Wetland Birds of the Hydrographic Network of Altyn Asyr

Eldar A. Rustamov and Anna V. Belousova

Abstract The term "hydrographic network of Altyn Asyr" was introduced, the spatial–temporal dynamics of wetlands and wetland birds' habitats during migration and in wintering areas was described, data on the composition, type of staying, and monitoring of wetland birds on the water bodies of the hydrographic network of Altyn Asyr was shown, a forecast for the growth of the avifauna and wetland birds' population on the Altyn Asyr Lake was given.

Keywords Ecosystems, Hydrographic Network, IBAs, Karakum Darya River, Lake Altyn Asyr, Turkmenistan, Waterbirds, Waterfowl, Wetlands, Wintering of birds

Contents

E.A. Rustamov (✉)
Expert in Wetlands and Waterbirds, Ministry for Nature Conservation of Turkmenistan, Ashgabat, Turkmenistan
e-mail: elldaru@mail.ru

A.V. Belousova
All-Russian Research Institute for Nature Protection, Moscow, Russia

I.S. Zonn and A.G. Kostianoy (eds.), *The Turkmen Lake Altyn Asyr and Water Resources in Turkmenistan*, Hdb Env Chem (2014) 28: 261–290, DOI 10.1007/698_2012_217,

1 Introduction

In Turkmenistan, due to positive climatic and natural factors, there are environmental conditions for the wintering of many species of wild avifauna, particularly for wetland birds, which is mainly due to the absence of a period of deep winter depression, which is present in the northern regions of Eurasia. Favorable temperature conditions on the plains, and, as a consequence, good food supply are the main prerequisites for the formation of wintering clusters of wetland birds in inland water bodies of the country, which are connected, in one way or another, with the Turkmen Lake Altyn Asyr. Indeed, as observations have shown, the emergence of new, suitable for birds, wetlands on artificial reservoirs, as well as expansion of the irrigated land has a positive impact on the number of wintering birds, contributing to their concentration near water bodies and to the formation of new wintering areas. So far there has been no summarizing work on the inventory and the cross-spectrum analysis of the wetland birds' wintering, including all wetlands of the plain Turkmenistan, despite the fact that the beginning of the study of bird fauna of the country started already in the second half of the nineteenth century and the research was the most intensive in the twentieth century when artificial wetlands were appearing and when they were expanding their network.

The first survey about wintering of waterbirds in Turkmenistan was conducted by Laptev in the South-Eastern Caspian [1] and was continued in the same area by Isakov and Vorobiev [2, 3]. In inland water bodies regular winter surveys have been held since 1967 in the areas of the Amu Darya River, Karakum Darya (the Karakum Canal), Murgab, Tejen and Kopetdag foothills, and later also in the north of the country by: Khakyev in 1970–1976; Rustamov in 1977–1984 and 1999–2012; Poslavsky in 1985–1989 and in 1994, and by other ornithologists [4–10]. In 1970–1994 accounts were conducted by aircraft (airplane An-2, helicopters Mi-1, Mi-2, Mi-4, and Mi-8), and in other years – by ground methods from the shore by car. As a rule, as one account was taken one survey of a water body (lake, reservoir). There were used 8–10 times zoom binoculars, and since 2005 – 40–60 times zoom telescopic tubes [5, 7, 11]. Color photographs of birds are taken from the book of Rustamov "Wildlife of Turkmenistan and its protection" [12].

2 Habitat Transformation of Wetland Birds in Connection with the Development of the Hydrographic Network of Altyn Asyr

The main purpose of the design and construction of the Turkmen Lake Altyn Asyr, as it is known, is to collect drainage water from the huge surfaces of irrigated agriculture lands that emerged on the territory of Turkmenistan as a result of wild lands development and transformation of ancient oasis lands. The large-scale construction of irrigation systems that took place in the twentieth century and is continuing nowadays highly influenced the structure and spatial dynamics of the

biotic components of desert and anthropogenic landscapes. Therefore, regarding the diversity of wetlands ecosystems it is not sufficient to consider the Turkmen Lake Altyn Asyr isolated from the whole basin of the artificial drainage, it will not reveal the whole picture of diversity change of such an important group of birds as wetland birds. Almost the entire hydrographic network of Turkmenistan (with the exception of the south-west), both natural and artificial, is directly or indirectly related to the Turkmen Lake Altyn Asyr. The authors found it useful to consider global (in the secular context) changes in the waterbirds, including all water bodies of this system. Based on the foregoing, under the term "hydrographic network of Altyn Asyr" we deem reservoirs, lakes, flooded areas, and canals of all types, connected directly or indirectly by waterways with the Turkmen Lake Altyn Asyr.

Turkmenistan, as well as the whole south-western part of Central Asia, is one of the areas of transit flights and wintering areas for birds that gather and migrate to the south from areas of Northern Eurasia, mainly from Western Siberia, Kazakhstan, and Eastern Europe. In desert conditions water as an environmental factor and wetlands as habitats are important and crucial especially for water limnophilous birds. In autumn and winter on the plains one can observe vegetation of some species of herbaceous plants, development of quite a variety of invertebrates that lead an active life, even despite the short-term cooling periods. Favorable environmental (climate: mild winters) and ecological conditions of the region determine the relevant feed. As far as waterbirds are concerned – it is also the lack of freeze-up and the availability of submarine and surface feed.

However, at the beginning and in the middle of the last century, overall scarcity of water resources in flat parts of Turkmenistan determined also a low concentration of waterfowl, especially in winter, despite the fact that the population of these birds in Eurasia as a whole, compared to the present time, was ten times bigger. In Turkmenistan, with the exception of shallow waters of the South-Eastern Caspian, there were no large concentrations of them [13]. Naturally, on the plains of the country waterfowl tended to stay in wetland habitats in the valleys of the Amu Darya, Murgab, and Tejen Rivers. However, a small number of birds stayed for wintering because of small surfaces and the capacity of wetlands, and they were used mainly for stops during seasonal migrations. In floodplains of the Amu Darya River birds tended to stick to coastal and island stretches and small floodplain lakes and oxbow lakes, as the river was not regulated, reservoirs were not built on it. There were no large concentrations of birds either on the Murgab or Tejen Rivers, despite the fact that in the valleys of these rivers there was conducted construction of reservoirs, though small, but still, they did build reservoirs there in order to regulate water collection and reduce discharges of flood water in the desert.

Habitat transformation of wetland birds' habitats on the plains of Turkmenistan was uneven for 100–120 years. Of course, in the first and even in the second half of the last century it was impossible to assume that such great crucial transformation processes and development of wetland ecosystems would take place and that, ultimately, there would be an integrated hydrographic network of Altyn Asyr. In the twentieth century wildlands and oasis lands were gradually developed, which was accompanied by irrigation and drainage construction. Specific changes

in the hydrographic network in the southern half of the country were associated mainly with the complex and gradual process of construction of the Karakum Canal (now Karakum Darya), as referred to in an article by I.S. Zonn which is included in this book.

To avoid repetitions, we will omit the spatial–temporal characteristic of wetland birds' habitat transformation in the area of Karakum Darya. However, it should be emphasized that in the expansion process of constructing, strengthening Karakum Darya's influence and stabilizing developed areas in its zone as well as in adjacent to the old oases, there was transformation of arid ecosystems and their replacement by wetlands with all the components of biodiversity, especially in case of wetland birds. It is sufficient to consider the example of the lake system Kelif Uzboy that once consisted of fluvial reservoirs: on its large (Lake Karashor and Chaskak) and small (Kargaly, Petdeli, Swan, Turkmen, Twenty) stilling and filtration lakes there emerged conditions not only for nesting but also for wintering of wetland birds. The total area of all the Kelif Lakes by the mid-1950s amounted to 93 km^2 (82 km^2 – the water table), and even already then there appeared a wintering area not only for the *Anseriformes* but also for other wetland birds. The lakes turned out to be so significant that in 1970 there was formed the Kelif Ornithological Reserve [14]. However later, in the process of silting and overgrowing this lake system began to lose its value for mass wintering of waterfowl and its area decreased by ten times and now totals 8.5 km^2. However as a result of the creation of the new reservoir Zeid in the mid-1990s (in 2005 the surface area was 365 km^2), the role of Uzboy Kelif as a place of concentration of waterbirds, especially in winter, started to increase again.

Thus, one of the main causes of the emergence of the new wintering area in southern and south-eastern Turkmenistan (or the southern part of the hydrographic network of Altyn Asyr) turned out to be the anthropogenic formation of wetlands that has caused since the 1960s underflooding of lower parts of the desert along the route of Karakum Darya and near-delta areas of the Murgab and Tejen Rivers, during the withdrawal and discharge of drainage waters from agricultural arrays of the river valleys in the Central Karakum.

The development of Karakum Darya as an artificial river led to the unification of the basins of the Amu Darya, Murgab, Tejen and small rivers of the Kopetdag macroslope, causing the growth of surfaces of already existing and the emergence of new anthropogenic landscapes and wetland ecosystems and, as a consequence, biotope redistribution of birds during migration, their nesting and wintering. It is vital to add that this has led to the restructure of the other components of the wildlife in the zoogeographical context; for example, there was infiltration of elements of ichthyofauna from the Amu Darya basin into the Murgab and Tejen, as well as the partial union of their theriofauna.

The hydrological situation was changing not only in the southern half but also in the north and in the far east of Turkmenistan. Thus, in the early 1960s there was an increase in cultivated areas for cotton and rice in the lower lands of the Amu Darya, which increased the flow of irrigation water, and, therefore, the volume of drainage water, which began to be diverted (since 1961) to the Sarykamysh basin, 150 km to

the west of the so-called Khorezm – Kunyaurgench oasis, and that has been dumped there to this day. As a result, since the mid-1960s Lake Sarykamysh has been rapidly increasing its area (in 1975 – about 1,500 km^2, in 2000 – more than 2,500 km^2, and now – about 3,900 km^2), and by now it has become one of the largest artificial lakes of the Central Asian region. Uncontained growth of the volume of drainage water has led to an increase not only of the water table but also of the capacity of the entire Sarykamysh basin as a territory suitable for the habitat of wetland birds. One could observe the emergence of a new area of birds' concentration during migration and partly wintering (in the first half of winter) in Central Asia, and new nesting sites for the *Anseriformes* and colonial nesting species such as pelicans, cormorants, gulls, and terns. Due to the drop of the Aral Sea level and drying of the Amu Darya delta there happened a "relocation" of some nesting places of colonial nesting waterbird species from Southern Sub-Aral area to Sarykamysh.

At the top of the Amu Darya delta at the border with Uzbekistan since 1977 there was carried out the construction of new reservoirs – Tuyamuyun or Dueboyun (according to the project – more than 600 km^2, however, today the water table is about 130 km^2) and Soltansanjar (350 km^2), from which in 1982 there was built the Tuyamuyun left bank water supply canal (20 km), which joined the Malyab Canal, and together they are now called Turkmen Darya (180 km). The expansion of the delta of the Amu Darya to the west and the emergence of the large transboundary Lake Sarykamysh in northern Turkmenistan, as well as large drainage lakes in the east – in depressions of the right-bank of Amu Darya – in the middle of its course (see below) – this is the second large-scale transformation of the surface hydrographic network of the country.

Speaking more about Sarykamysh, it should be noted that there with the formation of a vast wetland already in 1975–1976 there were registered 39 species of waterbirds, of which five are *Anseriformes* [15], and today their number, respectively, increased to 90 and 24 species [16]; in the middle of the last century there were nesting only Eurasian Bittern, Common Shelduck, Mallard, Eurasian Coot and Black-winged Stilt [17]. It is natural that over the past decades the number of wetland birds' species has grown many times. Approximately 75% of all species of waterbirds stop during migration, about 25% stay to nest. Large wintering and migratory clusters of waterbirds in Sarykamysh before its large-scale filling did not exist due to the shortage of water – the lake's surface at the end of the nineteenth century and in the middle of the twentieth century was not more than 100 km^2. Now wintering exists there, but usually in the first half of winter (till mid-December), until the temperature falls to the limits pessimal for wintering wetland birds (complete freezing).

It must be said that in the early 1980s there were formed new reservoirs also at the right bank of the Amu Darya in the Sundukli Desert at the border with Uzbekistan. This is a system of lakes Soltandag (103 km^2), Gyzylburun (11 km^2) and Tailak (3 km^2), emerged as a result of filling depressions of the same name by large volumes of drainage water diverted along collectors and the river bed of the Mehejan from the Karshyn Region of neighboring Uzbekistan. In these wetlands

there were also observed concentrations of waterbirds that settled for wintering, moving during migrations from the north-east, that is, from the valley of the Zeravshan River and plain lakes of neighboring Uzbekistan. At first, these drainage lakes existed in isolation, but later they were connected to the Amu Darya, and thus, with the whole hydrographic network of Altyn Asyr.

Finally, a large-scale transformation of the hydrography of Turkmenistan as a habitat for wetland birds started recently as a result of the implementation of the following project since 2000 – construction of the Transturkmen (Main) Collector of 720 km length and construction of the Turkmen Lake Altyn Asyr. Aspects of this construction are thoroughly described in the chapter by I.S. Zonn and A.G. Kostianoy, included in this book, as well as in the book "Turkmen Lake Altyn Asyr" [18], and that is why this information was not included in this chapter.

Thus, long-term and large-scale construction covering almost the entire territory of the country (by the way, not only of Turkmenistan but partially of neighboring Uzbekistan) has led to redistribution of huge volumes of water and to the emergence of the artificial, along with the natural one, hydrographic network consisting of different types of canals, the main ones of which are irrigation canals (main and secondary irrigation) and drainage canals – tertiary, secondary, and main. The network of canals as a system of complex hydraulic constructions with numerous branches is a zone of underflooding on the vast, usually low areas in different parts of the Karakum Desert. However, irrigated and developed were not only desert areas but also territories inside oasis, previously not cultivated in the end deltas of the Murgab and the Tejen, on the piedmont plains of Kopetdag, as well as newly developed lands (wildlands), such as arrays of Khauzkhan and Shasenem. Irrigation construction on the plains of Turkmenistan and the corresponding transformation of ecosystems has been continuing till now.

In the first half of the last century in the valleys of the Amu Darya, the Murgab and the Tejen wintering areas witnessed a relatively small number of waterbirds; however due to a large number of water bodies that appeared (reservoirs, large and small lakes, drainage floods) in the Karakum were formed wetlands' habitats, which serve as places of concentration of waterfowl during migration and wintering and during the nesting period. This is especially true for the southern half of the country. In addition there emerged huge territories of agricultural lands, where in the second half of the last century there were mainly cotton fields, but during last 20 years it has changed towards winter cereals and forage crops. As a result, there emerged places with good food supply not only for White-fronted and Greylag Geese and Ruddy Shelducks, but also Common Cranes; when these fields are filled with irrigation water or meltwater, then some dabbling ducks also concentrate there. Finally, as a result of climate warming, an essential role plays continuation of vegetation of native grasses and weed plants, in free, as well as in flooded or underflooded sandy areas or winter fields.

In the hydrographic network of Altyn Asyr (Fig. 1) we identified 67 wetlands (sites), combined into 9 districts, of which 13 water bodies (19.4%) were not surveyed.

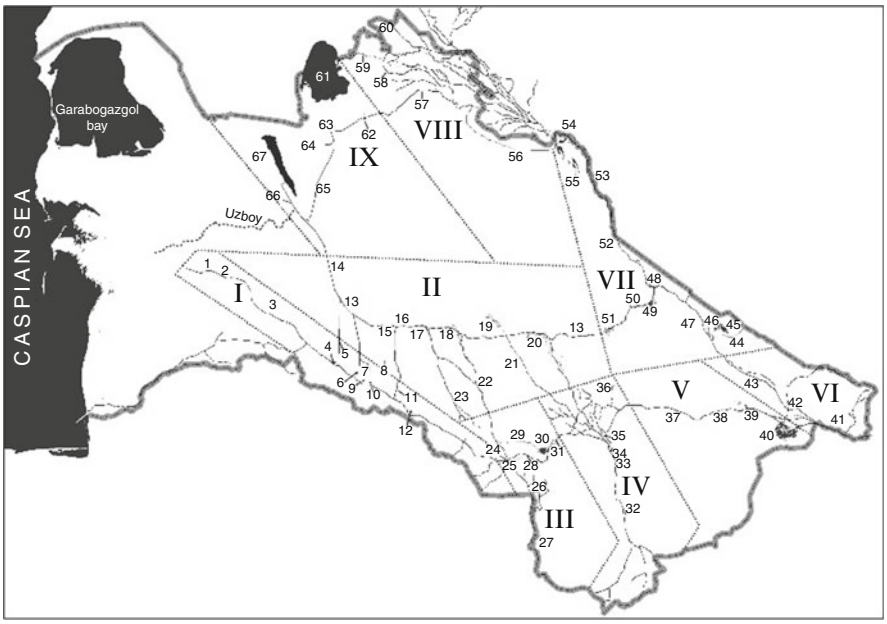

Fig. 1 Wetlands of the hydrographic network of Altyn Asyr: I. Near-Kopetdag Region: 1 – Chokrak Lake, 2 – Donuzaji Lake, 3 – Uzynshor flooded area, 4 – Kopetdag Reservoir, 5 – Geokdepe Collector (Akhal flooded area), 6 – Rukhabat Collector (Ovadandepe flooded area), 7 – Ashgabat Collector (Northern Ashgabat flooded area, Djaparlytakyr Collector and Lake 37th km), 8 – Akbugday or Gyaur Collector (Lake Bozkel, Chukurtakyr and Deryatakyr flooded areas), 9 – Kurtli Water Reservoir, 10 – Ashkhabad Water Reservoir, 11 – Lake Mergen (the former Lake Kulankyrlan), 12 – Gyaurs Fishery; II. Central Karakum Region: 13 – Main Turkmen Collector, Altyn Asyr, and flooded areas: 14 – Atabeg, 15 – Mollakurban, 16 – Kelili, 17 – Garajaovlak, 18 – Ayrakly, 19 – Khangui and Gushliburun, 20 – Djarsay flooded area and Djarsay Collector, 21 – Murghab or Shikhmansur Collector, 22 – Tejen or Garavekil Collector, 23 – Kaka Collector or former Soltandesht flooded area; III. Tejen-Khauzkhan Region: 24 – Tejen Fishery, 25 – Tejen Water Reservoir, 26 – Khorkhor Water Reservoir, 27 – Dostluk Water Reervoir, 28 – Main Canal, 29 – Karakum Darya in the limits of Khauzkhan oasis, 30 – Khauzkhan Water Reservoir, 31 – Karakum Darya between settlement Energetik and Khauzkhan Water Reservoir, IV. Murgab Region: 32 – Saryazy Water Reservoir, 33 – Soltanbent Water Reservoir, 34 – Yelotan Water Resrvoir, 35 – Gindikush Water Reservoir, 36 – Seyrab flooded area (5th water discharge); V. Kelif Region: 37 – Karakum Darya between settlements Zakhmet and Nichka, 38 – Karakum Darya between settlements Nichka and Karametniyaz; 39 – Kelif Lakes; 40 – Zeyit Water Reservoir; VI. Upper Amu Darya Region: 41 – Amu Darya between settlements Kelif and Mukry, 42 – Amu Darya between settlements Mukry and Atamurat (former Kerki), 43 – Amu Darya between settlements Atamurat and Garabekaul; VII. Middle Amu Darya Region: 44 – Mekhejan Collector and flooded area, 45 – Lake Soltandag, 46 – Lakes Kyzylburun, Taylak and Turangyldyz, 47 – Amu Darya between settlement Garabekaul and Turkmenabat Town, 48 – Amu Darya between Turkmenabat and Seidi (former Neftezavodsk) towns, 49 – Lake Ulyshor (former Kattashor), 50 – Lake Rakhmankel (former Ramankeldogajik), 51 – Lake Eraji, 52 – Amu Darya between settlements Seidi and Birata (former Darganata), 53 – Amu Darya Valley between settlement Birata and Tuyamuyun Water Reservoir, 54 – Tuyamuyun Water Reservoir, 55 – Soltansanjar Water Reservoir; VIII. Lower Amu Darya Region: 56 – Turkmen Darya (former Ilyaly Canal), 57 – Malyab Canal, 58 – Dostluk or Kolli Collector, 59 – Daryalyk Collector, 60 – Lake Kernay or Aybovur; IX. Sarykamysh Region: 61 – Lake Sarykamysh, 62 – Lake Zengibaba or Goyungyrlan, 63 – Lake Uzynshor, 64 – Lake Atabayshor, 65 – Dashoguz Collector, 66 – Akyaila flooded area, 67 – Turkmen Lake Altyn Asyr (project)

By the mid-1980s irrigation and drainage lakes of the future hydrographic network of Altyn Asyr became a prominent, if not a dominant type of wetlands of Turkmenistan. Drainage lakes turned out to be so to say ecological oases – areas of biological diversity maintenance, on the other hand, they have become involved in the socioeconomic sphere and are used for recreation, fishing, hunting, and cutting reed, etc. Preservation or loss of their social and environmental significance depends largely on their current state, that is on the stage of ecological succession, speed and direction of the main processes of succession, as well as on possible technical reclamation activities and solutions, which might predetermine environmental progress or ecological regression of these ecosystems and, therefore, maintenance or loss of their biosphere and socially useful functions.

3 Composition and Status of Wetland Birds

Of the 135 species of wetland birds of the avifauna of Turkmenistan for water bodies of the hydrographical network of Altyn Asyr 120 species are considered here, of which at the time of special accounts (2005–2011) authors registered in total 81 species, 27 species were met during the examination of water bodies during other periods, and 12 species were included based on the published data. The greatest number of species was found in Waders – 40 species (33.3%), and also in *Anseriformes* – 27 (22.5%), among which – dabbling, diving ducks, and shelducks (respectively, 10, 9, and 2 species), Geese (4 species) and Swans (2), and the remaining groups – Grebes (5 species), Pelicans and Cormorants (2 species each), Herons (9), Ibises (2), Storks (1), Flamingo (1), Cranes (3), Rails (8), Skuas (2), Gulls (10), and Terns (8).

Diversity and status of birds according to the nature of travel and their relative abundance are shown in Table 1, which demonstrates that 16 species may be met in water bodies throughout the year, that is, both during the nesting time and during seasonal flights and wintering. Nesting birds have 41 species, or one third of the registered species; migratory and wintering birds – 27 species. It should be noted that the birds are distributed in wetlands of the hydrographic network of Altyn Asyr unevenly, which depends both on the ecological characteristics of a particular bird species and on the location of the corresponding water body in relation to the transit routes of birds and its biotope conditions, which determines, in its turn, its capacity as a wetland in a given season. Figures 2, 3, 4, 5, and 6 show 30 different wetland birds.

4 Population Dynamics

Long-term changes in the population of waterfowl during wintering can be examined based on the example of Kelif Lakes as a model area of the southern half of the hydrographic network of Altyn Asyr, where the bird census has been held since

Table 1 Species diversity and status of waterbirds at water bodies of the network of Altyn Asyr

	All water bodies (except of Altyn Asyr Lake)				Altyn Asyr Lake (after filling by water)				
Character of stay species (shown in figures 2–31 with the same numbers)	Summer staging	Migrating–breeding	Migrating	Wintering	First stage – Ak-Yaila flooded areas, present state	Summer staging	Migrating–breeding	Migrating	Wintering
Little Grebe[2] – *Tachybaptus ruficollis*	X	XXX	XXX	XX	+	X	XX	XXX	X
Great Crested Grebe – *Podiceps cristatus*		XX	XXX	XXX	+		X	XXX	X
Red-necked Grebe – *Podiceps grisegena*			X	X	+			X	X
Horned Grebe – *Podiceps auritus*			X	X				X	X
Black-necked Grebe – *Podiceps nigricollis*	X	X	XXX	XX	+	X	X	XX	X
Great White Pelican[3] – *Pelecanus onocrotalus*		X	XX	X				X	
Dalmatian Pelican – *Pelecanus crispus*		X	XX	XX				X	
Great Cormorant[3] – *Phalacrocorax carbo*	XXX	XXX	XXXX	XXXX	+	XX	XXX	XXX	XX
Pygmy Cormorant – *Phalacrocorax pygmaeus*		X	XX	XX			X	X	
Eurasian Bittern[4] – *Botaurus stellaris*		XX	XXXX	XXX			XX	XXXX	XXX
Little Bittern – *Ixobrychus minutus*		XX	XXXX	X	+			XX	
Black-crowned Night Heron – *Nycticorax nycticorax*	X	XX	XXX		+	X	X	XX	

(continued)

Table 1 (continued)

Character of stay species (shown in figures 2–31 with the same numbers)	All water bodies (except of Altyn Asyr Lake)				Altyn Asyr Lake (after filling by water)				
	Summer staging	Migrating–breeding	Migrating	Wintering	First stage – Ak-Yaila flooded areas, present state	Summer staging	Migrating–breeding	Migrating	Wintering
Squacco Heron – *Ardeola ralloides*	X	X	X						
Cattle Egret – *Bubulcus ibis*	X	X	X						
Great Egret[5] – *Ardea alba*	XXX	XX	XXXX	XXX	+	XX	XX	XXX	X
Little Egret – *Egretta garzetta*	X	XXX	XXX	X			XX	XXX	
Grey Heron – *Ardea cinerea*	XX	XXX	XXX	XX	+	XX	XX	XXX	X
Purple Heron[6] – *Ardea purpurea*	X	XX	XX			X	X	XX	
Common Spoonbill – *Platalea leucorodia*			XX					X	
Glossy Ibis[7] – *Plegadis falcinellus*		X	XXX				X	XX	
Black Stork – *Ciconia nigra*			XX	XX					
Greater Flamingo[8] – *Phoenicopterus roseus*				XX		X	?	XXX	
Mute Swan – *Cygnus olor*	XX	XX	XXX	XXX	?	X	X	X	XX
Whooper Swan – *Cygnus cygnus*			XX	XXX	?			XX	XX
Greater White-fronted Goose[9] – *Anser albifrons*			XXXX	XXXXX				XXX	XXX
Lesser White-fronted Goose – *Anser erythropus*			XX	XX				XX	X
Greylag Goose[10] – *Anser anser*			XXXXX	XXXXX				XXXX	XXX

Ruddy Shelduck – *Tadorna ferruginea*	XX	XXX	XXX	XXXX	+	XX	XXX	XXX	XXX
Common Shelduck – *Tadorna tadorna*	XX	XXX	XXX	XXX	+	XX	XXX	XXX	XXX
Eurasian Wigeon[11] – *Anas penelope*	X		XXXX	XXXX	+			XXX	XX
Gadwall – *Anas strepera*	XX	X	XXXX	XXX	+	X	X	XXX	XX
Eurasian Teal – *Anas crecca*	X		XXXXX	XXXXX	+	X		XXXX	XXX
Mallard – *Anas platyrhynchos*	XXX	XXX	XXXXX	XXXXX	+	XXX	XXX	XXXXX	XXX
Northern Pintail[12] – *Anas acuta*			XXXX	XX				XXXX	X
Garganey – *Anas querquedula*			XX	X				XX	
Northern Shoveler – *Anas clypeata*			XXX	XX				XXX	X
Marbled duck – *Marmaronetta angustirostris*		X	XX	XX			X	X	
Red-crested Pochard[13] – *Netta rufina*	X	XX	XXXXX	XXXXX	+	X	XX	XXXX	XXXX
Common Pochard[14] – *Aythya ferina*			XXXXX	XXXXX	+			XXXX	XXXX
Ferruginous Duck[15] – *Aythya nyroca*	X	XX	XX	XXX		X	XX	XX	XX
Tufted Duck[16]– *Aythya fuligula*			XXXX	XXXXX	+			XXXX	XXXX
Greater Scaup – *Aythya marila*			XX	XX				XX	XX
Common Goldeneye – *Bucephala clangula*			XXX	XXX				XXX	XX
Smew – *Mergellus albellus*			XXX	XXX				XXX	XX
Red-breasted Merganser – *Mergus serrator*			XX	XXX				XX	XX

(continued)

Table 1 (continued)

Character of stay species (shown in figures 2–31 with the same numbers)	All water bodies (except of Altyn Asyr Lake)				Altyn Asyr Lake (after filling by water)				
	Summer staging	Migrating–breeding	Migrating	Wintering	First stage – Ak-Yaila flooded areas, present state	Summer staging	Migrating–breeding	Migrating	Wintering
Common Merganser – *Mergus merganser*			XXX	XXX	+			XXX	XX
White-headed Duck[17] – *Oxyura leucocephala*			XX	XX				XX	X
Common Crane – *Grus grus*			XXXXX	XXX				XXXX	
Water Rail – *Rallus aquaticus*			XXXX	XXX	+			XXXX	XX
Little Crake – *Porzana parva*	X	X	XX			X	X	XX	
Baillon's Crake – *Porzana pusilla*	X	X	X			X	X	X	
Common Crake – *Porzana porzana*	X		XX			X		XX	
Corn Crake – *Crex crex*			XX					XX	
Common Moorhen[18] – *Gallinula chloropus*	X	XXX	XXXX	XXX	+	X	XXX	XXXX	XX
Purple Swamphen – *Porphyrio porphyrio*		XXX	XXX	XX			XX	X	
Eurasian Coot[19,20] – *Fulica atra*	XX	XXX	XXXXX	XXXXX	+	XX	XXX	XXXXX	XXXX
Stone Curlew[21] – *Burhinus oedicnemus*		XXX	XXXX		+		XXX	XXXX	
Little Ringed Plover[22] – *Charadrius dubius*	XX	XX	XXX		+	XX	XX	XXX	
Ringed Plover – *Charadrius hiaticula*		XXX	XXX				XXX	XXX	

Kentish Plover – *Charadrius alexandrinus*	XX	XXX	XXXX	XXX	+	XX	XXX	XXXX	XXX
Greater Sand Plove – *Charadrius leschenaultia*	XX	X	XX		+	XX	X	XX	
Caspian Plover – *Charadrius asiaticus*	X		XX			X		XX	
Eurasian Golden Plover – *Pluvialis apricaria*			X					X	
Grey Plover – *Pluvialis squatarola*			XX	XX				XX	XX
White-tailed Lapwing[23] – *Vanellus leucurus*			XXXX	X	+			XXXX	
Red-wattled Lapwing – *Vanellus indicus*		XX							
Northern Lapwing – *Vanellus vanellus*			XXXX	XXX				XXX	X
Ruddy Turnstone – *Arenaria interpres*		X	XX				X	XX	
Black-winged Stilt[24] – *Himantopus himantopus*		XXXX	XXXX		+		XXX	XXXX	
Pied Avocet – *Recurvirostra avosetta*			XXX					XXX	
Eurasian Oystercatcher – *Haematopus ostralegus*		XX	XXX				XX	XXX	
Little Stint[25] – *Calidris minuta*			XX					XX	
Temminck's Stint – *Calidris temminckii*			XX					XX	
Curlew Sandpiper – *Calidris ferruginea*			XXX					XX	
Dunlin – *Calidris alpina*		XXXX	XXXX		+		XXX	XXXX	

(continued)

Table 1 (continued)

Character of stay species (shown in figures 2–31 with the same numbers)	All water bodies (except of Altyn Asyr Lake)				Altyn Asyr Lake (after filling by water)				
	Summer staging	Migrating–breeding	Migrating	Wintering	First stage – Ak-Yaila flooded areas, present state	Summer staging	Migrating–breeding	Migrating	Wintering
Broad-billed Sandpiper – *Limicola falcinellus*		X					X		
Ruff – *Philomachus pugnax*	XX		XXXX		+	XX		XXXX	
Jack Snipe – *Lymnocryptes minimus*			XXX					XXX	
Common Snipe – *Gallinago gallinago*			XXX	XX				XX	
Eurasian Woodcock – *Scolopax rusticola*			XX	XXX				XX	
Black-tailed Godwit – *Limosa limosa*			XXX	XX				XXX	X
Whimbrel – *Numenius phaeopus*			XXX	XX				XXX	
Eurasian Curlew – *Numenius arquata*			XX	XX				XX	
Spotted Redshank – *Tringa erythropus*			XX	X				XX	X
Common Redshank[26] – *Tringa totanus*		XX	XXXX	XXXX	+		XX	XXXX	XX
Marsh Sandpiper – *Tringa stagnatilis*			XXX	XX				XXX	X
Common Greenshank[27] – *Tringa nebularia*			XX	X				XX	X
Green Sandpiper – *Tringa ochropus*			XXX	XXX				XXX	XX

Wood Sandpiper – *Tringa glareola*			XXXX		+			XXXX	
Terek Sandpiper – *Xenus cinereus*			XX					XX	
Common Sandpiper – *Tringa hypoleucos*			XX	X				XX	
Red-necked Phalarope[28] – *Phalaropus lobatus*			XXXXX		+			XXXXX	
Collared Pratincole – *Glareola pratincola*		XX	XXX				X	XXX	
Black-winged Pratincole – *Glareola nordmanni*			X					X	
Pallas's Gull[29] – *Larus ichthyaetus*	X	XX	XXX	XX		X	XX	XXX	
Little Gull – *Larus minutus*			XX	XX				XX	
Black-headed Gull[30] – *Larus ridibundus*	XX		XXXXX	XXXX	+	XX		XXXXX	XX
Slender-billed Gull – *Larus genei*		XX	XXX	X			XX	XXX	
Mew Gull – *Larus canus*			XXX	XXX				XXX	XX
Caspian Gull – *Larus cachinnans*		XXX	XXXX	XXXX	+		XXX	XXXX	XXX
Gull-billed Tern – *Sterna nilotica*		XX	XX				X	XX	
Sandwich Tern – *Sterna sandvicensis*		XXX	XXX				XXX	XXX	
Caspian Tern[31] – *Sterna caspia*		XX	XX				XX	XX	
Common Tern – *Sterna hirundo*		XXXX	XXXXX		+		XXXX	XXXX	

(continued)

Table 1 (continued)

Character of stay species (shown in figures 2–31 with the same numbers)	All water bodies (except of Altyn Asyr Lake)				Altyn Asyr Lake (after filling by water)				
	Summer staging	Migrating–breeding	Migrating	Wintering	First stage – Ak-Yaila flooded areas, present state	Summer staging	Migrating–breeding	Migrating	Wintering
Little Tern – *Sterna albifrons*		XXX	XXX				XXX	XX	
Whiskered Tern – *Chlidonias hybridus*	XX		XXX			XX		XX	
Black Tern – *Chlidonias niger*	X		X			X		X	
White-winged Tern – *Chlidonias leucopterus*	XX		XX			XX		XX	

Population estimation: X – singular encounter; XX – rare; XXX – not numerous; XXXX – common; XXXXX – numerous)

Comments: 2–31 – number of figures with the corresponding bird species. Vagrant birds that are not registered at the time of the field work and made listed by the authors from the literature: Swan goose – *Anser cygnoides*, Siberian Crane – *Grus leucogeranus,* Demoiselle Crane – *Grus virgo,* Mongolian plover – *Charadrius monqolus,* Eurasian Dotterel – *Ch. morinellus,* Sanderling – *Calidris alba,* Great Snipe – *Gallinago media,* Bar-tailed Godwit – *Limosa lapponica,* Red Phalarope – *Phalaropus fulicarius,* Pomarine Jaeger – *Stercorarius pomarinus,* Parasitic Jaeger – *St. parasiticus*, Ross's Gull – *Rhodostethia rosea*

Fig. 2 (**a**) Little Grebe (photo – Suleiman Kankul). (**b**) Great White Pelicans and Great Cormorants (photo – Arazmyrat Amanov). (**c**) Eurasian Bittern (photo – Suleiman Kankul). (**d**) Great Egret (photo – Suleiman Kankul). (**e**) Purple Heron (photo – Suleiman Kankul). (**f**) Glossy Ibises (photo – Evgeny Agryzkov)

1967. From the very first it should be noted that in the 45-year period wetlands of the hydrographic network of Altyn Asyr have witnessed changes, whose main feature has been the reduction in the total number of birds, annual changes in the ratio of wintering birds species.

The total number of birds on Kelif Lakes is characterized by sharp fluctuations in different years (Fig. 7). For example, in the winter of 1973/1974 more than 450,000 birds of all species of *Anseriformes* and other wetland birds were counted, in 1983/1984 – only 2,000 birds. In all years of counts, on average, there were 53,800 birds counted. Significant fluctuations are characteristic also for the number of species (in average 14 species were observed): in the unusually cold winters of 1968/1969, 1971/1972, and 1976/1977, when these lakes and other water bodies were almost

Fig. 3 (**a**) Greater Flamingo (photo – Suleiman Kankul). (**b**) Greater White-fronted Goose (photo – Nicky Petkov). (**c**) Greylag Goose (photo – Lars Lachmann). (**d**) Eurasian Wigeon (photo – Nicky Petkov). (**e**) Northern Pintail (photo – Nicky Petkov). (**f**) Red-crested Pochard (photo – Nicky Petkov)

completely frozen, there were recorded from 5 to 9 species, in the warmer, more favorable winters of 1973/1974, 1975/1976, 1977/1978, and 2001/2002 – from 21 to 25 species.

The dominant species on the lakes are Eurasian Coot, from *Anseriformes* – Mallard and Red-crested Pochard; their share, based on the average data, is, respectively, 30.7%, 21.9% and 14.9%. Codominants (1–10%) are Eurasian Wigeon, Gadwall, Eurasian Teal, Northern Pintail, Northern Shoveler, Common Pochard, Tufted Duck. In the category of rare species (<1%) – Pelicans, Cormorants, from *Anseriformes* – Mute Swan and Whooper Swan, Greylag Goose, Ruddy Shelduck, Common Goldeneye, Common and Red-breasted Mergansers, Smew, and Lesser White-fronted Goose, Ferruginous, White-headed and Marbled Ducks.

Fig. 4 (**a**) Common Pochard (photo – Nicky Petkov). (**b**) Ferruginous Duck (photo – Nicky Petkov). (**c**) Tufted Duck (photo – Nicky Petkov). (**d**) White-headed Duck (photo – Nicky Petkov). (**e**) Common Moorhen (photo – Suleiman Kankul). (**f**) Eurasian Coot (photo – Vladislav Vasiliev)

Dynamics of the population correlation for the major groups of waterfowl has always depended on the degree of development and transformation of these lakes. For instance, in the late 1960s and the beginning of 1970s along with the stable maintenance of their level, set and controlled from the late 1950s, there was rapid development of surface and especially underwater vegetation (by the way, that's exactly the time when the issue was resolved regarding the release and growth of herbivorous fish – grass carp [*Ctenopharyngodon idella* (Valnciennes)] and silver carp (*Aristichthys nobilis* Rich) into Kelif Lakes, and, as a consequence, phyto- and zoobenthos. The result is good food supply for wintering of the birds of the wetland complex that eat both plant and animal food. It is no coincidence that the population of birds started to increase exactly in that period. The percentage of Eurasian Coot

Fig. 5 (**a**) Flying Coots (photo – Robert Kozubov). (**b**) Stone Curlew (photo – Yashin Atajanov). (**c**) Little Ringed Plover (photo – Suleiman Kankul). (**d**) White-tailed Lapwing (photo – Suleiman Kankul). (**e**) Black-winged Stilt (photo – Suleiman Kankul). (**f**) Little Stint (photo – Suleiman Kankul)

was the highest in 1968–1972 and in the average totaled 56%, which reduced the percentage of Diving ducks (29%, of which 27% was Red-crested Pochard) and Dabbling ducks (13%), whose populations were also high. One can assume that such a pattern existed earlier, since the beginning of the 1950s when surveys were not conducted.

The mid-1980s were characterized by strong siltation of lakes, which led to their almost complete degradation and loss of their feeding value both for Eurasian Coot and for *Anseriformes*. In 1984–1988 the percentage of dabbling ducks (16%, of which 10% Mallard) and diving ducks (39%, including Red-crested Pochard – 26%) increased compared with the previous period; the percentage of Eurasian Coot decreased (to 27%). These changes occurred along with the sharp fall in the total

Fig. 6 (**a**) Common Redshank (photo – Suleiman Kankul). (**b**) Common Greenshank (photo – Suleiman Kankul). (**c**) Red-necked Phalarope (photo – Suleiman Kankul). (**d**) Pallas's Gulls (photo – Yashin Atajanov). (**e**) Black-headed Gull in winter plumage (photo – Suleiman Kankul). (**f**) Caspian Tern Colony (photo – Yashin Atajanov)

number, so we can talk only about the decrease in the percentage of Eurasian Coot and not about the actual increase in the number of Diving ducks. For the majority of wetland birds, except for Waders and, to some extent, *Ciconiiformes*, wintering conditions gradually worsened. On the other hand, the slow sedimentation led to a habitat patches, which apparently caused an increase in a variety of other birds (up to 18%).

In 2002–2006, when Kelif Lakes in the form in which they were three decades ago almost ceased to exist, the process of construction and expansion of the reservoir Zeyit was started in the southeast of Kelif Uzboy and wintering of birds had been "transferring" to it. The emerged water body is under the filling process; the banks, especially the southern ones, are being blurred, so the strip of coastal

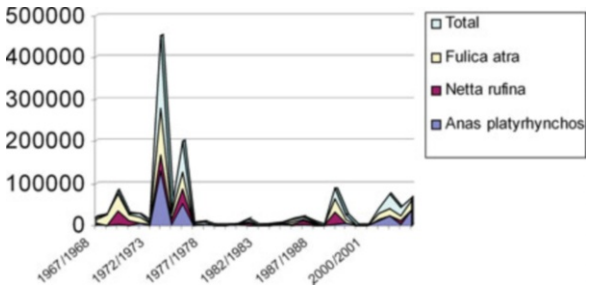

Fig. 7 Long-term dynamics of the population of common species of wetland birds on Kelif Lakes

vegetation in many places has not been formed yet. In recent years, the total number of birds here began to increase significantly, despite the disturbing factor due to randomly developing fisheries. The ratio of groups of species has also changed. The percentage of Eurasian Coot does not exceed, on average, 34%; the percentage of dabbling ducks (41%) has increased as never before, especially that of Mallard (36%), however the percentage of diving ducks has fallen to the minimum (20%); among diving ducks the percentage of Red-crested Pochard and that of Common Pochard total 5% and 10%, respectively. The water body still doesn't have sufficient underwater plant matter, phyto- and zoobenthos. The process of wintering formation at Zeit Water Reservoir is most likely to be similar to the process of filling the depressions of Kelif Uzboy and wintering formation there in the 1950s, but then there was a higher number of birds of the wetland complex.

The dynamics of birds' population in these lakes, apparently, is typical also of other wintering areas of the southern half of the hydrographic network of Altyn Asyr, and to a large extent correlates with the cycles of population changes (of course, with different quantitative figures) of waterbirds in the nesting habitats along with the decadal climate change in Central Asia. Thus, according to Krivenko [19], at the end of the warm and dry period of the 1960s compared to the previous decade, everywhere, including in Kazakhstan (and in the south of Western Siberia), a relatively small population of wetland birds was determined by a general increase in aridity. In addition, at the same time a disturbing factor greatly increased, which led, among other negative factors, to the dramatic decline in the abundance of birds. However, in the next cool and moist period, with significant abundance of water, although brief (1970–1972), the number of breeding pairs in these regions increased by 50%. Apparently, therefore, their abundance in the wintering areas in Turkmenistan, in particular, on Kelif wetlands, also increased dramatically (on an average, from 22,183 to 119,213 birds). In 1973–1979 in this vast region a warm and dry period was again developing, which, coupled with anthropogenic pressure, caused in Kazakhstan and Southern Siberia sharp regression of lake systems and a reduction in the population of nesting birds from 1.8 to 0.9 million pairs [19].

This also coincides with a double reduction in their abundance also on Kelif Lakes (on an average, from 119,213 to 62,182 birds). Then – again a cool-wet phase of 1980–2005, which lasted up to the present time [20]. Along with the increasing irrigation there was a noticeable increase in the population of a number of species in

the nesting field, such as Greylag Goose, Eurasian Coot, Ruddy Shelduck, Common Shelduck, and Mute Swan [19]. However, the growing impact of the anthropogenic factor suppressed the natural tendency of the population growth [21, 22], which had a negative effect on the population of waterbirds, particularly *Ciconiiformes,* and it continued to decrease. Apparently it is no coincidence that in Kelif wintering areas their population in the second half of the 1980s fell by more than six times (on an average, from 62,182 to 9,528 birds). However, the number of birds on these lakes later stabilized and started to increase, by also six times – on an average, from 9,528 to 61,325 birds. Still, based on the average performance, this figure is twice less than it used to be in the first half of the 1970s.

5 The Role of the Lake as a Promising Wetland of the Hydrographic Network of Altyn Asyr and as One of the Important Birds' Areas of Turkmenistan

The Karashor Depression, reserved for the Turkmen Lake Altyn Asyr, more specifically, its northern and eastern parts, is not yet a wetland in the truest sense of the word. However, it is considered one of the Important Birds' Areas (IBAs) not only of Turkmenistan but also of Central Asia [23]. Among 50 IBAs of Turkmenistan wetlands total 32 (64%), of which 9 (18%) are coast-marine and 23 (46%) are part of the hydrographical network of Altyn Asyr. Three wetland IBAs (Fig. 1) are located most closely to Altyn Asyr, because they are situated in the area of a single flyway of wetland birds. This is an IBA, which covers the ancient riverbed Uzboy to the southwest of Karashor (see Fig. 1) and two IBAs to the northeast – Sarykamysh and Zengibaba (or Goyungyrlan).

Currently, in the IBA Karashor we have found: resident birds – 10 species, migrating–breeding – 20, migrating–wintering – 8, migrating – 85. Since the Karashor Depression has not been filled yet, there prevails a complex of plain-chink species, of the so-called desert type of avifauna. Among resident birds, in the nesting areas there can be observed: Saker Falcon, Golden Eagle, Long-legged Buzzard, Chukar, Rock Pigeon, Eurasian Eagle-Owl, Little Owl, Brown-necked Raven, Streaked Scrub-Warbler, etc.; among migratory-nesting species – Egyptian Vulture, Short-toed Snake-Eagle, Common Kestrel, Greater Sand Plover, Alpine Swift, Finsch's Wheatear, Eurasian Hoopoe, etc. All of these are associated with chinks and ravines of the eastern and northern parts of Karashor, except for Greater Sand Plover, which is found on the outskirts of the solonchak and on the takyrs at the western border of the depression. After filling of the depression a complex of waterbirds should be formed (see below).

On Sarykamysh there is already a formed complex of birds, numbering in total more than 250 species. Among them there are more than 100 species of wetland birds, including 24 species of *Anseriformes* [16], and their total number currently is more than 20,000 in all seasons, except for unusually cold winters when Sarykamysh

gets frozen. Naturally, the proportion of the number of different species changes. Among endangered species – Dalmatian Pelican nests and stops during migration, and Ferruginous Duck also migrates. Moreover, the number of some species under IUCN/Birdlife International criteria exceeds the 1% level of their biogeographic populations: Dalmatian Pelican and Great White Pelican, Great Cormorant and Pygmy Cormorant, Common Pochard and Tufted Duck and Gull-billed Tern. Also there nest the following birds: Pallas's Gull and Caspian Gull. During migration the following ones dominate: Eurasian Coot, Mallard, Red-crested Pochard, Common Pochard and Tufted Duck. Among the species of codominants – Eurasian Wigeon, Gadwall, Eurasian Teal, Northern Pintail, Northern Shoveler, etc. On the neighboring in the east and west chinks of South Ustyurt following predatory birds nest: Golden Eagle, Common Kestrel and, probably, Lesser Kestrel; Saker Falcon and others; during migration and wintering there can be observed White-tailed Eagle, Steppe Eagle, and Eastern Imperial Eagle.

Lake Zengibaba (Goyungyrlan), as a wetland and IBA, supports waterbirds in the warm season, because in winter the lake usually freezes. Properties of the complex of wetland species that stay here during seasonal migration are characteristic for the lake, but their population is not as big as on Sarykamysh. Basically, these are: ducks, coots, waders, gulls and some terns, of which Gull-billed Tern can nest. However, one should also pay attention to the species that normally are not characteristic for aquatic biotopes, such as Saker Falcon and Lesser Kestrel, individual pairs may nest at the southern coast of the IBA on the remnant hill of Goyungyrlan.

After filling of the Ak-Yaila Depression (from the Ak-Yaila well till the Gumsepshen well), that is, upon the final completion of the 1st phase of the project, the water will go into the Karashor Depression, and the Turkmen Lake Altyn Asyr can be regarded then as a new intrazonal habitat of birds, including not only solonchaks and gullies-chink biotopes but also wetland biotopes. The fact is that in the Karashor Depression a solonchak there was no vegetation originally, except for rare halophyte in small shallow saline lakes in the lowest places of the most northern part of the depression. On the eastern and north-eastern borders of the solonchak and along the elevated sections of the depression, where water in the near future will not come, in particular, along the ravines Uch-agyzchay coming down from the north – from the Kaplankyr Plateau, grow sparse Halocnemum associations (*Halocnemum strobilaceum*). Along the western border of Karashor there is a strip of takyrs with communities of blue-green algae and lichens with insignificant amount of ephemera and 1-year thistle. In the higher parts of this strip grow such half-shrubs as *Anabasis salsa* and various Russian thistle (*Salsola arbuscula, Salsola rigida, Salsola gemmascens*), sometimes even shrubs of black saxaul (*Haloxylon aphyllum*). Further and higher, already in the adjacent sand edge of Uchtagankum, vegetation cover consists of psammophyte-shrub groups. It is clear that such a habitat, which Karashor is now, in terms of wetland birds is not suitable for their existence and their permanent residence. Here one can briefly observe only small groups of shorebirds during their migrations.

In the long term the ecological situation and stability of the Turkmen Lake Altyn Asyr as a wetland ecosystem and habitat of wetland birds, of course, will largely depend on its weediness by underwater and coastal hydrophilous plants (Fig. 8). It is fairly safe to say that the development of hydrophilous vegetation and associated fauna, and the dynamics of waterfowl on the lake will correspond to the "Sarykamysh type". At depths up to 0.5 m, first grow various Pondweeds (*Potamogeton* sp.), at depths up to 1.5-m-thick reeds of Common reed (*Phragmites australis*), which will take most of the coastal strip, especially along the western shore. In addition to reed, in shallow water somewhere will grow Coon's tail (*Ceratophyllum demersum*), cane species of Club-rush (*Scirpus* sp.) and Cattail (*Typha* sp.). Depending on the extent and dynamics of water salinity one may predict the development of the algae: Stoneworts (*Charophyta*), as well as Spike Watermilfoil (*Myriophyllum spicatum*), Bladderwort (*Utricularia* sp.) and Duckweed (*Lemna* sp.).

The abundance of vegetation will contribute to the great diversity and biomass of aquatic invertebrates, which will serve as a corresponding food base for vertebrates and, above all, fish. Further, after aquatic organisms enter the lake, including fish, under corresponding conditions, self-replicating, growing in numbers populations should be forming, which over a short time will be able to provide food resources for such fish-eating birds as Gulls, Terns, Pelicans, Cormorants, to some extent, for Herons, and among prey species – for White-tailed Eagle, Eurasian Marsh Harrier and Osprey.

Currently wetland birds are seen only at the site of the 1st stage of Lake Altyn Asyr, that is, at the spills of Ak-Yaila. The number of species here is not more than 36, which is much less than in the same Sarykamysh and other water bodies of the hydrographic network of Altyn Asyr. This is despite the fact that the 1st stage is in the area of a historically formed flyway along the ancient riverbed of the West Uzboy. The water has been let flow through Ak-Yaila since the summer of 2009, but banks have not yet been covered with hydrophilous vegetation of the required thickness, which will create protection and feeding conditions for wetland birds, that is, conditions under which their diversity and population will be increasing.

Of course, it all depends on the actual volume of waste water inflow, based on which we can predict the water-salt balance of Lake Altyn Asyr. This is, in general, will determine the development of the flora and fauna of the lake and the surrounding areas, particularly vegetation, and animal populations, that depend on the vegetation, as already noted, fish, fish-eating and other wetland birds that are at the top of the emerging environmental (food) chain.

In the fauna of Turkmenistan there were as a whole revealed: 418 species of birds, of which 135 are wetland birds, including 33 *Anseriformes* [25], 27 of them are listed for the entire hydrographic network of Altyn Asyr. In fact, the total number of the birds at Lake Altyn Asyr, after its stabilization, can exceed 230 species; 116 will comprise the complex of wetland birds, including 46 nesting species (Table 1). According to our forecasts avifauna will be formed in the first place, on the basis of the birds species listed below. Mallard currently inhabits all the lakes of northern Turkmenistan, and it is more frequently observed during surveys at Lake Sarykamysh, so it will be one of the first to inhabit Lake Altyn

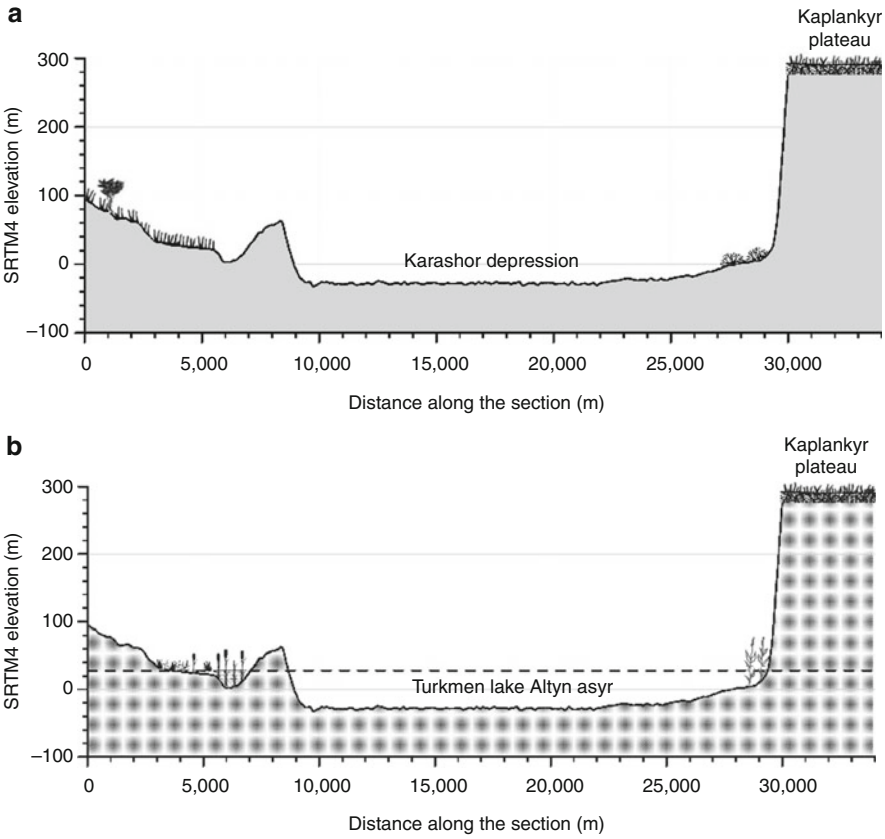

Fig. 8 The scheme of the profile of the Karashor Depression for the width of the Goklengui well before (**a**) and after (**b**) its filling

Asyr. But the number of mallards at nesting sites will be small due to the inability of the appearance of islands while flooding, except for one, 2 km east of the present Geklengui well as the rest of the bottom Karashor is flat; such islands could serve as a safe nesting place not only for Mallard, but also for other species of wetland birds. Eurasian Teal will be a migratory and wintering bird. It seems that Gadwall will become not a migratory, but also a nesting and even wintering bird. The future status of Eurasian Wigeon – just a migratory and wintering bird; Northern Pintail will be quite rare during migration, and Northern Shoveler will be a migratory and wintering bird. Red-crested Pochard in future will be a migratory and nesting bird and numerous in winter. Common Pochard will be seen both during migration and in winter. Ferruginous Duck in northern Turkmenistan is already now a rare migratory species; Tufted Duck is a migratory bird and stay for winter here, and will certainly be more numerous than Ferruginous Duck. Common Goldeneye, as well as on Sarykamysh, will be rare migratory and wintering bird. Smew in northern

Turkmenistan, as well as Common Merganser, migrates through and stays for winter regularly, but in small numbers, Red-breasted Merganser – even more rarely, only during migration. Ruddy Shelduck and Common Shelduck will no doubt nest, or maybe they already nest there; there are quite suitable nesting biotopes at Uzboy and at Karashor. Greylag Goose will not be numerous in winter and will be seen only during migration, as in the vicinity of the lake there will not be, at least in the near future, arable land for grain crops and fallow. Mute Swan will be a wintering species, and with appropriate development of the sloughs and the density of the reed will be able to nest. Whooper Swan will spend the winter with mute swans, but in small numbers. In addition, more or less common in winter and during migration will be Grebes, Pygmy and Great Cormorants, Grey Heron and Great Egret; among waders – Common Redshank, Black-winged Stilt and Avocet, Gulls and Terns. On the underflooded shallow areas there will be likely to be met Greater Flamingo, it is possible that this species will try to nest, as well as Great White Pelican and Dalmatian Pelican.

Of the birds that do not form the wetland complex, there will remain species inhabiting chinks (see above), and besides from other biotopes there will come birds that are not common for the wetland complex, particularly Common Pheasant, and synanthropic ones – Indian Myna, Eurasian Magpie, Eurasian Tree Sparrow, Laughing Dove and Eurasian Collared Dove and others.

Thus, in the future, the water surface of Lake Altyn Asyr, and most importantly – its dense riparian vegetation, should become a shelter for a lot of migratory and nesting birds and in warm winters – wintering wetland birds. This optimal picture can exist then development of vegetation will occur on the coastal stretches where the water line will be above the salt brine; it means that it would reach solid soil areas on the north-western edge of the depression, for example, in the well Geklengui, or water will flood at least low-lying parts of gullies and ravines of the northern and north-eastern chinks. The water level in the Lake Altyn Asyr will reach a point of about +28 m (absolute sea level), thus the maximum depth will reach 58 m.

It will not be crucial how much, in this case, the surface of the water body will be, because for a concentration of 20,000 wetland birds (minimum figure according to the IUCN/Birdlife International criteria that is needed for recognition of the international significance of a wetland as IBA) during their seasonal migrations (the water reservoir is located on one of the most important migration routes) you need not necessarily a certain surface of the water body (although it should not be <40 km^2), but its food resources and resistance to adverse weather conditions. The water table and the growth of the reservoir, of course, will depend on evaporation, direct precipitation and on the associated amount of temporary drains (for example, from the Kaplankyr Plateau along the dry riverbed Uch-agyzchay) into the basin with heavy rains, as well as on water filtration and its absorption by salt brine etc. The authors were not supposed to predict the actual water balance, that is why it is still difficult to say how the ecosystem of this wetland in terms of time will be developing. Mineralization of the accumulated in the lake waters should not exceed 10–12 g/l, the excess will have a negative impact on fish production [24]

and, in general, on biological productivity of Altyn Asyr, for example, as it is the case in Lake Sarykamysh, where in May 2009 we observed concentration of fish-eating and other wetland birds mainly in the near-mouth area and at the very mouth of Daryalyk at the eastern bank of Sarykamysh, but not at the opposite south-western banks, which indicates that large fish capacity remains in places where relatively "fresh", not strongly mineralized waters from Daryalyk penetrate.

After putting in operation Lake Altyn Asyr in northern Turkmenistan, along with wetlands Sarykamysh and Zengibaba (Goyungyrlan), in the next 10 years one more vast wetland will appear on the migratory route of the general direction from south-west to north-east, that connects the south-eastern Caspian Region through Uzboy corridor with delta of the Amu Darya and the Aral (with what is left of it). It should be noted that with the laying of the northern Dashoguz Collector two more small water bodies were formed – Uzynshor and Atabayshor (Fig. 1), the auxiliary role of which on the migratory route will also be positive. The branched location of the channels with water bodies in the desert not only in northern Turkmenistan, but also in its whole plain part has a positive effect on the migration situation and distribution of both wetland birds and terrestrial (with rare exceptions) birds. It seems essential to constantly monitor the environment and birds' population at the appropriate stages of flooding and the development of the Turkmen Lake Altyn Asyr.

6 Conclusions

1. The main purpose and objective of the Turkmen Main Collector of the Turkmen Lake Altyn Asyr is to collect and use, if possible, the whole collector-drainage water of Turkmenistan.
2. Favorable climate conditions on the plains of Turkmenistan and, as a consequence, good food supply, are the main prerequisites for the formation of wintering clusters of waterbirds on inland wetlands. However, the general lack of water resources on the plains of Turkmenistan in the beginning and in the middle of the twentieth century conditioned a small concentration of waterbirds on wetlands, especially in the winter period.
3. Large-scale construction, covering almost the entire flat part of the country, has led to redistribution of huge volumes of water and the formation of an artificial hydrographic network, one of the final stages of which is the Turkmen Lake Altyn Asyr. The authors propose the term of the "hydrographic network of Altyn Asyr", which unites 67 wetlands of 9 areas (basins).
4. Of 135 species of waterbirds of Turkmenistan, for wetlands of the hydrographic network of Altyn Asyr 120 species have been cited. The greatest number of species of waders – 40 species (33.3%), *Anseriformes* – 27 (22.5%), Grebes (5 species), Pelicans and Cormorants (2 species each), Herons (9), Ibises (2) and Storks (1), Flamingo (1), Cranes (3), Rails (8), Skuas (2), Gulls (10), and Terns (8).

On Lake Altyn Asyr after its filling and stabilization the total number of birds can exceed 230 species, of which 116 will be waterbirds, 46 of which may be nesting birds.

5. The dynamics of the population of waterbirds of the "hydrographic network of Altyn Asyr" to a large extent will be correlated with cycles of their population changes (of course, with different quantitative figures) in the nesting area along with interdecadal climate change in North and Central Asia.
6. The development of Lake Altyn Asyr as a wetland ecosystem will be determined by the volume of waste water inflow, based on which the water-salt balance of the lake will be forming, which in its turn will cause the biodiversity development of Lake Altyn Asyr, in the first place, vegetation and hydrobionts, on which will depend the composition and abundance of waterbirds that are at the top of the emerging food chain of the lake ecosystem.
7. Further forecasts of the development and stabilization of the Turkmen Lake Altyn Asyr as an ecosystem will depend on the timely and high-quality space and ground-based monitoring and control of the natural environment of this region, its biological component, in particular birds and their population dynamics.

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