lowering of sea level was favorable for the main algae divisions. Decreasing concentrations of some pollutants in the water had a positive effect on blue-green and partly green algae.

There was a non-linear inter-annual trend of reduction of the average individual weight of the zooplancter throughout all seasons. Considering the increase in zooplankton quantities, this may indicate an increase of eutrophication processes in the context of a sea level decline. Most of the external factors did not have a statistically significant impact on the inter-annual and spatial dynamics of plankton invertebrates.

From 2006 to 2016, there was a tendency of a decrease of the average annual values of the macrosoobenthos quantity during irregular inter-annual changes in the biomass value [15]. The number of small-sized autochthonous polychets M.caspica, H.kowalewskii and oligochet decreased the most. The inter-annual dynamics of macrosoobenthos population depended on changes of natural factors, primarily of hydrological (sea level change) and hydrochemical (salinity) parameters. The impact of anthropogenic factors on the structure of macrosoobenthos was local.

The purpose of the research is to monitor the dynamics of change of hydrobionts in the hydrocarbon fuel production area and assess their condition.

Object and methods of research. The object of the study is the Kashagan field area.

Phyto and zooplankton samples were taken from the surface layer of water, whereas zoobenthos was taken from the bottom by a known technique and fixed with 4% formalin. Then they were concentrated by sedimentary method [16-19] and these samples were processed by conventional methods in laboratory conditions [20-22], where the following parameters were determined: composition of species, number of species - million cl. per cubic meter, biomass – mg. per cubic meter of algae; taxonomic composition,

number (ex. per 1 m^3) and biomass (mg. per 1 m^3) of zooplanktons; taxonomic composition, number (ex. per 1 m^2) and biomass (mg. per 1 m^2) of zoobenthos.

Results and discussion. Samples were taken from 9 stations during spring and autumn periods and were delivered to an accredited laboratory after fixation. The results of the study are given below.

The condition of phytoplankton. The species composition for 2018 is given in table 1.

173 species of algae were found as a part of phytoplankton in spring 2018 and composed of 34 blue-green, 106 diatomic, 5 miozoa, 1 ohrophite, 25 green and 2 egglene.

154 species of algae were found as part of phytoplankton in autumn 2018 and composed of 26 blue-green, 89 diatomic, 6 miozoa, 1 ohrophite and 32 green.

The number of species decreased by 19 by autumn, but/however 2 species detected which were not found in spring and 3 species were not found which were detected in the spring study.

Table 1 – Species composition of phytoplankton by seasons of 2018 [20]

Species composition	Number of species	
	spring	autumn
Cyanophyta / blue-green	34	–
Bacillariophyta / diatomic	106	89
Dinophyta / dinophyta	5	–
Ochrophyta / ochrophyta	1	1
Chlorophyta / green	25	32
Euglenophyta / euglena	2	–
Cyanobacteria	–	26
Miozoa	–	6
Total	173	154

M contortum green algae, diatomic *C. choctawhatcheeana, N cryptocephala*, blue-green *M Punctata* were the most widespread in the studied water area in spring.

The total number of phytoplankton varied from 247 to 5353.8 million cl/m^3, with an average value of 933.2 million cl/m^3. Blue-green algae predominated in number, among of which *A.clathrata* (11%) and *L.limnetica* (14%) were the most.

The biomass of phytoplankton ranged from 112 to 3035 mg/m^3, with an average value of 874.8 mg/m^3. Diatomic predominated in biomass, the share of which was 82% in the total. Large-cell species *C.jonesianus* (22%) and *C.clypeus* (9%) have the largest contribution in biomass formation.

Blue-green algae species of *P.limnetica, G.laxissima, M punctata, Phormidium sp., P.contorta*, diatomic *C.choctawhatcheeana, C.meneghiniana*, green *B.lauterbornii, B.lauterbornii var.crassa* met on the most part of water area or throughout the water area in autumn.

The following species are common:

In spring from the group of Cyanophyta - *Lyngbya contorta – 53%, Merismopedia punctata – 62%, Microcystis pulverea f pulverea- 30%, Merismopedia minima – 30%, Lyngbya limnetica – 47 %, Phormidium tenue – 32%, Spirulina laxissima – 36%;*

– from group of Bacillariophyta - *Amphora coffeaeformis-53%, Cyclotella meneghiniana-57%, Diploneis Smithii – 51%, Navicula cryptocephala – 62%, Navicula radiosa – 34%, Navicula salinarum – 47%, Nitzschia tenuirostris – 32%, Nitzschia tryblionella – 34%, Sellaphora pupula – 55%;*

– from group of Dinophyta - *Gymnodinium variabile – 43%, Peridiniopsis polonica – 38%;*

– from group of Chlorophyta - *Monoraphidium arcuatum – 34%, Monoraphidium contortum - 87%, Monoraphidium griffithii - 36%, Planctonema lauterbornii – 49%;*

In autumn from the group of Cyanobacteria - *Anathece clathrata-55%, Aphanocapsa incerta – 66%, Chroococcus minimus – 70%, Chroococcus minutus – 57 %, Glaucospira laxissima – 96 %, Merismopedia minima – 77%, Merismopedia punctata – 98%, Oscillatoria amphibia – 77 %, Phormidium sp. -94%, Planktolyngbya contorta - 96%, Planktolyngbya limnetica – 100%;*

– from group of Bacillariophyta - *Actinocyclus octonarius – 36%, Caloneis amphisbaena – 30 %, Campylodiscus araliensis – 57%, Campylodiscus clypeus – 40%, Coscinodiscopsis jonesiana – 62%,*

Cyclotella choctawhatcheeana – 94%, Diploneis interrupta – 60%, Diploneis ovalis – 62%, Diploneis Smithii – 62%, Halamphora coffeiformis – 66%, Halamphora veneta - 36%, Haslea spicula -47%, Hyalodiscus sphaerophorus – 34%, Navicula cryptocephala – 74%, Navicula radiosa – 45%, Navicula rhynchocephala – 47%, Navicula salinarum – 74%, Navicymbula pusilla – 36%, Nitzschia tenuirostris – 68%, Podosira parvula – 53%, Proschkinia longirostris – 36%, Sellaphora pupula – 47%, Thalassiosira caspica – 68%, Tryblionella apiculata – 79%, *Tryblionella debilis* – 72%;

- from group of Miozoa - *Prorocentrum cordatum* - 64%;
- from group of Ochrophyta - *Mallomonas sp. – 57%;*
- from group of Chlorophyta - *Binuclearia lauterbornii* – 98%, *Binuclearia lauterbornii var.crassa* - 94%, *Chlorella vulgaris* - 70%, *Monoraphidium contortum* - 87%, *Monoraphidium griffithii* – 36%.

As it can be seen from these tables, the number of algae increases from spring to autumn during the study period. During autumn research the following spring algae were absent - blue-green, dinophytic and euglene, on the contrary there appeared other cyanobacteria and mioza.

Cyanobacteria having 51.68% predominated in number, blue-green having 30.4% was the second and the green ones having 10.31% was the third (figure 1). Figure 2 shows a chart in biomass, where diatomic predominated with 80.1%, then goes green with 8.44% and cyanobacteria with 7.7%.

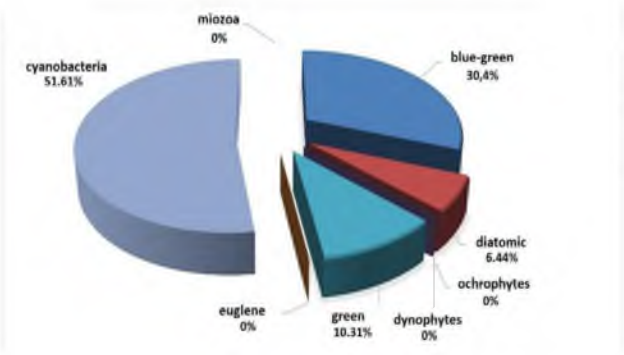

Figure 1 – Average number of main divisions of phytoplankton in % for 2018

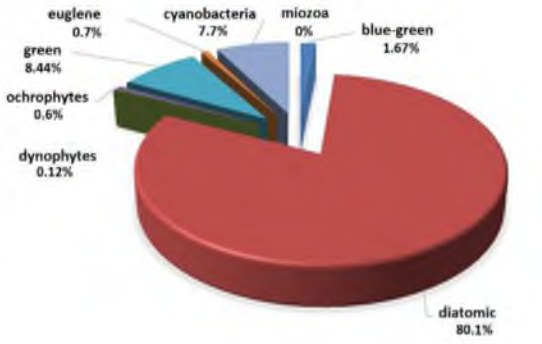

Figure 2 – Average biomass of main divisions of phytoplankton in % for 2018

The condition of zooplankton. 24 taxons were found as part of zooplankton, 8 of them were rotifer, 3 were cladocera, 7 were copepoda, 6 were other species in spring 2018 and 23 species were present in autumn study. The rotifer decreased from 8 to 3 species, whereas number of copepoda remained unchanged. Cladocera species were not detected, but the number of other species increased by 7 (table 2).

Table 2 – Species composition of zooplankton by seasons of 2018 [12]

Species composition	Number of species	
	Spring	autumn
Rotatoria / rotifera	8	3
Cladocera /cladocera	3	–
Copepoda / copepoda	7	7
Others /others	6	13
Total	24	23

As it can be seen from spring period of this table there were Brachionus quadridentatus – 49% and Synchaeta vorax – 38% from rotifera species, Podonevadne camptonyx – 38% and Podonevadne trigona – 43% from cladocera species, Acartia tonsa – 84%, Calanipeda aquae-dulcis – 100%, Halicyclops sarsi – 34% from copepoda species, Bivalvia gen.sp. – 83%. Cirripedia gen.sp. – 62% and Hediste diversicolor – 30% from other species.

In autumn period there were Brachionus quadridentatus - 40% from rotifera species, Acartia tonsa - 100%, Calanipeda aquae-dulcis - 100%, 32% Ectinosoma concinnum and 32% Harpacticoida gen.sp.

from copepoda, Bivalvia gen.sp - 47%, Cirripedia gen.sp.- 40%, Hediste diversicolor – 53% and Spionidae gen.sp. – 98% from the other species.

During the research period other zooplankton species predominated in the sea area with 68 060 pcs/m^3, copepoda were the second with 27345 pcs/m^3 and rotifera was the third with 4891 ec/m^3 (figure 3, 4).

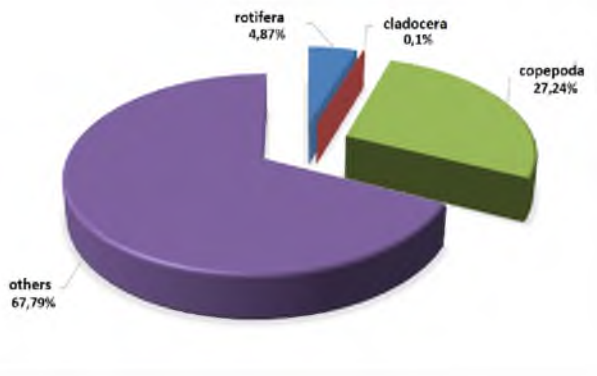

Figure 3 – The number of main zooplankton groups in % for 2018

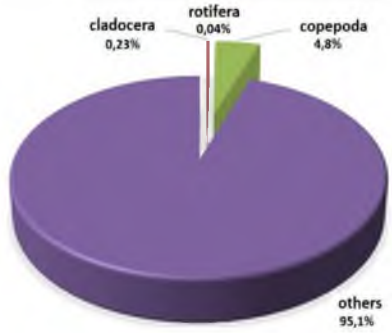

Figure 4 – The biomass of main zooplankton groups in % for 2018

Other species had 3942.6 mg/m^2 of biomass or 95.1% in number, copepoda crustaceans with 191.34 mg/m^2 or 4.6% occupied the following position and biomass of other species did not reach 1%.

The condition of macrzoobenthos. 50 taxons from 4 groups were detected during spring studies: worms - 7, shellfish - 9, crustaceans - 32, others - 2 (table 3). H. diversicolor, Oligochaeta gen sp., H. kowalewskii, Pt. pectinata, St. (St.) similis и St. graciloides met everywhere.

50 taxons from 4 groups were identified in autumn studies as well as in spring studies: worms – 7, shellfish - 10, crustaceans - 28, others - 4. H. diversicolor and Oligochaeta gen. sp. met everywhere. Polychete H. kowalewskii, C. lamarcki mollusc, and Pt. pectinata crustaceans, St. graciloides, G. (Y.) pusilla inhabit on the most part of water area.

Table 3 – Species composition of macrozoobenthos be seasons of 2018 [12]

Species composition	Number of species/taxons	
	spring	autumn
Vermes / worms	7	7
Mollusca / molluscs	9	10
Crustacea / crustaceans	32	28
Insecta / feeding	–	1
Others /	2	4
Total	50	50

The following species often met during spring period: Hediste diversicolor – 99.6%, Hypaniola kowalewskii – 74.3%, Oligochaeta gen.sp. – 98.2% all from group of worms, Abra ovata – 46.5% from group of mollusks, Pterocuma pectinata - 6.0%, Stenocuma gracilis – 49.7%, Stenocuma graciloides – 55.5%, Stenogammarus (Stenogammarus) kereuschi – 39.1%, Stenogammarus (Stenogammarus) similis – 59.3% from group of crustaceans.

During autumn period Nematoda gen.sp. 33,5%, Spionidae gen.sp. – 58,7%, Hediste diversicolor – 100,0%, Hypaniola kowalewskii - 79,2%, Oligochaeta gen.sp. – 98,8% all from the group worms, Abra ovata – 50,1%, Cerastoderma lamarcki – 78,6%, Hypanis angusticostata – 53,9% all from the mollusc group.

The average number of macrozoobenthos was 5045 ex./m^2, with extreme values ranging from 193 to 3660 ex./m^2. This number was formed mainly by worms - 72.54%, with the leading contribution of Oligochaeta gen. sp. (98,2%) и H. diversicolor (99,6%).

The average biomass of the bottom animals was 16507 mg/m^2, with varying range of 3277 to 6646 mg/m^2. Molluscs predominated with 40.26% of the total, worms subdominated - 39.9%. The species of H. diversicolor and D.trigonoides (50% and 15% of benthos biomass, respectively) were the most important (figure 5, 6).

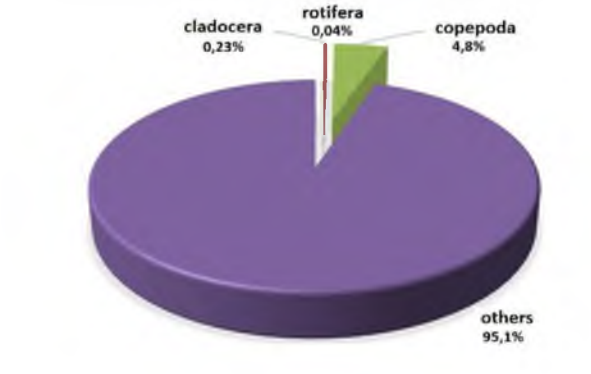

Figure 5 – Number of main groups of zoobenthos in % for 2018

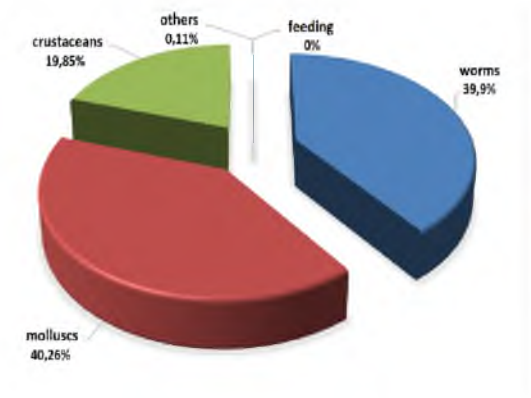

Figure 6 – Biomass of main groups of zoobenthos in % for 2018

Conclusions. Phytoplankton communities were enriched with species from spring to autumn 2018 (number of species per sample increased). In both seasons, blue-green algae predominated in number. Large-cell diatomic algae predominated in biomass.

Similar seasonal dynamics of all structural indicators of phytoplankton was reported in 2017. That year, as well as year later, blue-green predominated in number, diatomic algae predominated in biomass. The absolute values of number and biomass of algae in both years were close.

In 2018, the species wealth of zooplankton did not change significantly. The heterogeneity of the species composition of zooplankton communities, which formed two clusters, reflected the heterogeneity of abiotic factors during spring period. One of significant factors, contributing to the differences in species composition, may be the uneven warm-up of the water thickness at the beginning of the growing season. In autumn, the composition of zooplankton communities was uniform throughout the water area.

From spring to autumn 2018, the quantitative indicators of zooplankton increased by magnitude order.

The seasonal dynamics of zooplankton described above generally repeated that of 2017, when from spring to autumn there was also a decrease in diversity and an increase in the quantitative figures of zooplankton. However, in 2017 the growth of quantitative indicators of the community occurred on account of jellyfish, while in 2018 - on account of polycheta Spionidae.

The values of all structural indicators of macrozoobenthos increased from spring to autumn 2018. The worms made main contribution to the seasonal growth of the community. They predominated in biomass, in the sub-dominant position of shellfish. The diversity of the bottom community was moderate, with some increase in the autumn period.

In contrast to the pattern above, quantitative indicators of macrozoobenthos decreased from spring to autumn of 2017. Worms and mollusks predominated in the community, as in 2018.

The number and biomass of bottom invertebrates were higher in spring 2017 and lower in autumn 2017 than in the corresponding seasons of 2018. Benthos was less diverse and represented by smaller individuals in 2017, than in 2018.

А. Кенжегалиев[1], А. А. Абилгазиева[1], А. К. Шахманова[1],
Д. К. Кулбатыров[1], В. Ф. Зайцев[2], М. К. Уразгалиева[1]

[1]С. Өтебаев атындағы Атырау мұнай және газ университеті, Атырау, Қазақстан;
[2]Астрахан мемлекеттік техникалық университеті, Астрахан, Ресей

«ҚАШАҒАН» КЕН ОРНЫ АУДАНЫНДАҒЫ ҒИДРОБИОНТТАР ЖАҒДАЙЫ

Аннотация. «Қашаган» мұнай-газ кен орнын игеріп жатқан жасанды аралдар маңында 2018 жылдың көктем және күз мезгілінде жүргізілген іденістер қорытындысы бойынша, көктемде фитопланктондар құрамында теңіз балдырларының 173 түрі табылса, ал күзде 19-ға кеміп, 154 түрі анықталған. Саны жағынан 51,68 % цианобактериялар, ал биомассасы бойынша 80,1 % диатомды балдырлар басым болды. 2017 жылы саны жағынан көк-жасыл балдырлар басым түссе, биологиялық массасы бойынша 2018 жылғыдай диатомды балдырлар жоғары шықты.

Көктемде зерттелген акваторияда жасыл M.contortum, диатомды C.choctawhatcheeana, N.cryptocephala, көк-жасыл M. Punctata балдырлары кең тараған.

Фитопланктонның жалпы саны 247-ден 53,8 млн кл./м^3-ге дейін өзгерді, орташа мәні 933,2 млн кл./м^3. Көк-жасыл балдырлар басым, олардың ішінде ең көбі A.clathrata (11 %) және L.limnetica (14 %) болды.

Фитопланктон биомассасы 112-ден 3035 мг/м^3 дейінгі көрсеткішті көрсетті, орташа мәні 874,8 мг/м^3. Биомассасы бойынша диатомды басым болды, олардың жалпы көрсеткіштегі үлесі 82 %-ды құрады. Биомассаны қалыптастырудағы басым үлес C.jonesianus (22%) және C. clypeus (9%) ірі жасушалық түрлерге тиесілі.

Күзде көп бөлікте немесе барлық акваторияда көк-жасыл P.limnetica, G.laxissima, M.punctata, Phormidium sp., P.contorta, диатомды C.choctawhatcheana, C.meneghiniana, жасыл B.lauterbornii, B.lauterbornii var.crassa балдырлары кездесті.

Көктемде зоопланктон құрамында 24 таксон анықталса, күзгі ізденісте 23 түрі бақыланды. Ізденіс жүргізген уақыт ішінде саны және биологиялық массасы жағынан сәйкесінше 67,79 және 95,1 % өзге де түрлері басым болған. 2017 жылы да зоопланктондардың жоғарыда жазылған мезгілдік өзгеру динамикасы көктемнен күзге қарай олардың сан алуандығының төмендеуі және сандық көрсеткіштерінің артуы қайталанған.

Көктемгі және күзгі ізденістерде де зообентостың 50 таксоны анықталған. Санының негізі 72,54 % құрттан тұрады, ал биомассасы бойынша жалпы көрсеткіштің 40,26 %-ын моллюскалар құрады.

Ізденіс кезеңінде осы теңіз ауданында сандық көрсеткіш бойынша 68060 экз/м^3 тең зоопланктондардың басқа түрлері басым болды, келесі позицияда 27345 экз/м^3 ескек аяқты шаяндар, ал үштікті 4891 экз/м^3 көрсеткішімен коловраткалар түйіндеді.

Биомассасы бойынша 3942,6 мг/м^2 немесе 95,1 % сандық көрсеткіш бойынша өзге түрлер басым болып, одан кейін 191,34 мг/м^2 немесе 4,6 % көрсеткішімен ескек аяқты шаяндар орналасса, ал қалған түрлердің биомассасы 1 %-ға да жетпеді.

Көктемгі ізденіс бойынша макрозообентос 4 топтан 50 таксонды құрады, атап айтқанда, 7 құрт, 9 моллюска, 32 шаян тәрізді, 2 өзге түр.

Күзгі ізденістер де көктемгі ізденістегідей, 4 топтан 50 таксон тіркелді: 7 құрт, 10 моллюска, 28 шаян тәрізді, 4 өзге түр. Сонымен қатар, H. diversicolor және Oligochaeta gen. sp. кездесті. Акваторияның басым бөлігінде H. kowalewskii полихеті, C.lamarcki моллюскі, Pt. pectinata, St. graciloides, G.(Y.) pusilla шаян тәрізділері мекендеді.

Макрозообентос барлық құрылымдық көрсеткіштерінің мәиі 2018 жылдың көктемінен күзгі бағытқа қарай өсті. Қауымдастық санының маусымдық өсуінің негізгі үлесі құрттарга тиесілі. Дәл осы топ моллюскалардың суббасымдылық жағдайында да биомасса бойынша басым болды. Су түбі қауымдастығының көп түрлілігі оның күзгі кезеңде кейбір өсуіміне қарамастан орташа деңгейде болды.

Жоғарыда келтірілген жагдайга қарама-қарсы макрозообентостың сандық көрсеткіштері көктемнен күзге қарай төмендеді. Қауымдастықта 2018 жылгы сияқты құрттар мен моллюскалар үстем болды.

2017 жылдың көктемінде түпкі омыртқасыздар саны мен биомассасы жоғары, ал күзде 2018 жылдың тиісті маусымына қарағанда төмен болды. 2017 жылы бентос айтарлықтай көптүрлі болған жоқ және 2018 жылға қарағанда ұсақ дарақтары тіркелді.

Көктемгі кезеңде келесі түрлер – құрттар тобынан 99,6 % Hediste diversicolor, 74,3 % Hypaniola kowalewskii, 98,2 % Oligochaeta gen.sp. моллюскалардан 46,5 % Abra ovata, шаян тәрізділерден 55,5 % Stenocuma graciloides, 59,3 % Stenogammarus (Stenogammarus) similis жиі кездесті.

Күзде құрттар тобынан 58,7 % Spionidae gen.sp., 100,0 % Hediste diversicolor, 79,2 % Hypaniola kowalewskii, 98,8 % Oligochaeta gen.sp., моллюскалар тобынан 78,6 % Cerastoderma lamarcki түрлері анықталды.

Түйін сөздер: NCOC, «Қашаган» кен орны, жасанды арал, фитопланктон, зоопланктон, зообентос.

А. Кенжегалиев[1], А. А. Абилгазиева[1], А. К. Шахманова[1], А. Ш. Канбетов[1], Д. К. Кулбатыров[1], В. Ф. Зайцев[2], М. К. Уразгалиева[1]

[1]НАО «Атырауский университет нефти и газ им. С. Утебаева», Атырау, Казахстан;
[2]Астраханский государственный технический университет, Астрахань, Россия

СОСТОЯНИЯ ГИДРОБИОНТОВ В РАЙОНЕ МЕСТОРОЖДЕНИЯ КАШАГАН

Аннотация. Результаты исследований за состоянием гидробионтов в районе искусственных островов разрабатываемого нефтегазового месторождения «Кашаган» в весенний и осенний периоды 2018 г. показали, что весной в составе фитопланктона было обнаружено 173 вида водорослей, а осенью на 19 видов меньше, т.е. 154. По численности преобладали цианобактерии – от 51,68%, по биомассе – от 80,1% лидируют диатомовые. Если в 2017 г. по численности доминировали сине-зеленые, то по биомассе, как и в 2018 г. – диатомовые водоросли.

Весной на исследованной акватории наиболее широко были распространены зеленые водоросли M.contortum, диатомовые C.choctawhatcheeana, N.cryptocephala, сине-зеленые M. Punctata.

Общая численность фитопланктона изменялась от 247 до 5353,8 млн кл./м^3 при среднем значении 933,2 млн кл./м^3. Доминировали сине-зеленые водоросли, среди которых наиболее многочисленными были A.clathrata (11%) и L.limnetica (14%).

Биомасса фитопланктона варьировала от 112 до 3035 мг/м^3 при среднем значении 874,8 мг/м^3. По биомассе лидировали диатомовые, доля которых в общем показателе составляла 82%. Наибольший вклад в формировании биомассы играли крупноклеточные виды C. jonesianus (22%) и C. clypeus (9%).

Осенью на большей части или по всей акватории встречались сине-зеленые водоросли видов P.limnetica, G.laxissima, M.punctata, Phormidium sp., P.contorta, диатомовые C.choctawhatcheeana, C.meneghiniana, зеленые B.lauterbornii, B.lauterbornii var.crassa.

Весной в составе зоопланктона было обнаружено 24 таксона, а в осеннем исследовании присутствовали 23 вида. За исследованный период по численности, а также по биомассе от 67,79% и 95,1% соответственно доминировали прочие виды. Описанная выше сезонная динамика зоопланктона в целом повторяла таковую 2017 г., когда от весны к осени также произошло снижение разнообразия и повышение количественных показателей зоопланктона.

Как в весенних, так и в осенних исследованиях в зообентосе обнаружено по 50 таксонов. По численности основу составляли черви – 72,54%, а по биомассе – 40,26% моллюски.

За исследованный период в данном участке акватории моря по численности 68060 экз/м^3 доминировали прочие виды зоопланктонов, следующая позиция – 27345 экз/м^3 веслоногие рачки и 4891 экз/м^3 коловратки.

По биомассе 3942,6 мг/м^2 или 95,1%, как и по численности лидировали прочие виды, веслоногие рачки - 191,34 мг/м^2 или 4,6% занимали следующую позицию, а биомасса остальных видов не доходила и до 1%.

В весенних исследованиях макрозообентос насчитывал 50 таксонов из 4 групп: черви – 7, моллюски – 9, ракообразные – 32, прочие – 2. В осенних исследованиях, как и в весенних, зарегистрировано 50 таксонов из 4 групп: черви – 7, моллюски – 10, ракообразные – 28, прочие – 4. Повсеместно встречались H. diversicolor и Oligochaeta gen. sp. На большей части акватории обитали полихета H. kowalewskii, моллюск C. lamarcki, ракообразные Pt. pectinata, St. graciloides, G. (Y.) pusilla.

Значения всех структурных показателей макрозообентоса возросли от весны к осени 2018 г. Основной вклад в сезонный рост численности сообщества вносили черви. Эта же группа доминировала по биомассе, при субдоминирующем положении моллюсков. Разнообразие донного сообщества находилось на умеренном уровне, при его некотором увеличении в осенний период.

В противоположность описанной выше картине, в 2017г. количественные показатели макрозообентоса снижались от весны к осени. Доминирующее положение в сообществе занимали черви и моллюски, как и в 2018 г.

Весной 2017 г. численность и биомасса донных беспозвоночных были выше, а осенью ниже, чем в соответствующие сезоны 2018 г. В 2017 г. бентос был менее разнообразен и представлен более мелкими особями, чем в 2018 г.

За весенний период часто встречались следующие виды: из группы черви - Hediste diversicolor - 99,6%, Hypaniola kowalewskii – 74,3%, Oligochaeta gen.sp. – 98,2%, из группы моллюски - Abra ovata – 46,5%, из группы ракообразные - Stenocuma graciloides – 55,5%, Stenogammarus (Stenogammarus) similis – 59,3%.

Осенью, наиболее распространены были: из группы черви – Spionidae gen.sp. 58,7%, Hediste diversicolor – 100,0%, Oligochaeta gen.sp. - 98,8%, из группы моллюски – Cerastoderma lamarcki – 78,6.

Ключевые слова: NCOC, месторождения «Кашаган», искусственный остров, фитопланктон, зоопланктон, зообентос.

Information about authors:

Kenzhegaliyev Akimgali, Doctor of technical science, professor, Head of SRL «Geoekolgiya», Non-profit JSC «Atyrau Oil and Gas University n.a. S. Utebayev»; Atyrau, Kazakhstan; akimgali_k@mail.ru; https://orcid.org/0000-0003-0571-4056

Abilgaziyeva Ainagul Adilovna, Candidate of biological sciences, associate professor, Non-profit JSC «Atyrau Oil and Gas University n.a. S. Utebayev»; Atyrau, Kazakhstan; aaaina77@mail.ru, https://orcid.org/0000-0001-6914-1491

Shakhmanova Ayauzhan Kabdrashevna, Candidate of biological sciences, associate professor, Non-profit JSC «Atyrau Oil and Gas University n.a. S. Utebayev»; Atyrau, Kazakhstan; ashk.69@mail.ru, https://orcid.org/0000-0003-1082-3038

Kanbetov Assylbek Shakhmuratovich, Candidate of biological sciences, associate professor, Non-profit JSC «Atyrau Oil and Gas University n.a. S. Utebayev»; Atyrau, Kazakhstan; a.kanbetov@mail.ru; https://orcid.org/0000-0002-9990-0230

Kulbatyrov Dauren Kamysbayevich, Master of Natural Sciences, deputy chief of Management of information technology and education control, Non-profit JSC «Atyrau Oil and Gas University n.a. S. Utebayev»; Atyrau, Kazakhstan; d.kulbatyrov@atrmgu.kz; https://orcid.org/0000-0002-9463-149X

Zaitsev Vyacheslav FedorovichDoctor of Agricultural Sciences, professor, Head of the Department of Hydrobiology and General Ecology, Astrakhan State Technical University, Astrakhan, Russia; viacheslav-zaitsev@yandex.ru; https://orcid.org/0000-0001-6161-9948

Urazgaliyeva Meiramgul Kadyrbayevna, Master of engineering and technology, Non-profit JSC «Atyrau Oil and Gas University n.a. S. Utebayev»; Atyrau, Kazakhstan; mira_090578@mail.ru, https://orcid.org/0000-0002-3622-2356

REFERENCES

[1] Amirgaliev N., Askarova M., Normatov I., Ismukhanova L., Kulbekova R. (2019) On the choice of optimal parameters for theintegrated assessment of surface water quality. News of the Academy of Sciences of the Republic of Kazakhstan. Series of geology and technical sciences. Vol. 3, N 435. P. 150-158. https://doi.org/10.32014/2019.2518-170X.81. ISSN 2518-170X (Online), ISSN 2224-5278 (Print).

[2] Kenzhegaliyev A. (2010) Antropogennyye nagruzki morskikh neftepoiskovykh rabot na ekologiyu Kaspiya i metody yeye snizheniya. [Anthropogenic influence of offshore oil exploration works on the Caspian Sea ecology and methods of its reduction]. Almaty. 185 p. ISBN 978-601-289-010-5 (in Russ.).

[3] Kartamysheva E.S., Ivanchenko D.S. (2017) Posledstviya dobychi nefti i gaza na Kaspiyskom more. [The consequences of oil and gas production on Caspian Sea]. *Molodoi uchenyi [Young scientist].* N 25. P. 113-117. URL: https://moluch.ru/archive/159/44710/ (request date: 22.01.2020). (in Russ.).

[4] Johnston Daniel. (2003) Chapter 12. Kashagan and Tengiz - Castor and Pollux // International exploration economics, risk, and contract analysis. Tulsa, Oklahoma: PennWell Corporation. P. 201-203. 416 p. ISBN 978-0-87814-887-5 (in Eng.).

[5] Kenzhegaliyev A., Orazbayev B.B., Zhumagaliyev S.Zh., Kenzhegaliyev D.A. (2013) Istoriya otkrytiya i osvoyeniya mestorozhdeniya Kashagan. [The development history of Kashagan field]. *Neft i gaz [Oil and gas].* №5. PP. 107-118 (in Russ.).

[6] Abilgaziyeva A.A. (2006) Otsenka vliyaniya neftegazovoy promyshlennosti na sostoyaniye okruzhayushchey sredy i fitoplankton vostochnoy chasti severnogo Kaspiya. Avtoreferat dissertatsii na soiskaniye uchenoy stepeni kandidata biologicheskikh nauk. [The impact assessment of oil and gas industry on environment condition and phytoplankton at eastern part of Northern Caspian Sea. Dissertation thesis on theses for degree of candidate of biological sciences]. Makhachkala. 26 p. (in Russ.).

[7] Shakhmanova A.K. (2006) Ekologicheskiye osobennosti zooplanktona severo-vostochnoy chasti Kaspiyskogo morya (zony predstoyashchey razrabotki neftegazovykh mestorozhdeniy Kazakhstanskogo sektora). Avtoreferat dissertatsii na soiskaniye uchenoy stepeni kandidata biologicheskikh nauk. [The environmental features of zooplankton of the north-eastern part of the Caspian Sea (areas of the forthcoming development of oil and gas fields of the Kazakhstan sector). Dissertation thesis on theses for degree of candidate of biological sciences]. Makhachkala. 24 p. (in Russ.).

[8] Kalimanova D.Zh. (2008) Ekologicheskiye osobennosti severo-vostochnoy chasti Kaspiyskogo morya (zony osvoyeniya neftegazovykh mestorozhdeniy Kazakhstanskogo sektora) Avtoreferat dissertatsii na soiskaniye uchenoy stepeni kandidatov biologicheskikh nauk. [The environmental features of zoobenthos of the north-eastern part of the Caspian Sea (the zone to be developed in oil and gas fields of the Kazakhstan sector). Dissertation thesis on theses for degree of candidate of biological sciences]. Astrakhan. 24 p. (in Russ.).

[9] Sharapova L.I., Rakhmatullina L.T. (2014) Fitoplankton Severo-Vostochnogo Kaspiya. Monitoring prirodnoy sredy Severo-Vostochnogo Kaspiya pri osvoyenii neftyanykh mestorozhdeniy (Rezul'taty issledovaniy Adzhip KKO 1993-2006 gg.). [The phytoplankton of the North-East Caspian Sea. Monitoring of the environment of the North-East Caspian Sea during the

development of oil fields (Research results of Agip KCO, 1993-2006)]. Almaty. P. 90-104. URL: URL: https://www.ncoc.kz/Documents/Environmental_Monitoring_of_the_North-East_Caspian_Sea_rus.pdf (in Russ.).

[10] Sharapova L.I. (2014) Zooplankton Severo-Vostochnogo Kaspiya. Monitoring prirodnoy sredy Severo-Vostochnogo Kaspiya pri osvoyenii neftyanykh mestorozhdeniy (Rezul'taty issledovaniy Adzhip KKO 1993-2006 gg.). [The zooplankton of the North-East Caspian Sea. Monitoring of the environment of the North-East Caspian Sea during the development of oil fields (Research results of Agip KCO, 1993-2006)]. Almaty. P. 105-116. URL: https://www.ncoc.kz/Documents/Environmental_Monitoring_of_the_North-East_Caspian_Sea_ rus.pdf. (in Russ.).

[11] Mutysheva G.K., Epova Y.V., Smirnova D.A., Kochno L.I., Boos N.A., Falomeeva A.P., Kiiko O.A. (2014) Zoobentos Severo-Vostochnogo Kaspiya. Monitoring prirodnoy sredy Severo-Vostochnogo Kaspiya pri osvoyenii neftyanykh mestorozhdeniy (Rezul'taty issledovaniy Adzhip KKO 1993-2006 gg.). [The zoobenthos of the North-East Caspian Sea. Monitoring of the environment of the North-East Caspian Sea during the development of oil fields (Research results of Agip KCO, 1993-2006)]. Almaty. P. 117-131. URL: https://www.ncoc.kz/Documents/Environmental_Monitoring_of_the_North-East_Caspian_Sea_ rus.pdf. (in Russ.).

[12] Kenzhegaliyev A., Zhumagaliyev S.Zh., Orazbayev B.B., Kenzhegaliyeva D.A. (2013) Issledovaniya ekologicheskogo sostoyaniya gidrobiologicheskikh soobshchestv Kazakhstanskogo sektora Kaspiyskogo morya v period podgotovki neftegazovykh mestorozhdeniy k razrabotke. [Studies of ecological state of hydrobiological communities of Kazakhstan sector of Caspian Sea during preparation of oil and gas fields for development]. *Bezopasnost zhiznedeyatelnosti [Life safety].* N 10. P. 39-44. URL: http://novtex.ru/bjd/bgd2013/Bg1013_web.pdf (in Russ.).

[13] Kenzhegaliyev A., Orazbayev B.B., Zhumagaliyev S.Zh., Kenzhegaliyeva D.A. (2017) Sostoyaniye gidrobiontov v rayone iskusstvennykh ostrovov «D» Kashaganskogo mestorozhdeniya. [The condition of hydrobionts in the area of the artificial island "D" of Kashagan deposit]. *Neft i gaz [Oil and gas].* N 1, P. 77-90 (in Russ.).

[14] Environmental Monitoring of the North-East Caspian Sea during Development of NCOC N.V. Oil Fields in the Period 2006-2016. (2018) Almaty: NCOC C. V., KAPE. P. 400. ISBN 978-601-332-146-2 URL: https://www.ncoc.kz/Documents/NCOC_full_eng.pdf. (in Eng.).

[15] Kenzhegaliev A., Abilgazieva A., Shahmanova A., Kulbatyrov D., Saginayev A. (2018) Dynamics of the State of Macrobenthos in the Gulf of Tub-Karagan. IOP Conference Series: Materials Science and Engineering. Vol. 301, Issue 1. 5th Annual International Conference on Material Science and Environmental Engineering, MSEE, Xiamen, Fujian; China. https://doi.org/10.1088/1757-899X/301/1/012116 (in Eng.).

[16] Kiselev I.A. (1956) Metody issledovaniya planktona. V kn. Zhizn' presnykh vod SSSR. [The research methods of plankton. The life of freshwater of USSR]. L., ed. AN USSR. Vol. 4, ed. 1. P. 183-265 (in Russ.).

[17] Rukovodstvo po metodike gidrobiologicheskogo analiza poverkhnostnykh vod i donnykh otlozheniy. [The guide to hydrobiological analysis of surface waters and bottom sediments]. (1983) L., Gidrometeoizdat. P. 78-86 (in Russ.).

[18] Sostoyaniye bioraznoobraziya v Kazakhstanskoy chasti Kaspiyskogo moray. [The state of biodiversity in the Kazakhstan part of the Caspian Sea]. (2000) National report of RK, Atyrau. P. 26-36 (in Russ.).

[19] Metodicheskiye ukazaniya k izucheniyu bentosa yuzhnykh morey SSSR. [Methodological guidelines for the study of benthos of the southern seas of the USSR]. (1983) M.: VNIRO. 13 p. (in Russ.).

[20] Методика изучения биогеоценозов внутренних водоёмов. [The research method of biogeocenoses of inland water reservoirs]. (1975) M.: Nauka. 240 p. (in Russ.).

[21] Metodicheskoye posobiye pri gidrobiologicheskikh rybokhozyaystvennykh issledovaniyakh vodoyomov Kazakhstana (plankton, zoobentos). [The methodological manual for hydrobiological fisheries research of water reservoirs of Kazakhstan (plankton, zoobenthos)]. (2006) Almaty. 27 p. (in Russ.).

[22] Morskoy monitoring vozdeystviya. Otchet o NIR (zaklyuchit.). [Marine impact monitoring. Report about research work (final.)]. TOO «Kazakhstan Agency of Applied Ecology». [LLP «Kazakhstanskoe Agenstvo Prikladnoi Ekologii»]. (2018) Almaty. 326 p. (in Russ.).