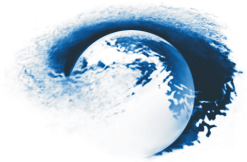


MICHAEL SUCCOW STIFTUNG
zum Schutz der Natur

MARION DÖNHOFF WORKING PAPER

The review of fauna and flora and its relation to water resources in the Ile-Balkhash Basin

Aiman Imentai
Dr. Niels Thevs
Sebastian Schmidt

CONTENT

Preface

This report reviews the literature on water resources, water management, flora and fauna of Lake Balkhash and the Ile Delta, which have been published since 1960s. Water level in Lake Balkhash is at 342 m and the requirement to maintain the natural value of the mean annual value is 341 m a.s.l. From 1990 there was an increasing trend of the runoff flowing into Lake Balkhash. After 2002 there is a decreasing trend at least until 2009. These two trends might be explained by natural climatic variability or land use and thus water consumption changes. The main water consumption in Kazakhstan as well as in China is irrigation. As in Kazakh part of the basin the total area of irrigation fields have decreased from 600 000 ha to 300 000 ha at the end of 1980s, the conversely happened in Xinjiang with China Western Development campaign. Kazakhstan with the support of UNDP and other stakeholders initiated the Integrated Water Resources Management to develop the water resources management. Since 2012 South Lake Balkhash and the Ile Delta is in the Ramsar List. Lake Balkhash and the Ile Delta provide a rich diversity of flora and fauna. The list of threatened fish, bird, and mammal species with an overview of flora is presented.

Keywords

closed river basin, water stress, Central Asia, wetland, dryland

1. Introduction

After the dessication of the Aral Sea (EC- IFAS, 2012; UNEP, 2014), Lake Balkhash has become the largest lake of Central Asia with an area of about 17 000 km^2. It is an endorheic lake in the south-eastern part of Kazakhstan. The Lake is divided into two parts: western and eastern by salinity. If western part of Balkhash has low salinity (1.1 g/l), the eastern part has four times higher with 4.3 g/l. (Petr 1992, Aladin et al. 2013). According to Aladin, Gulati, Isbekov, Plotnikov, Shivareva (2013) the reason of difference between two parts is inflow of the Ile River into western part. 70%-80% of the annual inflow into Balkhash Lake is provided by the Ile River, while the remaining 20%-30% stem from the four rivers Karatal, Aksu, Lepsi, and Ayaköz (Map 1).

Map 1: The Ile-Balkhash Basin

The Ile River's two source rivers, i.e. Künez and Tekes, originate in the Tian Shan Mountains in Xinjiang, China. Also the major tributary, the Kash River, has its headwaters in the Tian Shan Mountains in China.

Thus, about two thirds of the Ile runoff is generated in Xinjiang, China (Christiansen and Schöner, 2004). At its mouth, the Ile River has formed a delta with an area of approximately 8000 km^2 the Ile Delta is the largest natural delta on an inland lake of Central Asia, which still receives water permanently, after the Amu Darya Delta shrunk considerably in the course of the Aral Sea desiccation (Ramsar Convention, 2012).

Accordingly, the Ile Delta has been designated a Wetland of International Importance under the Ramsar Convention (Ramsar Convention, 2012): There are concerns that Lake Balkhash may desiccate like the Aral Sea due to water abstraction along its tributaries (UNEP, 2004). Central Asia is a region largely covered by drylands (MEA, 2005). Under such conditions water is the major driver for land use activities and the persistence of natural ecosystems with their biodiversity . The most productive and diverse ecosystems in the drylands of Central Asia are located along the rivers

(Ogar, 2003) i.e. reed beds (Thevs et al., 2007) and riparian forests (Thevs et al., 2012). Along the Ile River the irrigation is the main water consumer (Figure 2). As in Kazakh part of the basin the total area of irrigation fields have decreased from 600 000 ha to 300 000 ha at the end of 1980s, the conversely happened in Xinjiang with China Western Development campaign.

For regulation the water runoff of the transboundary rivers the Kazakh-Chinese comission was created in 2003. Several agreements were singed between two countries, however main question of water runoff from upstream to dowstream is under disccusion.

While much research work has been devoted to the Aral Sea (e.g. Kostianoy and Kosarev, 2010; Breckle et al., 2012) and to its tributaries[1] (e.g. Martius et al., 2012), the Ile-Balkhash Basin has received much less attention. We propose that the Ile-Balkhash Basin offers opportunities to study the interlinkages of natural ecosystems and biodiversity with water resource availability of an endorheic river basin with a rather undegraded terminal lake and wetland ecosystems. Furthermore, the water resource availability needs research, in order to assess the threats with regard to reduced inflow from the rivers of the Ile-Balkhash Basin and eventually develop water management approaches that help protecting the natural ecosystems and biodiversity in the Ile-Balkhash Basin.

Accordingly, the Ile Delta has been designated a Wetland of International Importance under the Ramsar Convention (Ramsar Convention, 2012): There are concerns that Lake Balkhash may

[1] **http://www.zef.de/khorezm.0.html**

2. Water resources and water use of Lake Balkash and the Ile Delta

During the 1960s, about 15 km^3 per year were drained into the Balkhash Lake, with about 12 km^3 per year coming from the Ile and 3 km^3 per year from the four minor rivers Karatal, Aksu, Lepsi, and Ayaköz. Additionally , about 3 km^3 per year precipitation fell over the lake surface so that the Balkhash Lake gained about 18 km^3 water per year. The area was 18 000 km^2. The annual evaporation was measured with 1000 mm in average, thus amounting to 18 km^3 per year and being equal to the water gained (Dostaj et al. 2006; Dostaj et al. 2012).

In 1970, the Kapchagay Reservoir on the Ile River (see Table 1) in today's Kazakhstan was filled and the area under irrigation was increased.

Thus, after 1970 the runoff of the Ile and the other rivers of the Ile Basin reaching Balkhash Lake shrunk from 12.9 km^3/a to 12.2 km^3/a (Petr 1992; Abdrasilov and Tulebaeva 1994). As the precipitation and the evaporation remained the same (Dostaj et al. 2006), the water balance of the lake turned into a minus (Petr, 1992, Guo et al., 2011). In 1983, the Balkhash Lake reached a water level of 341 m a.s.l., which was two meters below the level during the 1960s.The lake area shrunk to 16 000 km^2.

Meanwhile, between 1979 and 1983, in the upstream of the Ile River, in China the policy in agriculture has shifted from a collective- based to a family-based, which gave more freedom for them and increase the total value of agricultural outputs at 7.6 percent annually from 1979 to 1984 (Ezroj et al. 2008), which might also affected on the sharp decrease of lake.

However, the number of irrigation areas in western part of China is not available to consider the impact from upstream. 1988 was a turning point for the Ile River and Balkhash Lake, as the Kapchagay Reservoir was not further filled and as 1988 was an extremely wet year (Aladin and Plotnikov, 1993). By the end of the 1980s Kazakhstan had 600,000 ha irrigated fields along the Ile River (Tsytsenko 1988), which makes it the major water user in the Ile Basin. In 1993 to 1995, the inflow into Lake Balkhash reached 15 km^3 again. The total irrigation areas along the Ile River has shrunk to 300 000 ha in the year 2000 (Dostaj et al. 2006).

In 2002, it peaked with 26.3 km^3/a and showed a decreasing trend afterwards (Figure 2). Between 2000 and 2005 the irrigation systems in the Kazakh part of the Ile catchment have been restored, resulting in increasing water withdrawal (Starodubtsev and Truskavetskiy 2011). By 2009, the inflow into Lake Balkhash decreased to 15.7 km3/a. By 2003, the water level rose to 342 m a.s.l. (Tursunov, 2002; Propastin, 2008; Deng et al., 2011). Today, the water level still is at 342 m (Esekin et al., 2011). Also the water released from the Kapchagay Reservoir increased from the 1990s until today, as shown in Figure 1.

Table 1: Annual runoff of the Ile River and its tributaries before 1970

Ile catchment	**Annual runoff [km³]**
China	
Tekes	8,48
Kash	4,47
Künez	2,27
Rivers from the southern slope of the Zhetysuskij-Alatau	1,55
Rivers from the northern slope of the Uzynkara	0,27
Total runoff generated in China	**17,04**
Kazakhstan	
Rivers from the southern slope of the Zhetysuskij-Alatau	1,15
Rivers from the northern slope of the Uzynkara	1,58
Rivers from the northern slope of the Alatau und Shllek	2,60
Kurty	0,39
Rivers from the boundary between Ile and Chu catchments	0,10
Total runoff generated in Kazakhstan	**5,83**
Total runoff generated in the Ile Catchment	**22,8**

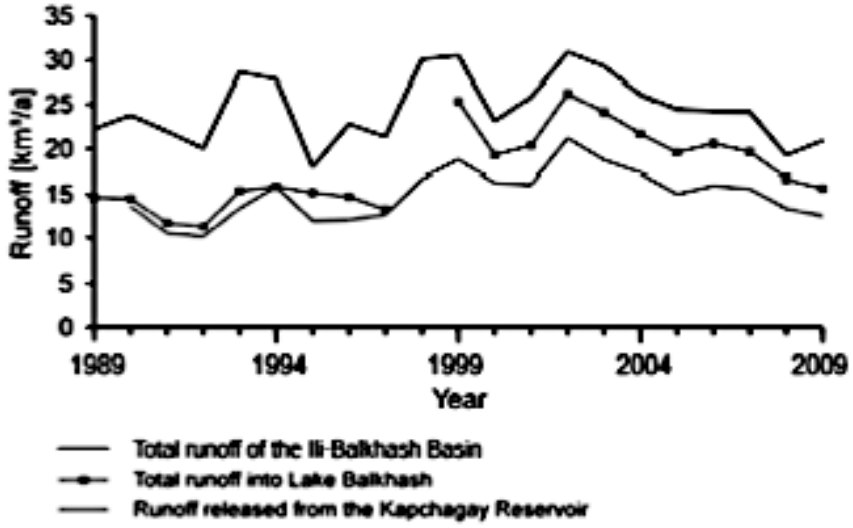
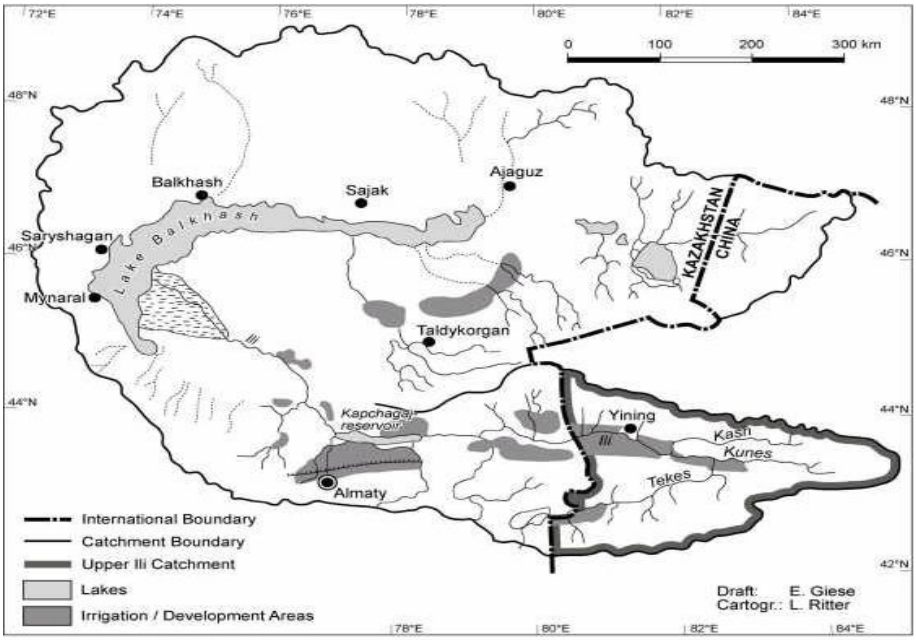


Figure 1: Annual runoff generated in the whole Ile-Balkhash Basin, runoff reaching Lake Balkhash, and runoff released from Kapchagay Reservoir from 1989 to 2009

Today , the Ile Balkhash basin has the biggest irrigation area-648 500 ha in Kazakhstan (see Map 2), where most of this area used for plowing- 447 500 ha, then for deposits -103 700 ha, for cattle grazing-41 400 ha, for perennials-25 900 ha and hayfields occupied 11 900 ha (Burlibaev et al. 2011). Along the Ile River there are plantations of rice, sugar beet, tobacco, maize, fruits and vegetables. Public utilities are on the second place of water copper, ore and lignite and there are two plants located in this area: Balkhash ferrous plant and Tekeli lead-zinc.

Fish industry and agricultural water supply are the least water users in the basin with 0,84% and 0,59% respectively (Kenshimov et al. 2011). The part of the Ile catchment in China corresponds to the Ile Autonomous Kazakh Prefecture (herein after: Ile Prefecture). This prefecture covers an area of 56300 km^2 and is home to a population of 2.04 million people. In 2000, in the Ile Prefecture there were 600 000 ha to 650 000 ha under irrigation consumption in the Ile Balkhash basin. One fifth (3.3 million) of the population of Kazakhstan live in the Ile-Balkhash basin, including 1,5 million people in rural areas and 1,45 million in Almaty city (Bragin 2009).

According to Kenshimov et al. (2011) in the Ile Balkhash basin basic and light industries consumed 3,69% of water in 2006. As it has huge deposits of (Christiansen and Schöner, 2004). The major crops are grains (wheat and corn), rape, and sugar beet (Luo and Gao, 2011). The Ile catchment in China is considered to offer the most favourable conditions for agriculture in Xinjiang. Therefore, the Ile Prefecture was indicated as key-region for further agricultural development in the 1990s. Within the 11th Five-Year-Plan, which covers 2006 to 2010, it has been planned to reclaim land for irrigation 133 000 ha land on top of the existing 600 000 ha to 650 000 ha (Luo and Gao, 2011).



Map 2: General map of the Ile-Balkhash Basin with main rivers and irrigation areas

3. Water resources management in Kazakhstan

The administaration of water recoures in Kazakhstan is divided into four levels: intergovermental, national, territorial and basin. Intergovermental level is resposible for the water bodies: Caspian Sea, Aral Sea and transboundary rivers that crosses political border of Kazakhstan. As Kazakhstan is landlocked country with the raise of water deficiency the importance of establishment water agreements is crucial. In 1992 the Republic of Kazakhstan, the Kyrgyz Republic, the Republic of Tajikistan, Turkmenistan and the Republic of Uzbekistan signed "Agreement on cooperation in joint management, use and protection of interstate sources of water resources" and founded a united body Interstate Coordination Water Commission (ICWC)[2].

At the national level, the Committee for Water Resources (CWR) is the main governmental agency. Eight basins in Kazakhstan are under the CWR, but each basin is located on the territory or territories of regions, which are controlled by akimats.

3.1 Transboundary dialog between China and Kazakhstan with accent to the Ile-Balkhash Basin

Since 1998 to 2001 Kazakhstan and People's Republic of China hold five rounds of consultations of the experts on transboundary rivers. In September 12 of 2001 the agreement on partnership in the sphere of use and protection of transboundary rivers between two governments was signed (Kenshimov et al. 2011). They created a Kazakhstan- Chinese on use and protection of transboundary rivers and the first meeting was held in 2003 (Beijing). Since then the joint commission holds the meetings each year. According to the article 5, the collaboration between countries considers several directions such as coordination and determination of location the meteorological stations, research on common methods of observation, measurement, analysis and evaluation and etc. Furthermore, several agreements: on emergency notification of the parties of natural disasters on the transboundary rivers (July 4, 2005, Astana), on the development of research cooperation on transboundary rivers (December 20, 2006, Beijing), on preservation of quality of water resources of transboundary rivers (February 22, 2011, Beijing), and on water quality protection of transboundary waters (June 13, 2011, Astana) were signed (Kenshimov et al. 2011). The last meeting was held in Astana (September 7, 2013) where the Joint Declaration on further deepening the comprehensive strategic partnership was signed[3].

[2] For more information see http://www.icwc-aral.uz/
[3] For more information see: http://www.inform.kz/eng/article/2659180

As a solution Kazakhstan tried to negotiate with China by providing food for 10 years of preferential contract and in return to increase the water inflow to Lake Balkhash, but China refused the deal. Meantime, China developed a "Going Global" policy by investing money in agricultural land, especially in Africa, Southeast Asia and South America for their own needs (Bräutigam & Xiaoyang 2009, Hoering 2010, Williams 2013). For instance, several state owned companies leased 10 000 hectares of land in Cameroon, 100 000 hectares of oil palm plantations in Democratic Republic of Congo (DRC), 10 000 hectares of land in Sudan and so on (Hoering 2010). The land grabbing is a common today, especially in developing countries, which depends on natural resources. China is not exception and moreover it has leases for agricultural land in Zambia, Tanzania, Zimbabwe and the Democratic Republic of Congo (Williams 2013). For instance, several state owned companies leased 10 000 hectares of land in Cameroon, 100 000 hectares of oil palm plantations in Democratic Republic of Congo (DRC), 10 000 hectares of land in Sudan and so on (Hoering 2010). The land grabbing is a common today, especially in developing countries, which depends on natural resources. China is not exception and moreover it has leases for agricultural land in Zambia, Tanzania, Zimbabwe and the Democratic Republic of Congo (Williams 2013). The information about quantities of land grabbing by China is not clear today.

Another solution is the international water convention (Helsinki, 1992), which is intend to protect transboundary surface waters and groundwaters It declares[4]:

„*The Convention obliges Parties to prevent, control and reduce transboundary impact, use transboundary waters in a reasonable and equitable way and ensure their sustainable management. Parties bordering the same transboundary waters shall cooperate by entering into specific agreements and establishing joint bodies. The Convention includes provisions on monitoring, research and development, consultations, warning and alarm systems, mutual assistance, and exchange of information, as well as access to information by the public".*

Since 2001 Kazakhstan is a Party of convention on the protection and use of transboundary watercourses and international lakes, while China has not signed any international water conventions or treaties yet.

In this case, there are suggestions (Ryabtsev 2011, Mustafina 2014) that with the help of the third country, as Russia or in a framework of Shanghai Cooperation Organization the agreement process could be reachable.

[4] For more information see: http://www.unece.org/env/water/

3.2 Water resources management in the Ile-Balkhash Basin

22% of the water resources of Kazakhstan are concentrated in the Ile-Balkhash Basin (Yerzhanova, Huszti 2013). Besides, it provides water for the almost 650 thousand irrigated areas and 42% of hydroenergy (Burlibaev et al. 2011; Yerzhanova, Huszti 2013). For Kazakhstan as a downstream country is very important to have a clear program to prevent pollution from the upstream and to develop the region for the needs of local people. In this case, water management is a key factor to sustain the basin.

In Kazakh part the Ile-Balkhash basin is divided entirely or partly between four administrative parts: Almaty oblast including Almaty city , Eastern Kazakhstan oblast, Karaganda oblast and Zhambyl oblast. In China the Ile River goes through the Xingjian region (Esekin et al. 2011). Meanwhile, in the management of water resources in Kazakhstan, the Ile Balkhash basin together with the Ala-kol-Sassykol lakes united to the Balkhash-Alakol Basin. It's one of the eight water basins, which are controlled by the main government agency, the Committee for Water Resources (See Map 3).

Source: *Water Resource Committee of the Republic of Kazakhstan*

Map 3: Main river basins in Kazakhstan

Since 2013, the Committee for Water Resources is under the Ministry of Environment and Water Resources[5]. The Chairman of the Committee is selected by the Minister of the Environment and Water Resources. It has two deputy chairmen, consists of seven management sectors and has eight basin inspections, including the Balkhash-Alakol Basin Inspection Committee (BABI).

[5] For more information see: http://www.eco.gov.kz/new2012/ministry.

Note: In August 2014 the Ministry of Environment and Water Resources was reformed and all functions including the Committee for Water Resources is under the the Ministry of Agriculture.

Each inspection committee is a legal entity and has their functions. The BABI Committee is regulating the use of water resources and protection, but not in all spheres and is reduced mainly to record and control (Kenshimov et al. 2011). The water allocation to users is regulated by akimats and maslikhats between the four oblasts of the basin (Mukhtarov 2009). Besides, the objects of water facilities and their maintenance are under the Republic State Enterprises, which are not funded by state budget (Mukhtarov 2009; Kenshimov et al. 2011).

3.3 Main Problems in water resources management

1. Centralized administration and high bureaucracy between the government agencies.

2. Weak communication and coordination among the governmental agencies with the fragmentation of responsibilities (Mukhtarov 2009).

3. Lack of specialists in the water government agencies. Today, the Committee of Water Resources has 69 people on staff[6]. In 2007 the Balkhash Alakol Basin Inspection has 32 people on staff (Kenshimov 2011).

4. Lack of effective water law and agreements regulation with the neighbor countries.

5. Often changes of head managers and conversion of governmental agencies responsible for the water resources management in different levels. The Committee for Water Resources was under the Ministry of Agriculture, which had negative effect as it was the main water consumer and since 2013 it is under the Ministry of Environment and Water Resources (Kenshimov et al. 2011).

6. Irrational use of water, e.g. seepage loss. In 2006, in the Ile-Balkhash Basin 86% of water is used for irrigation purposes and 41% is seepage loss from the earthen linings, which cause the salination of land (Burlibaev et al. 2011).

7. Water pollution. The pesticides, heavy metals, nutrients and etc. are polluted the lake by the industry, public utilities and from irrigated fields.

[6] For more information see: http://www.eco.gov.kz/new2012/RU/ministry/komitet/kvr/

3.4 Current national water programs and water projects

1. State program of the management of water resources of Kazakhstan, 2014-20407. The program contains the current investigation of the water facilities and the replacement by new canals with the water safe technologies. The main goal of the state program is to provide water safety for the whole country by 2040.

2. National Integrated Water Resources Management and Water Efficiency Plan for Kazakhstan, 2008-2025. Organizers: the Committee for Water Resources, with support from UNDP and the Global Water Partnership.

3. EU-UNDP project „Promoting Integrated Water Resources Management and Fostering Transboundary Dialogue in Central Asia" 2009-2013. The aim is to support bilateral cooperation and joint activities with China, engage stakeholders, as well as provide expert advice to the bilateral commission and in order to improve the existing legal agreements between the two countries.

4. Fauna of Lake Balkhash and the Ile Delta

Lake Balkhash and the Ile Delta harbor 25 fish species and 345 terrestrial vertebrate species, among them are 284 bird and 39 mammal species. It furthermore supports a range of threatened species, including one fish, 25 birds, and three mammal species. More than 70 000 birds have been counted in the lower reaches of the Karatal River (Solokha 2008; Ramsar Convention 2012). For eight bird species more than one percent of their global population breeds in or migrates through the Ile Delta, e.g. the Dalmatian Pelican (Pelecanus crispus) (Solokha 2008).

4.1 Aquatic Fauna of Lake Balkhash and the Ile Delta

Since the beginning of 20th century several expeditions were took place in Lake Balkhash to investigate hydrobionts (Abrosov 1973; Mamilov 2008).Fish, benthos and zooplankton diversity were recorded and described. The geographic isolation of the lake formed the endemic forms and the difference in mineralisation between eastern and western parts of lake made it more unique.

Therefore, the distribution of the aquatic organisms in lake is different. For instance, chemical composition of water largely determined zooplankton distribution: in the western part freshwater and euryhaline forms as Eudiaptomus graciloides, Bosmina longirostris, Leptodora kindtii and Mesocyclops crassus, together with the rotifers Keratella cochlearis, K. quadrata, Asplanchna, Fllenia, Polyarthra and Brachionus are dominated. While in the saline eastern basin:

[7] For more information see: http://www.eco.gov.kz/new2012/RU/ministry/komitet/kvr/
[8] For more information see: UNDP: http://www.kz.undp.org/content/kazakhstan/en /home/operations/projects/environment_and_energy/promoting-iwrm-and-fostering-transboundary-dialogue-in-central-a/

Arctodiaptomus salinus, Mesocyclops crassus and Eudiaptomus graciloides, Hexarthra oxyura and Synchaeta sp. are widespread. Most common in open areas are Keratella cochlearis, K. quadrata, Filenia longiseta, Polyarthra platyptera and Asplanchna herricki and three taxa of cladocerans: Diaphanosoma brachyurum, Daphnia cucullata and Leptodora kindtii. The highest number is concentrated in the western part in a freshwater salinity zone. The species compostion and biomass in lake changes in time, especially recent antropogenic factors as the regulation of the Kapchagay reservoir and the increase of water withdrawal have affected significantly. At the time, first concerns were raised that Balkhash may turn into a second the Aral Sea (Dostaj et al., 2006).

THE ARAL SEA

... is an endorheic lake in Central Asia. Before the soviet programm started irrigate the desert region by drawing of water from the main feeding rivers: the Amu Darya and the Syr Darya, it was the fourth biggest lake in the world. By 1987, 60% of volume had been lost, its watel level was down by 14 m and its salt concentration had doubled according to UNEP. Today, 85% of volume and approximately 74% of surface area has shrunk, which caused in the spread of 200,000 tonnes of salt and sand by wind around the region and even reached other countries;; the quality of drinking waterhas declined due to increasing salinity , bacteriological contamination and pesticides, heavy metals; the rose of deseases like anaemia, cancer and tuberculosis and allergies; fishing has stopped completely in the lake[9].

The water inflow from west to east of the lake decreased from 2,7 km^3/a to 2,1 km^3/a in 1999, which caused the increase of mineralisation near the Balkhash city from 1,5g/l to 2,3 g/l (UNDP, Ile-Balkhash, the concept of sustainable development). If the water level drop to 340 m or 337.6m Balkhash Lake might divide into two parts as the Aral Sea as modeled by Tursunov on Figure 2/3.

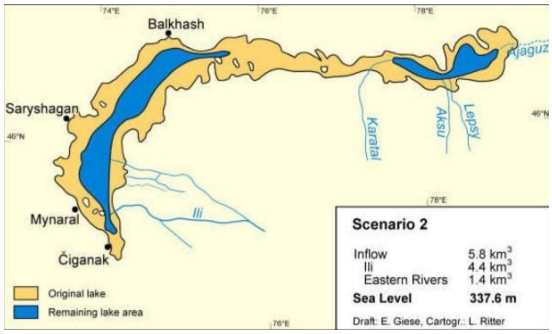


Figure 2 : Lake area of the Balkhash under an annual inflow of 10 km^3 per year as modeled by Tursunov (2002).

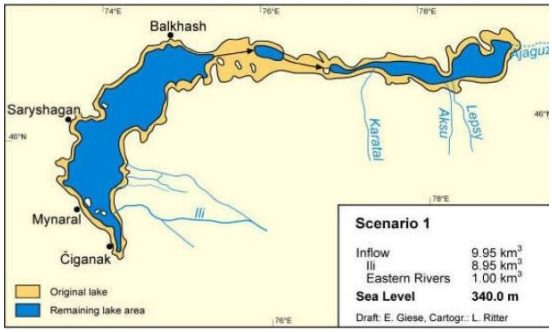


Figure 3 : Area of the Balkhash Lake under an annual inflow of 5.8 km^3 per year as modeled by Tursunov.

The changes of aquatic fauna recorded with the water mineralization and water level fluctuations in the lake. Krupa, Tsoy, Lopareva and others (2013) found the positive relationship between the long-term dynamics of zooplankton biomasses and water mineralization. The increase of zooplankton biomass recorded after the regulation of Kapchagay reservoir. We assume that with the salinity rise of Balkhash the euryhaline aquatic hydrobionts might spread around the basin, and for the benthos is no exception. The types of substrate and mineralization are important for the composition and distribution of benthos. In the western part oligochaetes, mollusks, mysids and amphipod are dominated, while in the eastern part of lake chironomids, oligochaetes and mollusks are most common (Aladin et al. 2013).

Modern zoobenthic fauna of Balkhash basically consists of introduced species (Aladin et al. 2013). During the period from 1961 to1971 mysids, polychaetes, molluscs and an amphipod were introduced, such as Hypania invalida and Hypaniola kowalevskyi (polychaetes), Monodacna colorata, Anodonta cellensis and A. cygnea (molluscs), Paramysis intermedia, P. kowalevskyi, P. ulakyi and P. baeri (mysids), and Corophium curvispinum (amphipod) (Petr 1992). During last decades Monodacna colorata increased by 95.6 % due to decline of fishes feeding on benthos, especially Cyprinus carpio (Krupa et al. 2013).

Fish decline is a serious problem for the lake which harbor only 25 fish species with a few indigeous ones such as: Schizothorax argentatus, S. pseudaksaiensis, Perca schrenkii, Nemachilus strauchi and N. labiatus. Of these, P. schrenki, S. argentatus and N. labiatus are endemic to the basin. Acipenser nudiventris, Leuciscus leuciscus, Barbus brachicephalus, Abramis brama, Cypri-

nus carpio, Lucioperca lucioperca, Siluris glanis, Pseudorasbora parva, Pseudaspius leptocephalus, Hemiculter leucisculus, Percottus glehni, Rhinogobio simlles, Stizostedion lucioperca, Aspius aspius, Chondrostoma nasus and Leuciscus lindbergi were introduced (Abrosov 1973;; Petr 1992). Only here acclimatized Acipenser nudiventris and Barbus brachycephalus remain as they completely disappeared in the basin of the Aral Sea (Ramsar Convention 2012). Most of alien species were successfully introduced and spread around the basin, but negatively affected on the indigenous ones. In 1972, 98% of commercial catches were the alien species and the aboriginal represented less than 2% (Petr 1992). Stocks of pikeperch, roach, and to a lesser degree of bream and wels declined, because of the lack of enforcement of the existing fishing regulations (Mitrofanov, Petr 1999).

Today, in Balkhash Lake eight alien species are commercial: Abramis brama orientalis, Stizostedion lucioperca, Rutilus rutilus caspicus, Aspius aspius aspius, Cyprinus carpio aralensis Spitshakow, Silurus qlanis, Stizostedion volgensis, Carassius auratus (Kenzhebekov et al. 2011).

For several commercial species the flucuations of water level has been found. For example, the common carp (Cyprinus carpio) was introduced in the lake in 1905 and became most commercial between the 1932 and 1960s.Thus, in 1962 more than 12 thousand ton of common carp were caught, however with the fullfilment of Kapchagay reservoir it decreased significantly with around 200 ton in 1988 as the result of dessication of the spawning places. It was recorded that the relation of catchment and water level for the years 1988 to 2010 was high (r=0.81) (Kenzhebekov et al. 2011). For bream the decrease of carp population has influenced positively, as after 1960s till today it became the most common in catchment. Commercial species play important role as they are the basic income for local people, moreover its the second basin (after Ural-Caspian basin) which has the highest fish catchment in a country.

4.2 Reptiles and Amphibians in the Ile Delta and South Balkhash

Fauna of reptiles is represented by 19 species tortoises, twelve species of lizards and six species of snakes. But only six species of them are comparatively typical and found in coastal habitats: Eremias velox, E. scripta, Natrix tessellate, Natrix natrix and Elaphe dione. In desert areas there are a great number of agamas (Agama sanguinolenta), typical species include Gecko (Tenuidactylus russowi, Alsophylax pipiens, Teratoscincus scincus), Lacertas (Eremias velox, E. arguta, E. scripta, E. intermedia, E. grammica), Steppe Tortoise (Agrionemys horsfieldi), among snakes – Eryx tataricus, Psammophis lineolatum, and toad agamas (Phrynocephalus guttatus, Ph.mystaceus) and Gloudius halys in some areas (Ramsar Convention 2012). Fauna of amphibian includes Bufo pewzowi and Rana ridibunda, while Rana asiatica has been extinct (Sultanova et al. 2012).

4.3 Birds in the Ile Delta and South Balkhash

The avifauna of the Ile Delta and South Balkhash consist of 284 bird species out of 53 families and 17 orders (Sultanova et al. 2012). Among them, 150 species are nesting birds, such as Pelecanus onocrotalus, Pelecanus crisps, Platalea leucorodia, Cygnus cygnus, Aythya nyroca, Oxyura leucocephala, Haliaaetus albicilla, Grus grus, Pterocles orientalis, Columba evesmanni, Bubo bubo, Dendrocopos leucopterus, Podoces panderi Ileensis, Parus bokharensis, Passer ammodendri and etc. (Sultanova et al. 2012; Ramsar Convention 2012).

In 2007 more than 70,000 birds were counted in the lower reaches of the Karatal River (Solokha 2008; Ramsar Convention 2012). Eight bird species: Anas platyrhynchos, Netta rufina, Aythya ferina, Bucephala clangula, Fulica atra, Pelecanus crispus, Pelecanus onocrotalus, Phalacrocorax carbo have more than one percent of their global population habitat in the lower reaches of the Karatal River and the Ile River Delta (Solokha, 2008). And 33 bird species out of 56 are in the Red Book of Kazakhstan inhabit in the Ile Delta and Balkhash Lake (Sultanova et al. 2012).

The Ile-Balkhash Basin is an important place for nesting, molting and feeding of shorebirds and waterfowl. Cormorants, herons, gulls, geese, ducks and other colonial birds are nesting in the Zhideli channel. Common Pheasant (Phasianus colchicus) inhabit mainly tugai forests along the Zhideli River (Ramsar Convention 2012). Also pelicans which are good indicators of wetland environment according to Morimoto (2005, 2008) are nesting in the Balkhash Lake, especially after the desiccation of the Aral Sea, where the breeding habitat for birds disappeared. Two species of pelicans (Pelecanus crispus, Pelecanus onocrotalus) stopped breeding at the center of the Aral Sea in the 1930s and population of Dalmatian Pelican (Pelecanus crispus) in the Ile Delta decreased from 900 pairs nesting in 1984-1993 and up to 500 pairs in 2005-2006 (Zhatkanbayev 2002; Morimoto 2008; Ramsar Convention 2012).

However, for the population of the White-Tailed Eagle (Haliaeetus albicilla) in the Ile Delta the number of pairs is increased. In 1996-1998 there were 40-43 pairs of eagles, about 43-45 pairs in 1999-2003 and 45-50 pairs in 2004-2007, which is possibly due to termination to kill raptors in this area (Zhatkanbaev 2011).

The Ile Delta is also a habitat for the biggest populations of Aythya nyroca in Central Asia and Columba eversmanni in Kazakhstan (Sultanova et al. 2012).

4.4 Mammals in the Ile Delta and South Balkhash

39 mammal species are recorded in the Ile Delta and South Balkhash. Three species: Vormela peregusna, Gazella subgutturosa and Salpingotus pallidus are in the Red Book of Kazakhstan (Sultanova et al. 2012). Rodents are widespread in this area. Six jerboa species inhabiting sand massifs and clayey deserts: Allactaga elater, Stylodipus telum, Dipus sagitta, Eremodipus lichtensteini, Salpingotus pallidus, Cricetulus migratorius. Typical squirrels represented by Spermophilopsis leptodactylus, Spermophilus erythrogenus are found in the plains and Spermophilus fulvus inhabits the left shore of the Ile River. Three species of jirds: Meriones tamariscinus, Meriones libycus and Meriones meridianus are found in shrubbery sands and floodplains of rivers and lakes, in sand and clayey deserts.

Among cloven-hoofed mammals, the most common are Sus scrofa, Capreolus pygargus and Gazella subguttorosa. Also tolai hare (Lepus tolai) is common in this area (Ramsar Convention 2012).

Rodents as Arvicola terrestris, Mus musculus, Apodemus sylvaticus and Ondatra zibethicus were common in the delta, but today due to habitat loss the population of Ondatra zibethicus declined. 818 species of Ondatra zibethicus was successfully introduced in the Ile Delta in 1935 and around 54 800 muskrats were counted there a decade later, but after 1970s the changes of water level destroyed its habitat and decreased it number (Abrosov 1973; UNDP 2004). As a result muskrats are no longer trapped.

Before the middle of 20th century the high number of deer and wild pigs inhabited in the Ile River , which was the main prey for the extinct now predator a Caspian Tiger or Turanian Tiger (Panthera tigris virgata) (Figure 5). It had been recorded in the wild until 1948 in the tugai forests of the Ile River. The main reasons of extinction were habitat loss due to fires, reed beds were converted to croplands, also wild pigs considerably decreased. Nevertheless, the major risk for tigers has started with the Russian colonization of Turkestan in the late 19th century (Jungius et al. 2009).

Today, the reintroduction of Amur tiger as the closest relative to Caspian tiger in the Ile Delta and south Balkhash has been proposed10. The project includes the investigation of suitable territory for the tigers, introduction of prey populations and tigers at last.

[10] For more Information see: WWF http://www.wwf.ru/about/where_we_work/asia/tiger/eng;
tengrinews http://tengrinews.kz/kazakhstan_news/vozrojdenie-turanskogo-tigra-v-kazahstane-pomojet-razvitiyu-ekoturizma-255930/

5. Vegetation of Lake Balkhash and the Ile Delta

The Ile Delta covers an area of 8000 km^2. It is a hotspot of plant and animal biodiversity and productivity of significance for whole Central Asia (Tsytsenko 1988; Kipshakbaev and Abdrasilov, 1994). This is reflected in the well-developed fishery, pasture economy and forestry (Ramsar Convention 2012).

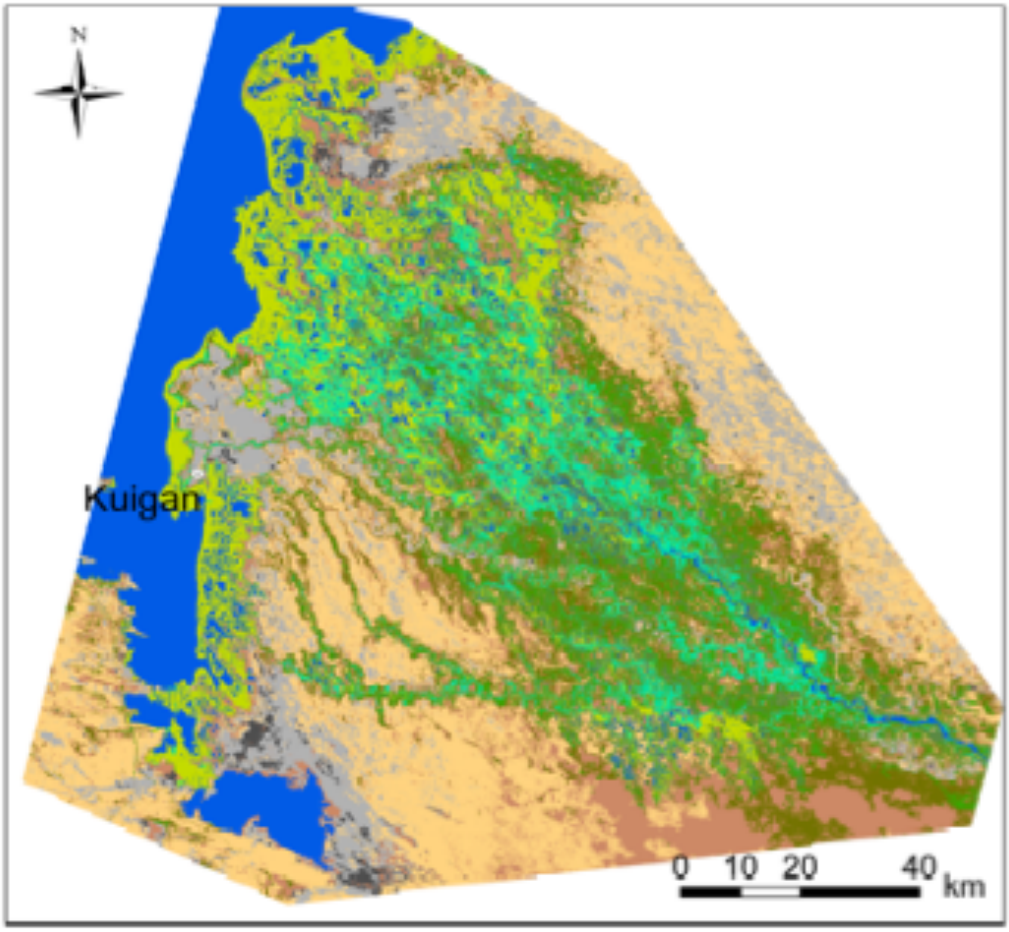
The Ile Delta is a mosaic from freshwater lakes, rivers, streams, creeks and seasonal or intermittent freshwater lakes with reed beds, meadow vegetation, riparian forests, and shrub vegetation (See Photo 1) (Ogar 2003; Sivanpillai et al. 2006; Ramsar Convention 2012). In total, there are 427 species of vascular plants from 241 genera and 68 families in the Ile Delta and South Balkhash.

Photo 1: Landscapes of the Ile Delta near Basa, June 2014

The unique of this ecosystem is represented by different categories of rarity: seven relict species (Peganum harmala, Nymphaea candida, Arthrophytum balchaschense, Nitraria sibirica, Nitraria schoberi, Populus diversifolia, Achnatherum splendens), 18 endemic species (Astragalus balchaschensis, Dendrostellera ammodendron, Megacarpaea iliensis, Linaria pedicellata, L. ramose, Microcephala subglobosa, Euphorbia sororia, Echinops albicaulis, Jurinea adenocarpa, Zygophyllum fabagoides, Artemisia albicerata, Kalidium schrenkianum, Eremosstachys rotatum, Saussurearobusta, Tulipa behmiana, Chondrilla bosseana, Rosa iliensis, Ephedra lomatolepis) and seven rare species (Scirpus kasachstanicus, Populus pruinosa, Nymphoides peltatum, Aldrovanda vesiculosa, Nelumbo nucifera, Berberis Ileensis, Lonicera Ileensis) (Sultanova et al. 2012; Ramsar Convention 2012).

The plant species of Tugai forests, meadow vegetation and most species of the shrub vegetation, i.e. those vegetation types, which are not submerged, survive under the arid climate, because they take up water from the groundwater as obligate or facultative phreatophytes (Lavrenko 1956; Thevs et al. 2008). Phragmites australis and the tree species of the Tugai forests are obligate phreatophytes, i.e. these species must have continuous contact to the groundwater (Gries et al. 2003; Thomas et al. 2006). In contrast, Tamarix, Haloxylon aphyllum, and other halophytic shrubs are facultative phreatophytes and thus are able to survive some time period disconnected from the groundwater, but using soil moisture from the unsaturated zone (Smith et al. 1998).

The groundwater is recharged from the river courses. Therefore, the groundwater level is highest adjacent to the river courses and drops the further one departs from the river course, as shown for the Tarim River by Hou et al. (2007). Groundwater level, flooding, and salinization of groundwater are the major factors, which control vegetation distribution (Rüger et al. 2005; Schlüter et al. 2006; Thevs et al. 2008).



Map 4: The semi-supervised classification (Lena Haeberlein, Verena Kaiser 2013)

Class 1 Water

Class 2 Reed (wet)

Class 3 Eleagnus-forest and reed (dry)

Class 4 Tugai shrub (›50%) and Tugai forest

Class 5 Tugai shrub and shrub (50%)

Class 6 Haloxylon shrub (25-50%) with psammophytes

Class 7 Shrub-vegetation

Class 8 Psammophytes and shrub-vegetation (‹50%)

Class 9 Tamarix alluvial plain

Class 10 Schorus

Figure 4: Legend of semi-supervised classification map

The reed beds of swamp meadows or paludal meadows are periodically or permanently submerged. They are mostly mono-species vegetation and dominated by Phragmites australis, Typha angustifolia, Bolboschoenus maritimus, Elytrigia repens, Calamagrostis epigeios, Elytrigia repens form the reed bed vegetation on small flat islands in the delta (Ogar 2003; Ramsar Convention 2012).

Halophytic Meadows are formed on sites which are not or seldom submerged with groundwater levels of 1.5-2.5 m (Ogar 2003). They are mainly distributed

in the downstream parts of the Ile Delta with the following dominant species: Aeluropus littoralis, Leymus multicaulis, Hordeum bogdanii, Puccinellia distans, Puccinellia tenuiflora. The following halophytic herbs are found as accompanying species: Limonium otolepis, L.gmelinii, Saussurea salsa, Plantago salsa, and the annual glassworts Suaeda acuminata, S.prostrata, Climacoptera brachiata, C.lanata (Ramsar Convention 2012).

Further away from river courses or lakes, on groundwater levels of deeper than three m desert meadows are distributed. Desert Meadows are formed by xeromesophytic and halophytic- xeromesophytic plant species. The most wide spread species are Alhagi pseudalhagi, Tamarix ramosissima, Halimodendron halodendron, Krascheninnikovia ceratoides, Limonium otolepis, Glycyrrhiza uralensis, and Apocynum venetum, as well as salt-resistant grasses, as Aeluropus littoralis, Puccinellia distans, P. dolicholepis, P. tenuissima. (Rachkovskaya 2003; Ramsar Convention 2012).

The riparian forests, also called Tugai in the Russian and partly in the international literature (Treshkin 2001; Ogar 2003, Thevs et al. 2008), are composed of Salix soongorica, Salix wilhelmsiana, S. caspica, S. cinerea, S. serrulatifolia, S. alba, Populus pruinosa, P. euphratica (syn. P. diversifolia), and Elaeagnus oxycarpa in the tree layer. Tamarix ramosissima, T. laxa, Halimodendron halodendron, Glycyrrhiza uralensis, Glycyrrhiza glabra, Apocynum venetum, Phragmites australis, Calamagrostis pseudophragmites, and Leymus multicaulis form the undergrowth. Furthermore, the climbing species Clematis orientalis, Cynanchum sibiricum, and Calystegia sepium are found in those forests (Ogar 2003).

The Salix species are restricted to sites directly adjacent to river courses or lakes, where they form narrow strip-like thickets along those water bodies. Elaeagnus oxycarpa grows along the active river courses under conditions of sufficient water supply (Rachkovskaya 2003). However, it is more salt tolerant than the Salix species (Maimaiti, Qiman Yunus et al. 2013). Populus euphratica is able to grow much deeper roots than the former species so that it can grow on sites with deeper groundwater levels, e.g. along the Tarim River up to 10 m groundwater depth (Thevs et al. 2008).

The shrub vegetation splits into Tamarix dominated shrub vegetation, Haloxylon aphyllum (Black Saxaul) vegetation, and shrub communities dominated by Halophytes, e.g. Halostachys caspica or Halocnemum strobilaceum (Ogar 2003). Such shrub vegetation is distributed on alluvial plains on groundwater levels too deep for the herb species of the Desert Meadows. At the Tarim River those herb species disappear when the groundwater is deeper than 6 m (Thevs et al. 2008).

At the boundary between the delta and the surrounding desert, the dune valleys partly are filled with water and form perennial or periodical lakes.

The peaks and slopes of the dunes are covered with psammophytic species, i.e. Haloxylon persicum, Artemisia songorica, Ammodendron bifolium, and Calligonum species. On the lower parts of the slopes and in the dune valleys which are not filled with water the phreatophytic species Karelinia caspica, Alhagi pseudalhagi, Tamarix ramosissima and Halimodendron halodendron are distributed. Along the shores of the lakes in the dune valleys Phragmites australis and the species of the Tugai forests are distributed.

In Lake Balkhash the dominant plant species are emerged macrophytes, Phragmites australis, Typha angustata and three species of cane: Schoenoplectus littoralis, Schoenoplectus lacustris and Scirpus kasachstanicus (World Lake Database). The latter three species are endemic. Reeds and cattails together with the cattail-reed bogs, reed waterlogged meadows are formed the belt on the southern shore of Balkhash Lake. On abrasion-accretion plains of the southern shore of the lake dominate reed and halophilec bushes (Phragmites australis, Tamarix ramosissima, Nitraria sibirica, N.schoberii, Lycium ruthenicum, Climacoptera obtusifolia, Suaeda foliosa, Suaeda prostrate). While on lake solonchaks and sors halophytic vegetation (Nitraria sibirica, Halostachys belangeriana, Tamarix hispida, Suaeda physophora, Kalidium foliartum) are dominated (Ramsar Convention 2012).

Higher aquatic and coastal aquatic vegetation includes communities of Butomus umbellatu, Eleocharis acicularis, Najas marina, Myriophyllum spicatum, Phragmites australis, Polygomum amphibium, Thelypteris palustris, and other species of the following genera: Potamogeton, Sagittaria, Scirpus, Sparganiunm, Typha. Free-floating vegetation includes the following species: Lemna minor, Utricularia vulgaris, and Ceratophyllum demersum.

6. Threats and conservation of biodiversity

In the Ile Delta, after the Kapchagay Reservoir was constructed, from 1974 to 1985, the area of open water shrunk from 1209 km^2 to 354 km^2. In the course of sinking water of Balkhash Lake

and Ile River, the groundwater level sunk. It was also observed that the river branches cut into the previous river beds as introduced for the Amu Darya Delta. Reed beds and Tugai forests degraded in parts of the Ile Delta due to sinking groundwater levels (Kipshakbaev, Abdrasilov 1994). Both effects not only harm ecosystems but reduce economics welfare of local communities (Figure 8). From 1990 there was an increasing trend of the runoff flowing into Lake Balkhash. After 2002 there is a decreasing trend at least until 2009 as shown in Figure 2. If this trend prevails due to increase of water consumption it will impact on the Ile Delta and possibly lake water level may drop again.

In the Ile Delta, the major land use on land is grazing, with Phragmites australis being the main fodder plant. Due to Kapchagay Reservoir, negative effects on the delta were observed from the 1970s onward: wetland degradation, rising salinity of water, changes in the flood regime (Petr 1992). Degradation of wetlands (reeds), because water level dropped to 341.8 m in 1975 resulted in reduction of pasture grounds. People thus grazed more in Tugai forests, which lead to enhanced degradation of that ecosystem. Pasture land was reduced to one third of before 1970 (Petr, 1992).

The woody plant species are used as timber and fuel wood, especially Haloxylon aphyllum. Haloxylon aphyllum is regarded to be a very valuable charcoal and therefore is sold as far as to Almaty and Astana. Therefore, the Haloxylon aphyllum shrub communities are largely degraded (Michael-Succow-Foundation 2011; Buras et al. 2012).

Fishery is considered as an important income source for the local people. Introducing of fish inadvertently in the beginning of the 20th century lead to a peak in fish yields in the 1941s with 18 650 tons/a but also to a change in the composition of fish fauna (Petr 1992; Petr and Mitrofanov 1998). In the 1980s the fish catch stabilized with around 11 000 tons/a which is far away from a sustainable catch of around 7000 tons/a (Petr and Mitrofanov 1998). Hand in hand with the decreasing water inflow into Lake Balkhash an increase in salinity can be expected. This will lead to an additional pressure on the fish population. A reduction of fish yields and with it the income of local people can be expected.

The major driver for the further existence or changes of the Ile Delta and Lake Balkhash is the availability of water, i.e. to a large extent the future runoff of the Ile River. As there are plans to increase the area under irrigation in the Ile river basin, concerns that the Ile runoff drops in the future were risen (Christiansen and Schöner 2004). Furthermore, constructions for a water transfer project, which shall transfer water from the Kash River to Karamay in the Zhungar Basin in Xinjiang have been started (pers. comm.). As the Kash River contributes about one quarter to the total runoff generated in Xinjiang, this water transfer may have significant impact on the runoff of the Ile River (Dostaj et al. 2006). Further plans to divert water from the Tekes River into the Tarim Basin were mentioned by Christiansen and Schöner (2004).

The fluctuations of water level in the Ile River are directly affected on species number and habitat in Ile Delta and Lake Balkhash. A group of researchers in 2011(Kenzebekov et al. 2011) found the positive correlation between interannual water level fluctuation and population of Cyprinus carpio aralensis in Lake Balkhash. The water level affected on the fish spawning and on feeding of juveniles, which after 5 years forms the population size. Since 1937 the correlative dependence was stable, but with the regulation of Kapchagay reservoir water level changed significantly and as a result the number of carp decreased. Now, the size of cathes of Cyprinus carpio aralensis rose, which is related with increase of water runoff since 2000. Long-term dynamics of zooplankton, phytoplankton and benthos with the connection of water level in Lake Balkhash was investigated in 2013 (Krupa et al. 2013). Besides, 19 species of birds, which are nesting in South Balkhash, Ile Delta and riparian vegetation are depend on water quality and quantity of lake and its tributaries.

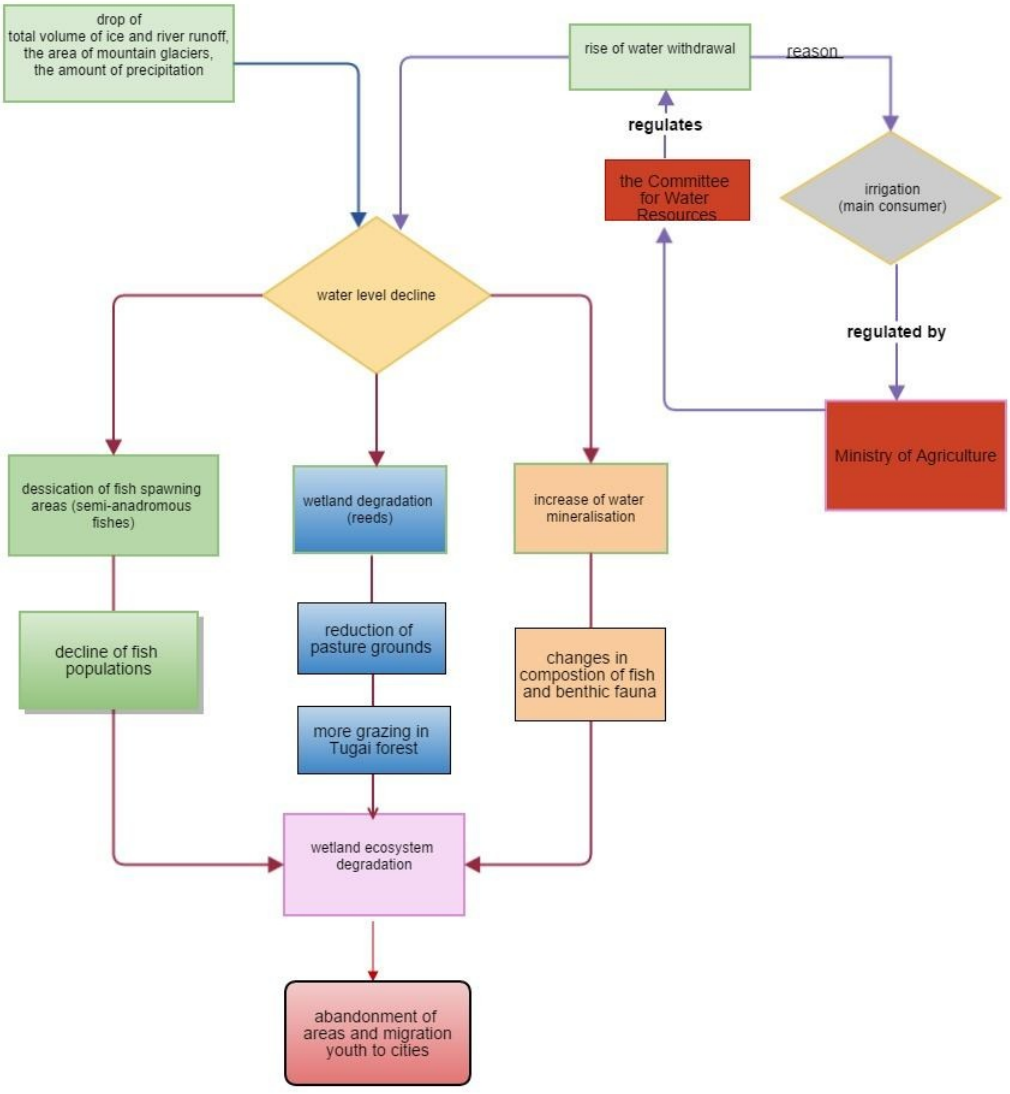


Figure 5: The main consequences of water level decline in the Ile Delta.

7. Conclusions / Research gaps

Water management in Kazakhstan is divided into four levels and in each of them the Ile Balkhash Basin has difficulties: in intergovernmental level the agreement between Kazakhstan and China on water quantity of the Ili River has not signed yet;; on national level the Committee for Water Resources is the main governmental body , but mainly its functions to control and regulate;; on the basin level there was founded a council, however it has much less power to control than local authorities (akims). In this case, Kazakhstan with support of UNDP and other stakeholders initiated the Integrated Water Resources Management to develop the water resources management.

As water resources management by the Committee for Water Resources is still developing and it responsible for water distribution between irrigation, households, industry, agriculture and fish industry it affected directly and indirectly on biodiversity of Balkhash and especially on the Ile Delta. The main factors are water withdrawal from the river and its pollution afterwards as wastewater from irrigation fields and industries. Besides, the water level is fluctuated by changes of climate and withdrawal from upstream which might have affect on flora and fauna, as fishes are migrating for spawning, birds are nesting in the wetlands (described in flora and fauna). The indirect effects are influenced on invertebrates' composition by changes of mineralization which related to water runoff.

From 1990 was an increasing trend of runoff flowing into Lake Balkhash. After 2002 there is a decreasing trend at least until 2009 as shown in Figure 2. These two trends might be explained by natural climatic variability or land use and thus water consumption changes. After independence of Kazakhstan irrigated areas were taken out of production. This may support the increase of runoff into Lake Balkhash after 1997. The runoff released from Kapchagay Reservoir also showed an increasing trend after 1997. So, the water consumption upstream of Kapchagay, i.e. including in China, did not increase so much that climatic variability and reduced irrigated land in Kazakhstan were over-compensated. In this field research is urgently needed, in order to clarify how much water is consumed in China and Kazakhstan and to what extent climatic variabilities cause runoff changes.

Overall, all information on flora and fauna is based mainly on soviet literature, which needs to be update now. The lack of latest information cannot provide yet clear picture on current situation of biodiversity. The understanding of problems in water resources management and environment management helps to understand the gaps and challenges to protect and keep the endangered species and commercial species on the same level.

Acknowledgements

Grateful acknowledgement is made to *Marion Dönhoff Fellowship in the Michael Succow Foundation* for providing a grant to study this topic.

I want to thank the following people, who helped me during the fellowship:

Supervisor Dr. Niels Thevs for contributing his data, for the correction of this paper and leading the structure of it.

Sebastian Schmidt for his helpful advices and for sharing his knowledge and ideas.

Christiane Fenske for sharing her knowledge in Aquatic fauna.

Rafael Ziegler for sharing his knowledge in water ethics and providing useful materials.

Abbreviations & Acronyms

ABABI	Balkhash- Alakol Basin Inspection Committee
CWR	Committee for Water Resources
ICWC	Interstate Coordination Water Commission
UNECE	United Nations Economic Comission for Europe
UNDP	United Nations Development Programme

List of literature & references

LITERATUR:

• Abrosov V. N.: *Lake Balkhash* (Ozero Balhash). Nauka, Leningrad, 1973.

• Abdrasilov S., Tulebaeva K.A.: *Dynamics of the Ile Delta with consideration of fluctuations of the level of Lake Balkhash.* Hydrotechnical Construction 28:9-12, 1994.

• Aladin N.,Gulati R.D., Isbekov Shivareva S.: *Lake Balkhash, Kazakhstan: Can we predict K., Plotnikov I.,its future from our knowledge of the past and present developments?* International Society of Limnology (SIL) news 63:16-17,2013.

• Asylbekova S.Zh., Isbekov K.B., Lopareva T.Ya., Anurieva A.N.: *Influence of air emissions of industrial complex „Balkhashtsvetmet" on biocenosis of Lake Balkhash* (Vliyanie vozdushnix vibrosov promishlennogo kompleksa „Balhashzvetmet" na biotsenozy ozera Balhash). Bulletin ASTU. Fish industry series 1:7-14, 2011.

• Berezovikov N.N., Zhatkanbaev A.Zh.: *Location and census of shorebirds and waterfowl in the downstream and delta of the Ile River* (South-Eastern Kazakhstan) (Razmeshenie i chislennost'vodoplavaushish i okolovodnih ptic v nizhnem techenii I delte reki Ili (Ugo-Vostochnii Kazahstan)). Russian ornithological journal 181:287- 297, 2002.

• Billard R.: *Les poissons d'eau douce des rivières de France. Identification, inventaire et répartition des 83 espèces*. Lausanne, Delachaux & Niestlé, 192p., 1997.

• Breckle S. W., Wucherer W., Dimeyeva L. A., Ogar N. P.: *Aralkum – a Man-Made Desert. Ecological Studies*. Springer, Heidelberg, 2012.

• Burlibaev M. Z., Dostaj Z. D., Mirhashimov I., Nikolaenko A. U.: *The current situation of agriculture in the Ile-Balkhash Basin.* In: Kenshimov A.K . [Eds.]: *Integrated Water Resources Management in the Ile- Balkhash Basin. Collection of scientific papers dedicated to water resources problems of the Ile- Balkhash basin and Balkhash-Alakol basin*. Almaty.P:3-16, 2011.

• Chou T.: *The problem of channel shifting of the middle reaches of the Tarim River in Southern-Sinkiang*. In: Murzayev E.M., Chou L. [Eds.]: *Natural conditions of Sinkiang. Chinese Academy of Sciences*. Peking, 1960.

• Christiansen T., Schöner U.: *Irrigation areas and irrigation water consumption in the Upper Ile Catchment, NW-China. Discussion Papers*, Zentrum für internationale Entwicklungs- und Umweltforschung, No. 20. Giessen. 79 p., 2004.

• Deng M. J., Wang Z. J., Wang J. Y.: *Analysis ofBalkhash Lake ecological water level evolvement and its regulation strategy*. Shulle Xuebao (Journal of Hydraulic Engineering) 42: 403-413. (in Chinese), 2011.

• Dostaj Z. D., Giese E., Hagg W.: *Wasserressourcen und deren Nutzung im Ile-Balchaš Becken*. Zentrum für internationale Entwicklungs- und Umweltforschung, Giessen, 2006.

• Dostaj Z., Alimkulov Myrzakhmetov A.: *Modern hydrological status of the estuary of Ile River. Applied Water Science*.Vol 2:227- 233, 2012.

• EC - IFAS: *Restoration of degraded lands through afforestation of the dried seabed of the Aral Sea. Executive Committee of the International Fund for saving the Aral Sea* (EC - IFAS). 28th European Regional Conference for Europe/37th European Commission on Agriculture, April 17–20, 2012, Baku, Azerbaijan, 2012.

• Esekin B. K., Sadomski V. ,Kamenev E., Ten V. K.: *Plan to save Balkhash Lake* (Plan sohraneniya ozera Balhash). In: Kenshimov A. K. [Eds.]: *Integrated Water Resources Management in the Ile-Balkhash Basin. Collection of scientific papers dedicated to water resources problems of the Ile-Balkhash basin and Balkhash-Alakol basin.* Almaty, pp 36-51,2011.

• Guo L. D., Xia Z. Q., Wang Z. J.: *Comparisons of hydrological variations and environmental effects between Aral Sea and Lake Balkhash*. Advances in Water Science 22: 764-770. (in Chinese), 2011.

• Isaeva F. S., Inelova Z. A.,Nesterova S. G.,Korotkov V. S.: *The accumulation of heavy metals (Mn,Co,Ni) in plants of the lower reaches of the Ile River. Biological diversity of projected Ile-Balkhash nature reserve*. Bulletin of KazNU. Ecology series. Vol. 1(33): 223- 225, 2012.

• Kenshimov A. K., Mahashova D., Medev B., Petrakov I.: *The analysis of structure and activities and overview of activities in the Ile-Balkhash Basin* (Analiz structur i meropriyatii i obzor deyatelnosti v Ile-Balhashskom basseine).

In Kenshimov A. K.[Eds.]: *Integrated Water Resources Management in the Ile-Balkhash Basin. Collection of scientific papers dedicated to water resources problems of the Ile-Balkhash basin and Balkhash-Alakol basin.* Almaty pp:144-198, 2011.

• Kenzhebekov B. K., Asylbekova S. Zh., Isbekov K. B., Anurieva A. N.: *Dependence of number of individual fish species in Lake Balkhash on abiotic factors*, Bulletin of ASTU. Fish Industry. Vol.2: 13-17 (in Russian), 2011.

• Kipshakbaev N. K., Abdrasilov S. A.: *Effect of economic activities on their hydrologic regime and dynamics of the Ile Delta*. Hydrotechnical Construction 28:5-8, 1994.

Kostianoy A.G., Kosarev A.N. (eds.),: The Aral Sea Environment. The Handbook of Environmental Chemistry Vol. 7. Springer, Heidelberg, 2010.

• Konkabayeva A. E., Tirzhanova S. S.: *The influence of heavy metals dust on behavioural reactions of animals in Balkhash city* (Povedenchiskie reakcii zhivotnih pri vozdeistvii polimetallicheskoi pili g. Balhasha). Bulletin of KarNU. Biology, medicine, geography series. Vol. 4(40):18-20, 2005.

• Krupa E. G., Tsoy V. N., Lopareva T. Yu., Ponomareva L. P., Anureva, A. N., Sadyrbaeva N. N., Assylbekova S.Zh., Isbekov K. V.: *Long-term dynamics of hydrobionts in Lake Balkhash and its connection with the environmental factors* (Mnogoletnya dinamika gidrobiontov ozera Balhash i ee svyaz s faktorami sredi). Bulletin of ASTU. Fish Industry. Vol.2:85-95, 2013.

• Kuzmina Z. V., Treshkin S. Y.: *Soil salinization and dynamics of Tugai vegetation in the southwestern Caspian Sea region and in the Aral Sea coastal region*. Eurasian Soil Science.- Springer. 30: 642-649, 1997.

• Lavrenko E. M.: *Vegetation Map of Central Asia* (Karta rastitelnosti srednej Asii). Akademijca a NAUK SSSR, Moscow, 1956.

• Lavrenko E.M.: *The Steppe Vegetation of Kazakhstan* (Rastitel'nost' stepej Severnogo Kazachstana). V . L. Komarova. Akad. Nauk, SSSR, Moscow, 1961.

• Lavrenko E. M., Karamysheva Z. V., Nikulina R. I.: *The Steppes of Eurasia* (Stepi Evrazii). NAUKA, Leningrad, 1991.

• Luo L., Gao Y. Q. : *Current status of policies and laws for sustainable development and utilisation of land and water resources along Ile River and its development strategies.* Journal of Southern Agriculture 42: 1579-1582. (in Chinese), 2011.

• Maimaiti A., Yunus Q., Iwanaga F., Mori N., Tanaka K., Yamanaka N.: *Effects of salinity on growth, photosynthesis, inorganic and organic osmolyte accumulation in Elaeagnus oxycarpa seedlings*. Acta Physiologiae Plantarum. Vol. 36: 881–892, 2013.

• Mamilov N. Sh.: *Fish diversity in the Balkash watershed small water bodies. Biodiversity, problems, ecology of Gorniy Altai (Altai Mountain) and neighbor regions: present, past, future: the materials of international conference*. 22- 26 September 2008. Grono-Altaisk State University.Vol 1:124-129 (in Russian), 2008.

• Martius, C., Rudenko, I., Lamers, J. P. A., Vlek P. L. G.: *Cotton, Water, Salts and Soums. Economic and Ecological Restructuring in Khorezm*, Uzbekistan. Springer Heidelberg, 2012.

• MEA (Millennium Ecosystem Assessment): *Ecosystems and Human Well-being: Synthesis* Island Press, Washington, DC, 2005.

• Morimoto Y., Horikawa M., Natuhara Y.: *Habitat Analysis of Pelicans as an Indicator of Integrity of the Arid Ecosystems of Central Asia.* - In: Shinichiro T. (2008): *Energy and environment in Slavic Eurasia: Toward the Establishment of the Network of Environmental Studies in the Pan-Okhotsk Region*. 21st Century COE Program Slavic Eurasian Studies No. 19:169- 183, 2008.

• Morimoto Y., Natuhara Y.,Morimura A., Horikawa M.: *The pelican scenario for nature restoration of Aral Sea wetland ecosystems*. Landscape Ecology Engish. Vol.1:85–92, 2005.

• Mukhtarov F. G.: *The hegemony of the Integrated Water Resources Management: a Study of Policy translation in England, Turkey, and Kazakhstan*. Doctoral thesis, Department of Environmental Sciences and Policy, Central European University, Budapest, 2009.

• Novikova, N. M.: *Ecological Basis for Botanical Diversity Conservation within the Amudarya and Syrdarya River Delta*. In: Breckle S.W., Veste M., Wucherer W. [Eds.]: Sustainable Land Use in Deserts. Springer. Heidelberg. pp:84-94, 2001.

• Ogar N. P.: *Vegetation of river valleys.* In: Rachkovskaya E.I., Volkova E.A., Khramtsov V.N. [Eds]: *Botanical geography of Kazakhstan and middle Asia* (Desert region). Komarov Botanical Institute of Russian Academy of Sciences. Saint Petersburg, Institute of Botany and

Phytointroduction of Ministry of Education and Science of Kazakhstan. Almaty, Institute of Botany of Academy of Sciences of Republik Uzbekistan. Tashkent. pp. 313-339, 2003.

• Petr T.: *Lake Balkhash, Kazakhstan*. International Journal of Salt Lake Research 1:21-46, 1992.

• Rachkovskaya E. I., Volkova E. A., Khramtsov V. N. (eds): *Botanical Geography of Kazakhstan and Middle Asia* (Desert Region). Komarov Botanical Institute of Russian Academy of Sciences, St Petersburg, 2003.

• Schluter, M., Ruger, N., Savitsky, A. G., Novikova, N. M., Matthies, M., Lieth, H.: *TUGAI: An integrated simulation tool for ecological assessment of alternative water management strategies in a degraded river delta*. Environmental Management 38: 638-653, 2006.

• Sivanpillai R., Latchininsky A.V., Driese K.L., Kambulin V.E.: *Mapping locust habitats in River Ile Delta, Kazakhstan, using Landsat imagery*. Agriculture, Ecosystems and Environment 117:128–134, 2006.

• Smith S. D., Devitt D. A., Sala A., Cleverly J. R., Busch D. E.: *Water relations of riparian plants from warm desert regions*. Wetlands 18:687-696, 1998.

• Starodubtsev V. M., Truskavetskiy S. R.: *Desertification Processes in the Ile River Delta under Anthropogenic Pressure*. Interaction between Continental Waters and the Environment 38:253-256, 2011.

• Solokha A. V.: *Lower reaches of Karatal River*. In Sklyarenko S.L., Welsh D., Brombacher M. [Eds.]: *Important Bird Areas of Kazakhstan*. Association for the Conservation of Biodiversity of Kazakhstan (ACBK) Almaty. pp. 215-221, 2008.

• Sultanova B. M., Rachkovskaya E. I., Ivashenko A. A.,Berezovikov N. N., Evstifeev U. G., Grunberg V. V., Malahov D. V., Kerteshev T. S., Belgubaeva A. E.: *Biological diversity of projected Ile-Balkhash nature reserve* (Biologicheskoe raznoobrazie proektiryuemogo Ile- Balhashskogo prirodnogo reservata). Bulletin of KazNU. Ecology series. Vol. 1(33): 230-233, 2012.

• Thevs N., Zerbe S., Gahlert F., Mijit M., Succow M.: *Productivity of reed (Phragmites australis Trin. ex. Staud.) in continental-arid NW China in relation to soil, groundwater, and land use*. Journal of Applied Botany and Food Quality 81: 62-68, 2007.

• Thevs N., Zerbe S., Peper J., Succow M.: *Vegetation and vegetation dynamics in the Tarim River floodplain of continental-arid Xinjiang*, NW China. Phytocoenologia 38:65-84, 2008.

• Thevs N., Buras A., Zerbe S., Kühnel E., Abdusalih N., Ovezberdyyeva A.: *Structure and wood biomass of near-natural floodplain forests along the Central Asian rivers Tarim and Amu Darya*. Forestry 81:193-202, 2012.

• Treshkin S. Y.: *The Tugai Forests of Floodplain of the Amudarya River: Ecology, Dynamics and their Conservation*. In: Breckle S.W., Veste M., Wucherer W. (eds.): *Sustainable Land Use in Deserts*. Springer, Heidelberg: 95-102, 2001.

• Tsytsenko K. V.: *Ile-Balkhash problem*. In: Man and Elements. Gidrometeoizdat, Leningrad: 100-102. Tursunov, A.A. (2002): From Aral to Lobnor. Hydrology of inland basins in Central Asia (Ot Arala do Lobnora). Gidrologija besstocnych bassejnov Centralnoj Azii. Almaty 1998.

• Xinjiang Linkeyuan Zaolin Zhisha Yanjiusuo: *Huyanglin Gengxin Fuzhuang Jishu Yanjiu*. Xinjiang Linkeyuan Zaolin Zhisha Yanjiusuo, Urumqi. (in Chinese), 1989.

Yerzhanova S., Huszti Z.: *Conditions and opportunities of environment management of a problematic lake: possible control over the change of the natural condition of the Ile- Balkhash Basin*. Carpathian Journal of Earth and Environmental Sciences. Vol.8 (4): 115-124, 2013.

• Zhadin B. F.: *Molluscs in freshwater and brackish waters USSR* (Molluski presnih i solonovatih vod SSSR). Akademia Nauk USSR, Leningrad, 1952.

• Zhatkanbaev A. Zh.: *White-Tailed Eagle in the Ile Delta of the Ile River and on the Balkhash Lake, South-Eastern Kazakhstan*. Raptor research. Raptors Conservation. Vol. 22. pp. 76-91,2011.

INTERNET:

• Bragin E. A.: *The overview of Lake Balkhash situation and policy in the water management in the Ile-Balkhash Basin*. 2009.

www.wwf.ru/data/asia/tiger/obzorIle-balhastigrruss.pdf

• Deborah A. Bräutigam and Tang Xiaoyang: *China's Engagement in African Agriculture: „Down to the Countryside"*. 2009.

http://www.american.edu/sis/faculty/upload/Brautigam-Tang-CQ-final.pdf

• Ezroj A., Mullin D., Pyle G., Sylvia S.: I*mpacts of developmental programs and policy reforms on rural areas of Northwest China. The Free Library (January,1.) 2008.*

http://www.thefreelibrary.com/Impacts-of-developmental-programs-and-policy-reforms-on-rural-areas...-a0215411537 (accessed August 08 2014)

• Hoering: *China's Agriculture „Going global"*. 2010.

http://www.globe-spotting.de/fileadmin/user_upload/globe-spotting/China/China_agriculture_going_global.pdf

• Jungius H., Chikin Y., Tsaruk O., Pereladova O.: *Pre-Feasibility Study on the Possible Restoration of the Caspian Tiger in the Amu Darya Delta.* WWF. 2009.

http://www.wwf.ru/about/where_we_work/asia/tiger/eng

• KazInform. International News Agency: *Joint work on draft Treaty on rivers between Kazakhstan and China is scheduled to begin in 2015* - National Coordinator of SCO activity Shahrat Nuryshev. 2014.

http://www.inform.kz/eng/article/2659180

• Mitrofanov V, Petr T: *Fish and fisheries in the Altai , Northern Tien Shan and Lake Balkhash.* Available online. 1999.

http://www.fao.org/docrep/003/x2614e/x2614e09.htm

• Ramsar Convention: *The Annotated Ramsar List: Kazakhstan.* 2012.

http://www.ramsar.org/cda/en/ramsar-pubs-notes-anno-kazakhstan/main/ramsar/1-30-168%5E16554_4000_0__

• UNDP: Ile Balkhash. *The concept of sustainable development.* 2004. Available via http://www.undp.kz/library_of_publications/files/1030-25100.pdf

UNDP: http://www.kz.undp.org/content/kazakhstan/en/home/operations/projects/environment_and_energy/promoting-iwrm-and-fostering-transboundary-dialogue-in-central-a/

• UNEP. 2004: http://www.grid.unep.ch/activities/sustainable/balkhash/

• UNEP: *The future of the Aral Sea lies in transboundary co-operation.* UNEP Global Environmental Alert Service. 2014.

http://www.unep.org/pdf/UNEP_GEAS_JAN_2014.pdf.

• The official site of the Ministry of Environment and Water Resources of the Republic of Kazakhstan: http://www.eco.gov.kz/new2012/ministry

http://www.eco.gov.kz/files/vod_resursy_2014_2040.htm

http://www.eco.gov.kz/new2012/RU/ministry/komitet/kvr/

List of figures & illustrations

FIGURES:

PHOTOS:

List of maps & tables

MAPS:

TABLES: