ҚАЗАҚСТАН РЕСПУБЛИКАСЫНЫҢ АУЫЛ ШАРУАШЫЛЫҒЫ МИНИСТРЛІГІ
ҚАЗАҚ ҰЛТТЫҚ АГРАРЛЫҚ УНИВЕРСИТЕТІ
ХАЛЫҚАРАЛЫҚ АРАЛДЫ ҚҰТҚАРУ ҚОРЫНЫҢ ҚАЗАҚСТАН
РЕСПУБЛИКАСЫНДАҒЫ АТҚАРУ ДИРЕКЦИЯСЫ

«ЖАЙЫЛЫМДАР МЕН СУАРМАЛЫ ЖЕРЛЕРДЕГІ СУ РЕСУРСТАРЫН ҮНЕМДЕУ ЖӘНЕ БАСҚАРУ»

Қазақ ұлттық аграрлық университетінің 85-жылдығы мен ғылым қайраткері Л.Е.Тәжібаевтың 100 жылдығына орай ұйымдастырылған Халықаралық ғылыми-тәжірибелік конференциясы материалдарының жинағы
2-3 қазан, 2015 жыл.

«ВОДОСБЕРЕЖЕНИЕ И УПРАВЛЕНИЕ ВОДНЫМИ РЕСУРСАМИ В ОРОШАЕМОМ ЗЕМЛЕДЕЛИИ И ОБВОДНЕНИИ ПАСТБИЩ»

Сборник материалов Международной научно-практической конференции посвященный 85-летию образования Казахского национального аграрного университета и 100-летию заслуженного деятеля науки Республики Казахстан Тажибаева Л.Е.
2-3 октября, 2015 год.

Алматы

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ АУЫЛ ШАРУАШЫЛЫҒЫ МИНИСТРЛІГІ
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АЛМАТЫ

ӘОЖ 626.81 (063)
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Ж 19

Қазақ ұлттық аграрлық университетінің 85 жылдығы және ірі ғалым, ғылым қайраткері Л.Е.Тәжібаевтың 100 жылдығына орай ұйымдастырылған «Жайылымдар мен суармалы жерлердегі су ресурстарын үнемдеу және басқару» атты Халықаралық ғылыми-тәжірибелік конференциясы материалдарының жинағы, (2-3 қазан 2015 жыл). - Алматы: ҚазҰАУ, - 290 бет.

Аталған жинақта шетелдік, отандық ғалымдардың және докторанттар мен магистранттардың ғылыми жұмыстары ұсынылған.

Жинақта ғылыми-зерттеу жұмыстарының нәтижелері келесі секциялар бойынша берілген:

1-секция. Суды үнемдеу және су ресурстарын бірігіп басқару. 2-секция. Мелиорация және суармалы егіншілік. 3-секция. Жайылымдарды суландыру және ауыл шаруашылығын сумен қамтамасыз ету, қайта жаңғыртылатын энергия көздерін пайдалану. 4-секция. Агроэкология және су шаруашылық нысандарында қоршаған ортаны қорғау.

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С 19 Сборник материалов Международной научно-практической конференции «Водосбережение и управление водными ресурсами в орошаемом земледелии и обводнении пастбищ», посвященный 85-летию образования университета и 100-летию крупного ученого, заслуженного деятеля науки Республики Казахстан Тажибаеву Л.Е. (2-3 октября 2015 год). – Алматы: КазНАУ, - 290 стр.

В данном сборнике представлены научные работы зарубежных и отечественных ученых, а также докторантов и магистрантов.

В сборнике приведены результаты исследований ученых по следующим секциям:

Секция 1. Водосбережение и интегрированное управление водными ресурсами. Секция 2. Мелиорация и орошаемое земледелие. Секция 3. Сельскохозяйственное водоснабжение и обводнение пастбищ, использование возобновляемых источников энергии. Секция 4. Агроэкология и охрана окружающей среды на водохозяйственных объектах.

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условиях Кызылординской области изучали эффективность картофеля при капельном орошении. Рассмотрена подготовка опытного участка для капельного орошения.

Ключевые слова: картофель, капельное орошение, способы полива, норма полива, экономия оросительной воды, урожайность

Tankybaeva B.R., undergraduate

PREPARATION OF TEST SITES FOR DRIP IRRIGATION UNDER SEVERE CLIMATIC CONDITIONS IN THE KYZYLORDA REGION

Currently, growing water scarcity, one of the most effective methods to combat this problem is considered - drip irrigation . In the harsh climate of Kyzylorda region have studied the effectiveness of potato under drip irrigation . We consider the training of pilot area for drip irrigation .

Key words: potatoes, drip irrigation, technology of watering, norm of watering, economy of irrigating water, productivity

UDC 556.048

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SALINITY AND TROPHIC STATUS OF THE SHALLOW STANDING WATER BODIES IN THE CENTRAL ASIAN STEPPE (NORTH KAZAKHSTAN)

Abstract

The estimated area of standing water bodies in Kazakhstan approximately is 1008861 km² including the big lakes (e.g. Caspian Sea, Lakes Balkhash etc.) what comprise 37 % of the total area of the country, and the saline standing water bodies (permanent & intermittent) are one of the most important aquatic habitats on the steppe in Kazakhstan. The ecology of large saline lakes are relatively well known (Caspian Sea, Aral Sea, Lake Balkhash, Lake Tengiz, Lake Alakol), but the ecology of „smaller" shallow permanent and intermittent saline lakes/pans/wetlands are less known in this area. Therefore salinity and trophic status of 27 saline shallow standing water bodies were characterized in this study on the Central Asian steppe (North Kazakhstan). Most of them were hypersaline, and had hypertrophic status based on total phosphorus (TP) concentration. They showed meso- eu- hypertrophic status based on chlorophyll *a* concentration, but the chlorophyll *a* concentration underestimates the trophic status of the lakes, concerning the high seasonal fluctuation of the planktonic algae. Although the TP concentration may depend on the land use around the water tables, but we cannot find significant differences among the protected, non protected and important bird population categories of the investigated waters.

Key words: saline lake, hypersaline, hypertrophic, total phosphorus, bird population

Introduction

There are more than 2800000 lakes in the CIS (former USSR), but most of them (99.2 %) are small and shallow, with an area of less than 1 km² (Aladin & Plotnikov, 1993). Because of small size and shallowness these standing water bodies are particularly endangered ecosystems in the arid Eurasian steppe by the climate change combined with human activities (e.g. Aral Sea). Beside the desiccation the increase of salinity are also being issued in inland standing waters of the steppes.

Based on Global Lakes and Wetlands Database GLWD (Lehner & Döll, 2004), the estimated area by GIS techniques of standing water bodies in Kazakhstan approximately is 1008861 km^2 including the big lakes e.g. Caspian Sea, the lake bed of Aral Sea, Lakes Balkhash etc. what comprise 37 % of the total area of Kazakhstan. The estimated spatial distribution of the standing water bodies in Kazakhstan can be seen on the Fig. 1.

The proportion of permanent lakes is 82% and the proportion of intermittent (astatic, non-permanent water) lakes and wetlands is 13%, while the contribution of freshwater marshes, fens, floodplains altogether 4 % and the reservoirs have only 1% spatial contribution to the total area of standing waters in Kazakhstan. The most of the permanent and almost all of intermittent lakes, wetlands are saline.

Based on the spatial statistics, the saline standing water bodies are important environmental factors on the steppe in Kazakhstan. The ecology of large saline lakes are relatively well known (Caspian Sea, Aral Sea, Lake Balkhash, Lake Tengiz, Lake Alakol), but the ecology of „smaller" shallow permanent and intermittent saline lakes/pans/wetlands are less known in this area. There is an older geographical overview about the lakes of North Kazakhstan (Пальгова et al., 1960), and several new data are also available about the geographical description, especially bird population states with some water quality data (Брагина and Брагин et al., 2002), but the trophic status of the lakes have not been studied yet.

Because of the importance of saline standing waters, our goals were to determine the actual salinity and trophic status of some characteristic shallow water bodies on the steppes of North Kazakhstan, and evaluate some environmental factors regarding the salinity and trophic state of these lakes.

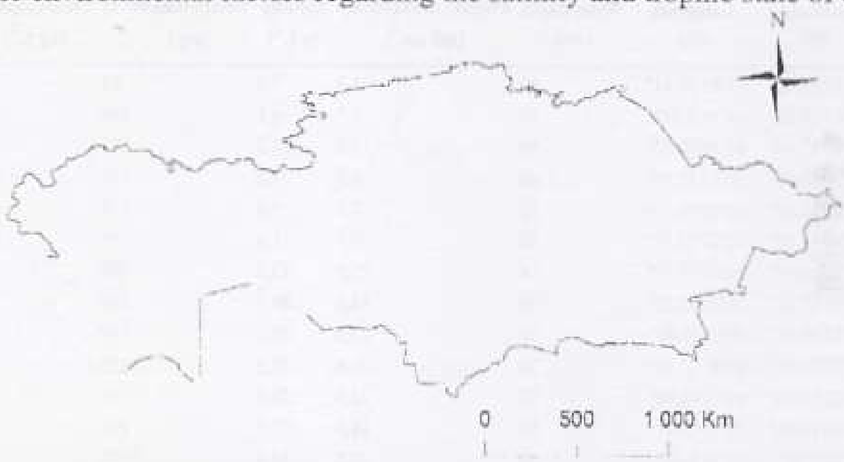

Fig. 1 The standing water bodies in Kazakhstan (source: Lehner B. & Döll P. 2004. Global Lakes and Wetlands Database, GLWD)

Study sites and methods

The study area is located in North Kazakhstan steppe along a 1000 km range from the western part of Kostanay county along Aqmola to Pavlodar county to the eastern steppe. Totally 27 shallow permanent and intermittent saline lakes, or wetlands with open water body were studied on the field and 37 water samples were taken during the 2014–2015 period in May (Fig. 2). Eight of investigated lakes situated on protected sites as Наурзумский заповедник, Коргалжынский заповедник (Озеро Тенгиз), and Алтын Дала резерват, while 16 were not protected by nature conservation inventions. The protection status was also considered during the data evaluation (see Table 1).

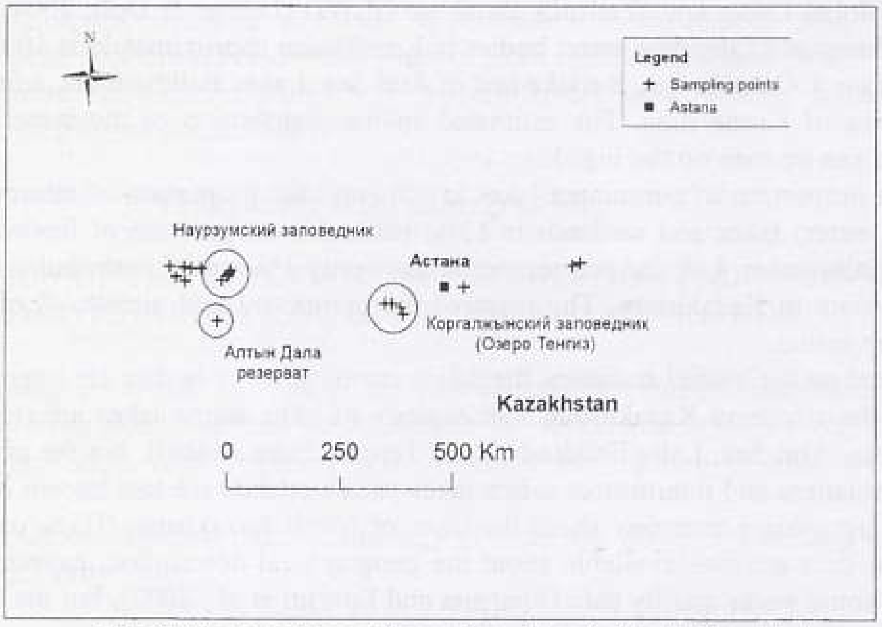

Fig. 2 The locations of sampling sites in North Kazakhstan

Table 1

Name of the water	Latitude (N)	Longitude (E)	Water depth (cm)	Electric conductivity (mS cm^{-1})	Salinity (g L^{-1})	Total phosphorus (µg L^{-1})	Chlorophyll *a* (µg L^{-1})	Land use categories
Unknow	51°32'51.92"	63°41'34.41"	40	1,3	1,4	69	19	Non-protected
Болшой Аксуат	51°27'39.99"	64°30'5.79"	10	3,7	4,1	146	12	Protected
Жарколь	51°40'45.34"	64°35'20.52"	50	3,8	4,2	341	10	important bird population
Шушуркопа	51°20'32.44"	62°23'35.96"	60	6,7	7,3	227	169	Non-protected
Шошкалы	51°21'25.90"	64°18'40.73"	25	7,7	8,4	238	34	Protected
Тениз	51°19'18.12"	62°21'25.78"	70	10,4	11,4	351	378	important bird population
Малый Аксуат	51°30'18.98"	64°29'38.37"	14	13,9	15,3	202	40	important bird population
Карасол	51°57'33.02"	75°42'21.05"	30	18,6	20,5	399	13	Non-protected
Балыксор	50°31'35.15"	70° 3'29.48"	10	20,2	22,2	147	27	important bird population
Unknow	51°32'2.42"	63°41'27.39"	20	21,4	23,5	1122	57	Non-protected
Unknow	51°22'12.28"	63° 1'46.92"	70	22,2	24,4	95	8	important bird population
Сарыоба	51°10'14.01"	72° 5'2.70"	50	28,3	31,1	112	9	Non-protected
Unknow	51°32'7.15"	63°41'0.40"	10	31,3	34,4	1102	47	Non-protected
Unknow	51°31'27.48"	64°30'52.67"	3	37,0	40,7	266	10	Protected
Жарман	51°35'18.60"	64°26'45.08"	4	40,5	44,5	151	11	Protected
Unknow	51°50'10.40"	75°32'52.82"	60	42,8	47,1	164	12	Non-protected
Сарыкопа Казалы	50° 9'36.43"	64° 5'34.24"	50	59,4	65,3	258	10	Protected
Unknow	51°31'10.73"	64°27'37.51"	20	67,9	74,7	49	6	Protected
Божасор	50°18'47.88"	70° 8'2.53"	10	85,7	94,3	214	8	important bird population
Ашутас	51°13'7.39"	62°34'57.09"	20	99,3	109,2	100	41	Non-protected
Жарсол	51°22'4.04"	62°48'26.11"	6	99,9	109,9	109	9	Non-protected
Unknow	51°24'38.37"	63° 1'24.52"	20	114,4	125,8	187	10	Non-protected
Малый Тенгиз	50°38'25.54"	69°30'13.46"	5	132,2	145,4	455	5	important bird population
Каинсор	51°12'36.05"	62°31'33.45"	20	137,3	151,0	135	23	Non-protected
Калмакты	50°38'34.55"	69°44'38.21"	10	146,4	161,0	397	5	important bird population
Unknow	51°21'28.11"	63° 1'25.95"	10	159,5	175,5	309	10	Non-protected
Уркаш	51°19'45.61"	62°40'21.14"	10	235,0	258,5	26	6	Non-protected
Mean			26	61	67	273	37	

Some of basic physical data (e.g. water depth, temperature) were measured and water samples were taken on foot from the water at each lake. The electric conductivity (EC) was measured on the field by WTW Multiline P–4 field instrument with TetraCon–325 electrode. Based on our calibration between TDS and conductivity resulted that salinity can be estimated via conductivity (EC) in the investigated waters:

Salinity ($g\ L^{-1}$) = 1.1 × EC ($mS\ cm^{-1}$)

Because the nutrient load of aquatic birds may also be an important factor concerning the trophic state of shallow waters (Boros et al., 2008a; 2008b), we also identified and counted the birds on the water bodies at the same time, and additional information were collected from local experts about the size and composition of bird populations. The list of considered aquatic bird species list is in Table 2. Based on these information we determined those lakes and wetlands where important (significant) bird populations were existing (see Tab. 1).

The total phosphorus (TP) concentration were determined spectrophotometrically (Menzel & Corwin, 1965) in the laboratory. To measure chlorophyll *a* water samples were filtered through a GF–5 glass fibre filter and the concentration was determined spectrophotometrically with hot methanol extraction (Wetzel & Likens, 1991).

The mapping analyse was made by ArcGIS 9 software. The statistical procedures and graphs were carried out by OriginPro 9 software with significance level of $P < 0.05$. The Kruskal-Wallis ANOVA test was used for comparison of variable with non-normal distribution.

Table 2

Scientific name	English name
Actitis hypoleucos (LINNAEUS, 1758)	Common Sandpiper
Anas acuta LINNAEUS, 1758	Northern Pintail
Anas clypeata LINNAEUS, 1758	Northern Shoveler
Anas crecca LINNAEUS, 1758	Common Teal
Anas penelope LINNAEUS, 1758	Eurasian Wigeon
Anas platyrhynchos LINNAEUS, 1758	Mallard
Anas querquedula LINNAEUS, 1758	Garganey
Anas strepera LINNAEUS, 1758	Gadwall
Anser albifrons (SCOPOLI, 1769)	White-fronted Goose
Anser anser (LINNAEUS, 1758)	Greylag Goose
Ardea cinerea LINNAEUS, 1758	Grey Heron
Aythya ferina (LINNAEUS, 1758)	Common Pochard
Aythya fuligula (LINNAEUS, 1758)	Tufted Duck
Aythya marila (LINNAEUS, 1761)	Scaup
Bucephala clangula (LINNAEUS, 1758)	Goldeneye
Calidris alpina (LINNAEUS, 1758)	Dunlin
Calidris ferruginea (PONTOPPIDAN, 1763)	Curlew Sandpiper
Calidris minuta (LEISLER, 1812)	Little Stint
Calidris temminckii (LEISLER, 1812)	Temminck's Stint
Charadrius alexandrinus LINNAEUS, 1758	Kentish Plover
Charadrius dubius SCOPOLI, 1786	Little Ringed Plover
Charadrius hiaticula LINNAEUS, 1758	Common Ringed Plover
Chlidonias leucopterus (TEMMINCK, 1815)	White-winged Tern
Chlidonias niger (LINNAEUS, 1758)	Black Tern
Clangula hyemalis (LINNAEUS, 1758)	Long-tailed Duck
Cygnus cygnus (LINNAEUS, 1758)	Whooper Swan
Cygnus olor (Gmelin, 1789)	Mute Swan
Egretta alba (LINNAEUS, 1758)	Western Great Egret
Gallinago gallinago (LINNAEUS, 1758)	Common Snipe
Gelochelidon nilotica (GMELIN, 1789)	Gull-billed Tern
Glareola nordmanni Fischer *in* Nordmann, 1842	Black-winged Pratincole
Grus grus (LINNAEUS, 1758)	Common Crane
Grus virgo (LINNAEUS, 1758)	Demoiselle Crane
Haematopus ostralegus LINNAEUS, 1758	Eurasian Oystercatcher
Himantopus himantopus (LINNAEUS, 1758)	Black-winged Stilt
Larus cachinnans PALLAS, 1811	Caspian Gull
Larus canus LINNAEUS, 1758	Mew Gull
Larus genei BRÈME, 1840	Slender-billed Gull
Larus ichthyaetus PALLAS, 1773	Pallas's Gull
Larus minutus PALLAS, 1776	Little Gull
Larus ridibundus LINNAEUS, 1766	Black-headed Gull
Limosa lapponica (LINNAEUS, 1758)	Bar-tailed Godwit
Limosa limosa (LINNAEUS, 1758)	Black-tailed Godwit
Mergus albellus LINNAEUS, 1758	Smew
Netta rufina (PALLAS, 1773)	Red-crested Pochard
Numenius arquata (LINNAEUS, 1758)	Eurasian Curlew
Numenius phaeopus (LINNAEUS, 1758)	Whimbrel
Oxyura leucocephala (SCOPOLI, 1769)	White-headed Duck
Pelecanus crispus LINNAEUS, 1758	Dalmatian Pelican
Phalaropus lobatus (LINNAEUS, 1758)	Red-necked Phalarope
Philomachus pugnax (LINNAEUS, 1758)	Ruff
Phoenicopterus ruber LINNAEUS, 1758	Greater Flamingo
Podiceps auritus (LINNAEUS, 1758)	Slavonian grebe
Podiceps cristatus (LINNAEUS, 1758)	Great Crested Grebe
Podiceps grisegena (BODDAERT, 1783)	Red-necked Grebe
Podiceps nigricollis C. L. BREHM, 1831	Black-necked Grebe
Recurvirostra avosetta LINNAEUS, 1758	Pied Avocet
Sterna caspia PALLAS, 1770	Caspian Tern
Sterna hirundo LINNAEUS, 1758	Common Tern
Tadorna ferruginea (PALLAS, 1764)	Ruddy Shelduck
Tadorna tadorna (LINNAEUS, 1758)	Common Shelduck
Tringa glareola LINNAEUS, 1758	Wood Sandpiper
Tringa nebularia (GUNNERUS, 1767)	Common Greenshank
Tringa stagnatilis (BECHSTEIN, 1803)	Marsh Sandpiper
Tringa totanus (LINNAEUS, 1758)	Common Redshank
Vanellus gregarius (PALLAS, 1771)	Sociable Lapwing
Vanellus vanellus (LINNAEUS, 1758)	Northern Lapwing
Xenus cinereus (GÜLDENSTÄDT, 1775)	Terek Sandpiper

Results

The measured and estimated data of the investigated waters are summarised in Table 1. The mean water depth was very shallow (26 cm) at the sampling points. The salinity varied in a wide range (Fig. 3.), between 1 and 134 g L^{-1} concentration with hypersaline average value (67 g L^{-1}) in the 27 water bodies during the investigation period. Proportionally, 41% of the lakes were hypersaline, 35% of them mesosaline, 12% of them hyposaline, while only 1 lake was subsaline by the international terminology (Hammer, 1986). Nevertheless, there was an obviously inverse but non-significant non-linear relationship between water depth and salinity.

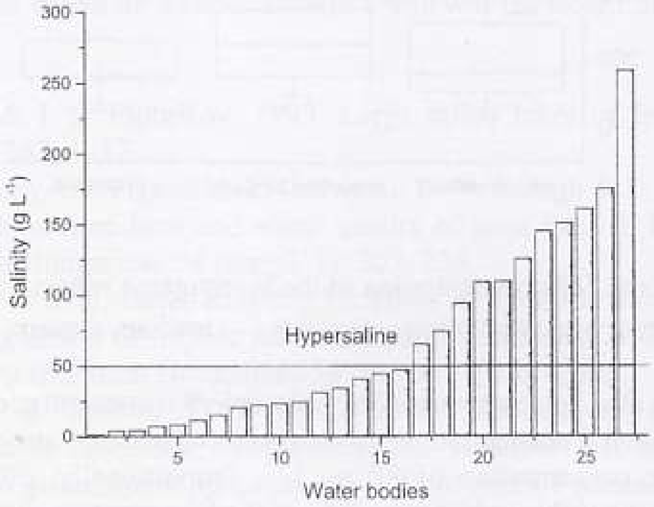

Fig. 3 The salinity of the investigated water bodies

The trophic status can be identified by total phosphorus (TP) concentration according to the OECD (1982) classification. The TP varied in a wide range (Fig. 4.), between 26 and 1122 µg L^{-1} with an average concentration of 273 µg L^{-1}in these lakes during the investigation period. Proportionally, the 81% of the waters were hypertrophic, 15% of them eutrophic, while one water was mesotrophic by TP. The extreme highest concentrations (1102 and 1122 µg L^{-1}) occurred those lakes, which were located very close to the settlements, and may indicate the human pollution.

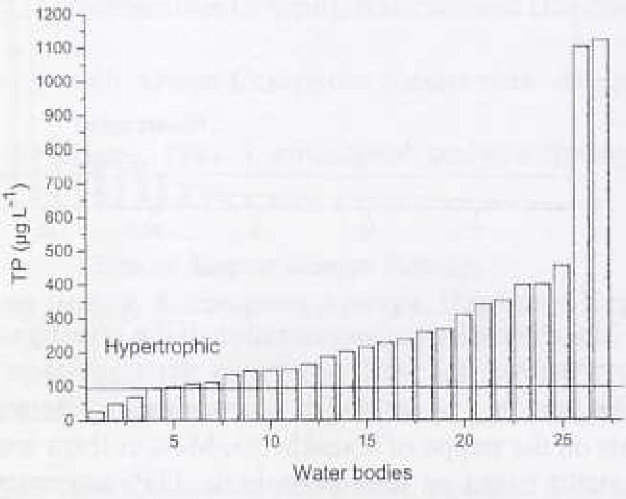

Fig. 4 The total phosphorus (TP) concentration of the investigated waters

We have found some but non-significant differences between TP concentration of the lakes in the investigateed land use categories. The non-protected lakes had highest TP concentrations but not at all sites, and the relatively lowest concentrations occurred in the protected lakes, while the TP concentrations were between them in lakes having important bird populations (Fig. 5.).

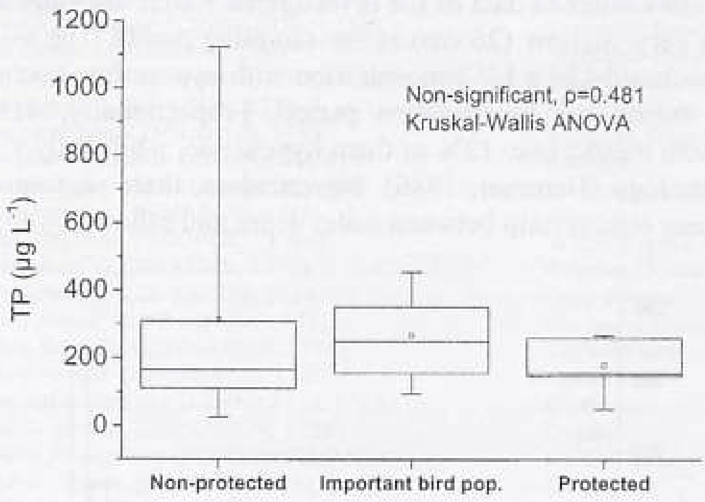

Fig. 5 The total phosphorus (TP) concentration of the investigated waters in the protected, non-protected and important bird population categories (— median, □ mean, ⊥ min., ⊤ max.)

Trophic status may also be characterised by chlorophyll *a* concentration after OECD (1982) classification. The chlorophyll *a* concentration also varied in wide range, between 5 and 378 $\mu g\ L^{-1}$ (Fig. 6.) with an average concentration of 37 $\mu g\ L^{-1}$. Proportionally, 30% of the lakes were hypertrophic, 52% of them eutrophic, while only 19% of the lake was mesotrophic.

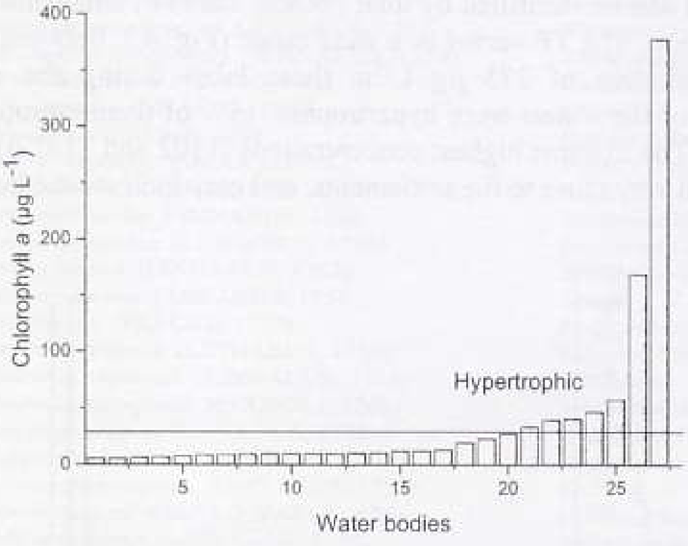

Fig. 6 The chlorophyll *a* concentration of the investigated waters

Conclusion

The shallow saline standing water bodies (permanent & intermittent) are one of the most important aquatic habitats on the steppe of Kazakhstan. Most of them were hypersaline, and most of them had hypertrophic status based on total phosphorus (TP) concentration. They had meso- eu- hypertrophic status based on chlorophyll *a* concentration, but the chlorophyll *a* concentration underestimates the trophic status of these lakes, concerning the high seasonal fluctuation of the planktonic algae. Although the TP concentration may depend on the land use around the water tables, but we cannot find significant differences among the protected, non protected and important bird population categories of the investigated waters. More detailed ecological and limnological studies need of these important aquatic habitats in the future on the steppe in Kazakhstan.

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СОЛЕНОСТЬ И ТРОФИЧЕСКИЕ СОСТОЯНИЯ МЕЛКОВОДНЫХ СТОЯЧИХ ВОДОЕМОВ В СТЕПИ ЦЕНТРАЛЬНОЙ АЗИИ (СЕВЕРНЫЙ КАЗАХСТАН)

Статья характеризует соленость и трофические условия 27 стоячих вод Северного Казахстана. Большинство из них гиперминерализованные и на основе концентрации общего фосфора имеют гипертрофическое состояние.

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ОРТАЛЫҚ АЗИЯ ДАЛАСЫНЫҢ (СОЛТҮСТІК ҚАЗАҚСТАН) ТҰРАҚТЫ ЖӘНЕ ТАЯЗ СУЛАРЫНЫҢ ТҰЗДАНУЫ МЕН ТРОФИКАЛЫҚ ЖАҒДАЙЫ

Мақалада Солтүстік Қазақстан бойынша 27 тұрақты және таяз суларының тұздану мен трофикалық жағдайлары сипатталған. Олардың басым көпшілігі гиперминералданған және жалпы фосфор концентрациясы негізінде гипертрофикалық болып табылады.

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IMPROVING WATER-SALT REGIME IN IRRIGATED AGRICULTURE

Abstract. This article studies the ameliorative condition of lands in Shieli irrigation massif by analyzing the volume of salts ingression into soil along with irrigation water and salt outcrop from the soil in sewer waters. The paper presents materials with experience of flushing saline on the area of 71.15 hectares, which gave positive results in water-and salt regime of soil.

Keywords. Salinity, experimental plot, agriculture, checks, flushing, drainage.

Introduction. In the Shieli district of Kyzyl-orda region in 2013, the area of irrigated land was 31,118 hectares. Out of that area, the area of irrigated land with utility systems is 25,801 hectares, and the total area of fields is 22,736 hectares. [1]

Weather conditions. The Shieli district is characterized by hot summers and very cold winters. The favorable period for crop planting continues from April to mid-October. The hottest month is July; the coldest months are January and February.

Within the area, except for some years, rainfalls are very rare. Atmospheric precipitation occurs in winter and spring.

According to the data from the Shieli Weather Stations, the amount of precipitation this year was 164.7 mm. The highest temperature was +27°C and the lowest temperature was 4.80°C; the average temperature being +13.30°C [2, 3]

The main source of water for irrigation of agricultural crops in the Shieli area is the Syrdarya River. The main part of the river water intake originates in the Tomenaryk town through the trunk channel Novy Shieli. Through this channel, agricultural land in Akmaya, Kodamanov, Begezhanov, Zhuantobe, Bestam and other farms is irrigated. Through the Kamystyayak channel, farms in villages Bidaykol and Jahanev are irrigated.

In the area, the water supply into the channels starts on the third week of April. Water supply to the fields starts in May and continues until August 25.

Hydrogeological and ameliorative conditions of the irrigated lands are a complex system, i.e., they depend on soil salinity, water supplied to crops and the level of ground water. [4, 5]

Through pipes located in irrigated areas, groundwater level and salinity indicator were identified. The ameliorative condition of the irrigated land in farms was considered unsatisfactory only in certain farming lands, due to their lowland and highland location, a change was noticed in soil mechanical composition.

Soil salinity index depends on mineralization of irrigation water and groundwater. In the autumn of this year, a rapid drop of the groundwater level has been observed. This was caused by