

REPORT ON AN EXPEDITION TO THE NORTHERN PART OF THE ARAL SEA (August 29-Sept. 16, 2011)

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Introduction

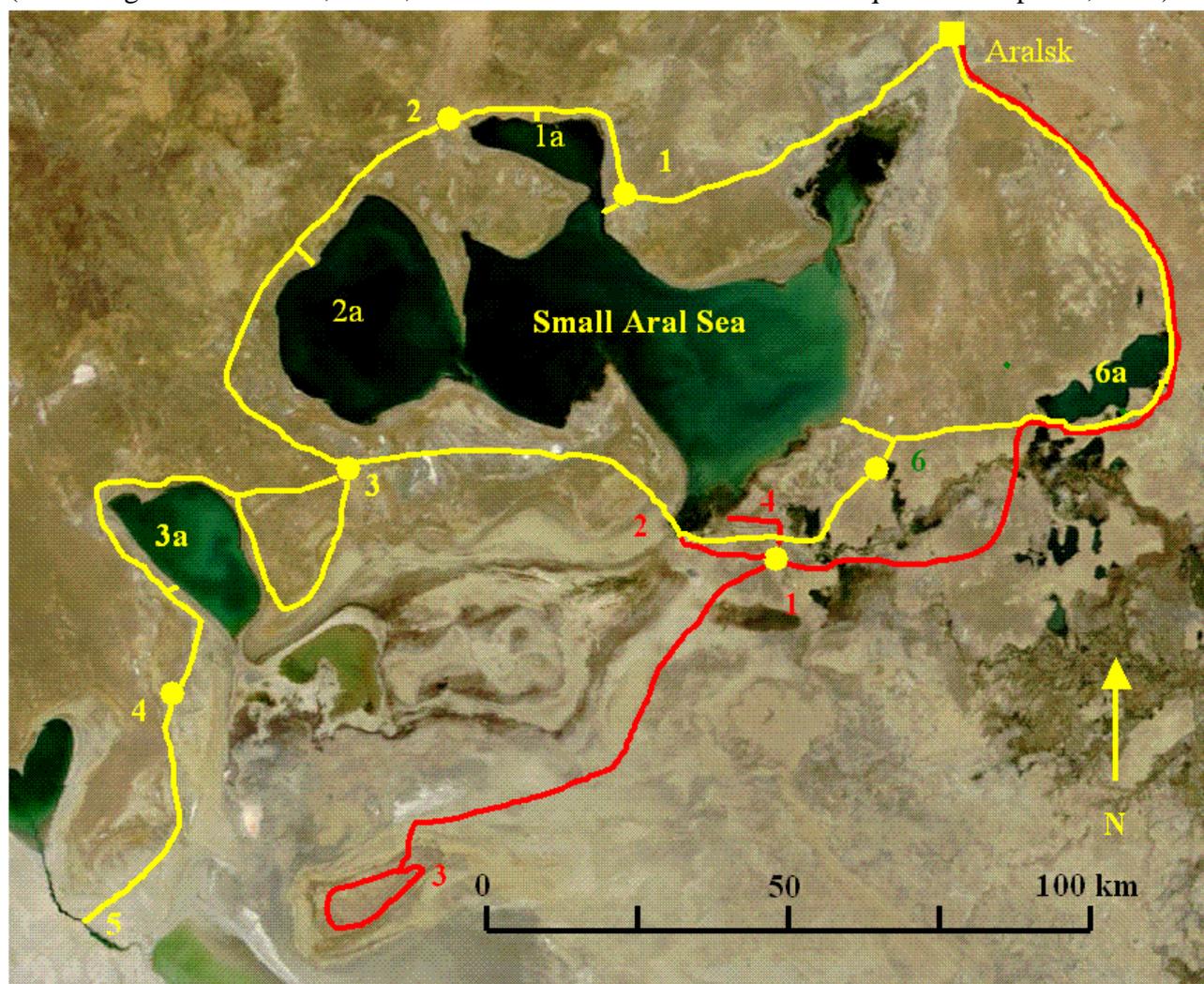
This report recounts and reports the results of an expedition to the northern part of the Aral Sea, which lies within the Central Asian nation of Kazakhstan. The image map (Figure 1) shows the routes of the expedition and the places visited. The expedition was conducted jointly with Dr. Nikolay Aladin and Dr. Igor Plotnikov of the Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia. Dr. Aladin is an aquatic zoologist and well-known international expert on the Aral Sea. Dr. Plotnikov is a specialist on the plankton and benthic communities of the Aral Sea. I have worked with both for a several decades and participated with them in two previous expeditions to the Aral Sea in 2005 and 2007. The field part of the expedition consisted of two parts as discussed below. We were accompanied for the whole expedition by a diverse group including two journalists (one American, the other Swiss), a limnologist from Ljubljana University in Slovenia, two geographers, one American and the other Swedish, a French concert pianist who is interested in the Aral Sea, and a videographer (Ivan Aladin, Engineer, BAN,). For parts of the expedition we were also accompanied by representatives from the International Fund for the Aral Sea (IFAS) which is the official Central Asian regional entity charged with overseeing efforts to improve the condition of the Aral Sea and surrounding zone of so-called "Ecologic Catastrophe" along with personnel from the two local organizations that handled logistics for our field work.

The main purpose of the expedition was to evaluate the success of a project to raise, stabilize, and improve the ecology of the Small Aral Sea. The Small Sea, also known as the northern Aral, separated from the Large (southern) Aral in 1989. The Syr Dar'ya, one of two major rivers, flows into it. Beginning in the early 1990s, local attempts were made to raise its level, lower its salinity, and improve ecological conditions via construction of an earthen dike to block outflow of Syr Dar'ya water to the Large Aral. The makeshift dikes repeatedly failed and were rebuilt until a catastrophic breach in April 1999 that cost two lives. Beginning in 2003, the World Bank and Government of Kazakhstan funded an \$85 million project to build a reliable, properly engineered dike and dam, to construct a regulating hydrocomplex at Ak-Lak on the lower Syr Dar'ya about 15 kilometers up river from that rivers entrance into the Small Aral and to make other improvements to the bed of the Syr Dar'ya to improve its flow carrying capacity. The discharge gates of the new dam were closed in August 2005 and the Small Aral reached design level (two meters above the August 2005 mark) by March 2006, far faster than anticipated. Since 2005, the ecology and fishery of the Small Aral Sea have undergone dramatic improvement.

Philip Micklin flew to Almaty, Kazakhstan, leaving the U.S. on Sept. 27 and arriving early morning on Sept. 29. There he met Kristopher White, an American geographer and participant in our expedition, who has been teaching at an English Language University in Almaty for some years. The next morning Micklin and White flew to Kyzyl-Orda, a city of about 150,000, to catch the train to Aralsk, formerly the main port at the northern end of the Aral Sea.

FIGURE 1. IMAGE MAP OF 2011 EXPEDITION AROUND NORTHERN PART OF ARAL SEA

(base image from MODIS, Terra, 250 meter resolution natural color acquired on Sept. 23, 2011)



First half of expedition 2011 from 9-1-2011 to 9-3-2011 (red line); numbers indicate sequence of visit.

1. Village of Karateren
2. Kok-Aral Dam and dike
3. Barsekelmes Nature Preserve
4. New delta of Syr Dar'ya

Second half of expedition from 9-5-2011 to 9-10-2011 (yellow line); numbers indicate sequence of visit.

1. Village of Tastubek
 - 1a. Butakov Bay
2. Village of Akespe
 - 2a. Shevchenko Gulf
3. Village of Ak-basty
 - 3a. Tshche-bas Bay

4. Village of Kulandy
5. Channel from Western Large Aral basin to Eastern Large Aral Basin
6. Village of Bugun
 - 6a. Lake Kamyslybas

Dr. Torekhan Kharlihanov, a Professor from Korkyt-Ata Kyzylorda State University (who had formerly worked for the International Fund for Saving the Aral Sea - IFAS) met Micklin and White at the airport. Along with other expedition participants who had arrived earlier, they took the train to Aralsk, about a seven-hour trip. The group arrived in Aralsk late on the 30th of August and were met by other expedition participants who had come by train from St. Petersburg and Almaty. Base location would be Aralsk. Our entire group stayed in the only hotel in town, not surprisingly named “Aral”.

The following day, August 30th we met with local officials (including the deputy *Akim* or mayor of the city and district) to explain the intent and purpose of the expedition. Dr. Nikolay Aladin as the most knowledgeable and locally known member of our party took the lead on this. The local administration was friendly and supportive of our efforts. Micklin requested a visit to the newly rebuilt fish processing plant, which they granted. This was one of the highlights of the trip. The old fish canning plant, left over from Soviet days that had been in decline owing to the lack of catch as the fishing industry on the Aral collapsed (and may even have closed down) had been torn down and replaced by a very modern facility. The rapid recovery of the Small Aral fishery (both in terms of total catch and species diversity of catch) that has taken place since the Kok-Aral dike completion in 2005 made possible the plant restoration. Now enough fish, and especially valuable types, are being caught in the Small Aral to supply the plant with all the fish it can handle. Fish are brought in refrigerated trucks along rutted two track roads from the village of Tastubek, which lies on the shore of the Small Aral some 71 km southwest of Aralsk (see Figure 1). The less valuable fish (e.g. catfish) are processed for sale locally or in nearby communities. The more valuable types are cleaned and frozen for sale in more distant locales. The most valuable fish (pike-perch or sudak in Russian) are fillet and flash frozen in a state-of-the-art facility. We saw a large room filled with plastic sacks of frozen sudak fillets for sale in Russia, Ukraine and other parts of the former Soviet Union. The plant manager said that they are seeking certification to sell the frozen sudak in European Union countries where they would draw a very high price.

The First Field Excursion

The first, and shorter part of the fieldwork began early on September 1 and ended late on September 3. The Barsekelmes Nature Preserve, headquartered in Aralsk, provided logistical support and the director (Zauresh Alimbetova) accompanied us on the visit. Other participants in the first phase were Philip Micklin (retired geography professor, Western Michigan University, USA); Dr. Nikolay Aladin and Dr. Igor Plotnikov (aquatic zoologists from the Zoological Institute, Russian Academy of Sciences); Ivan Aladin videographer (Engineer BAN); Dr. Kristopher White an American geographer who teaches at the Kazakhstan Institute of Management, Economics and Strategic Research (KIMEP) in Almaty; Dr. Gunilla Bjorkland (Swedish geographer from GeWa Consulting); Chris Pala, an American journalist, Peter Durtschi, a Swiss Journalist, Wilfred Humbert, a French pianist with an interest in the Aral Sea; Dr. Torekhan Karlikhanov and Erzhan Alimbaev from Korkyt-Ata Kyzylorda State University; Dr. Michael Toman (limnologist from Ljubljana University in Slovenia) and a group from the IFAS office in Almaty, including Albert Diebold, Technical Director, and Murat Bekniyazov, Representative for the Republic of Kazakhstan in the Executive Committee of IFAS. Myrzagaziev Zhasulan, Nurlan, Satikeyev Timerbek, Absultan and Bekbulat drove the vehicles used in the trip.

We visited the Kok-Aral dike and dam, the delta of the Syr Dar'ya (dar'ya means river in the Persian language) near the dam, the nearby village of Karateren and the recently completed Ak-Lak hydrocomplex north of it on the Syr Dar'ya intended to regulate the flow of the lower Syr and divert some water to nearby lakes to maintain their levels and ecologic conditions, and the former Island of Barsekelmes far out on the dried bottom of the Aral Sea, which is a nature preserve. We traveled in 4-wheel drive jeeps known as "Uazik", an acronym for the factory in Russia that produces the vehicles. Although providing a very rough ride over the rutted two-tracks that pass as roads, they are extremely durable and well suited to local conditions.

Micklin used the YSI-85 salinity, conductivity, temperature and dissolved oxygen meter acquired for the 2005 expedition (from funds provided by the National Geographic) to measure key ecological parameters at the Kok-Aral dam and in the lower Syr Dar'ya (see Table 1). Salinity in the lake above the dam was higher than we expected, but we were told that so far this year inflow to the Small Aral has been well below the average for recent decades owing to a low-flow year on the Syr, which would mean less fresh water input near the dam and, thus, higher salinity. During the 2005 expedition, salinity here was 3.5 g/l. Nevertheless, ecological conditions near the dam seemed very good with high water transparency and very high levels of dissolved oxygen (DO). Dr. Toman, The Slovenian limnologist, raised a concern that the presence of bottom rooted macrophytes and extensive areas of reeds could signal a future problem of eutrophication from high levels of nutrients in the bottom sediments. Certainly this is something that needs careful monitoring as the lake evolves.

We saw many small family-scale fishing boats near the dam. The American journalist with us (Chris Pala who has written on the Aral for Science, the Wall Street journal and other media) talked with local fishers who confirmed the fishing was superior. Ivan Aladin took extensive video and interviews (including with local folk) of this portion of the expedition. (A total of seven hours of video material was recorded during the expedition. A summary of the video material is found in appendix 1.) Igor Plotnikov collected plankton for his studies of these organisms. We stayed one night in Karateren with local families in comfortable, newly renovated and expanded homes with new electric appliances, and satellite TV on digital flat screens. Karateren appeared much better off economically than was the case during visits there in 2005 and 2007. We were told this owed primarily to the rejuvenated fishing industry. The catch has greatly enhanced local incomes.

The trip to the former Barsekelmes Island across the dried seabed was long and hot. The island is now a plateau standing above this barren wasteland, with scattered salt-cedar and saksaul bushes breaking the monotony. The former island is considerably more vegetated than the surrounding dried sea bottom, but its flora and fauna have suffered serious degradation and simplification as the surrounding sea disappeared. Kulan (wild Asiatic Ass) used to roam the island, but owing to rapidly degrading habitat conditions, mainly lack of drinkable water, were moved to other locations in Kazakhstan in the mid-1980s. We stayed at the former research complex. Some of the buildings here have been refurbished, but others have been torn down. Some of our party made the "Grand Tour" of Barsekelmes, including visiting the ruins of the meteorological station, the Butakov Monument, and other sites.

Nikolay Aladin visited the former shoreline below the cliffs on the southern part of the island. There he collected detritus (including invertebrate shells), which were left by the influx of Amu Dar'ya water in the summer of 2010. His analysis of the shells indicates that salinity in the Eastern Basin of the Large Aral during the summer months of 2010 may have fallen to around 20 g/l, far below its level in 2009 that probably approached 200 g/l.

Some of our party slept outside that night. For them, the breathtaking view of the night sky was most memorable as the extremely clear air, lack of clouds, and absence of lights made the stars, constellations and Milky Way visible in a rarely seen way.

The next day, representatives of IFAS drove to Kzyl-Orda and the remaining members of the expedition visited the Amu Dar'ya delta and lower reaches.

The Second Field Excursion

After a one-day rest in Aralsk, on September 5 we set out on the 2nd phase of the field-work. The branch of the Kazakhstan Fisheries Institute located in Aralsk handled logistics for us. A smaller group participated in this phase of the expedition as the IFAS people returned to Kyzyl-Orda and Almaty. The director of the Fisheries institute (Zaulkhan Ermakhanaov) accompanied us on the trip. Those participating in the 2nd phase besides him were Philip Micklin (retired geography professor, Western Michigan University, USA); Dr. Nikolay Aladin and Dr. Igor Plotnikov (aquatic zoologists from the Zoological Institute, Russian Academy of Sciences); Ivan Aladin (Engineer BAN), Dr. Kristopher White an American geographer who teaches at the Kazakhstan Institute of Management, Economics and Strategic Research (KIMEP) in Almaty; Dr. Gunilla Bjorkland (Swedish geographer from GeWa Consulting); Chris Pala, an American journalist, Peter Durtschi, a Swiss Journalist, Wilfred Humbert, a French pianist with an interest in the Aral Sea; Dr. Torekhan Karlikhanov and Erzhan Alimbaev from Korkyt-Ata Kyzylorda State University; and Dr. Michael Toman (limnologist from Ljubljana University in Slovenia). The drivers for this portion of the trip were Myrzagaziev Zhasulan, Satikeyev Timerbek, and Bakhit.

Our route is shown on Figure 1. We first visited the village of Tastukbek located on the north shore of the Small Aral. This settlement has become the most important fishing center on the Small Sea. As noted earlier, fish from here are sent to the new processing plant in Aralsk. Fishing is small-scale with boats ranging from about 14 feet (4.3 meters) to over 20 feet (6 meters). Most have an inboard or outboard motor. Gill netting is the catch mode. The fishers set their nets in the afternoon and gather them early the next morning. We had the opportunity the next morning to watch the boats come back with their catch. The nets were loaded with fish including sazan, *Cyprinus carpio* L. (a carp-like species that is highly prized by local people), som, *Silurus glanis* L. (catfish), shchuka, *Esox lucius* L. (pike), zherekh, *Aspius aspius* L. (aspe), lyesch, *Abramis brama* L. (bream), vobla, *Rutilus rutilus aralensis* L. (roach) and the very valuable sudak, *Lucioperca lucioperca* L. (pike-perch).

The Fisheries Institute monitors the industry carefully to protect against over fishing and to gather biological data on the fish inhabiting the sea. Currently the Institute estimates the fish biomass of the Small Aral at 18,000 metric tons/annually. The legal catch is 4,500 tons and the illegal (poached) catch is estimated to be 1,500 tons. Hence the overall take is 6,000 tons, one-third of the estimated biomass. Chris Pala, the American journalist who has written on world fisheries issues said that this is the most restrictive (and protective) catch limit of which he is aware. The Christian Science Monitor for October 3, 2011 (Volume 103/issue 45, pp. 24-25) has a brief piece on the Small Aral that states the catch is slated to reach 10,000 tons by 2012.

The next morning (Sept. 6) we went to Butakov Bay, where Philip Micklin measured environmental parameters with the YSI-85 and Igor Plotnikov collected plankton samples (Table 1). We then proceeded to the village of Akespe where we conversed with local people and ate lunch in a local home. Akespe seemed improved from the last time visit in 2007, including having converted a sulfurous, hot artesian well gushing from a pipe into a fancy new "hot-spring" fountain and associated swimming hole. One of our drivers swam in the pond even though the water temperature was over 45 °C! In Akespe we met with a revered fisherman and did a video interview with him.

We then proceeded southward to the main part of the Western Small Aral known as Shevchenko Bay, stopping along the way so Philip Micklin could take more readings with the YSI-85. We spent the night in Akbastay, a major former fishing village on the southern coast of the bay. The next morning (Sept. 7) we went to the shoreline about 5 km away where Philip Micklin gathered more YSI-85 data and Igor Plotnikov collected more plankton samples. Nikolay Aladin collected benthos samples and washed them with the help of a special sieve. For the other expedition members, most of the day was spent relaxing at a pleasant sand beach where Philip Micklin gathered additional data with the YSI-85. Part of our group stayed overnight at the beach, a most enjoyable experience of exceptionally clear skies and refreshing

breezes from the lake. There were extensive wetlands lying behind the primary dune adjacent to the lake. These were filled with waterfowl of various types and sizes, including sandpipers, swans, flamingoes and pelicans.

Sept. 8 we traveled from Akbasty to Kulandy a village to the southwest (Figure 1). Along the way, we stopped along the shoreline of Shche-bas Bay formerly part of the southern (Large) Aral Sea. We visited the old military port that was used as the Aral Sea shallowed and ships were not able to reach Aralsk to transport supplies to the super-secret bioweapons-testing complex on Vozrozhdeniya (Resurrection) Island, now a peninsula separating the Eastern and Western basins of the Large Aral Sea. Practically nothing was left of the port except some concrete ruins and a few pieces of ship not taken by scrappers for recycling. We also visited a few mainly intact vessels stranded and abandoned along the west coast of the bay. Zaulkhan Ermakhanov, the director of the fisheries institute, showed us a place where one could walk to the sea (very difficult most places because of extensive flats of gooey, deep mud that are almost impossible to cross). Walking through a short expanse of mud, Philip Micklin was able to reach the bay and collect a bottle of water. He measured the water's salinity with a brine refractometer purchased for the trip. This was necessary as the salinity would be too high for the YSI-85. Two readings indicated salinity at 84/85 g/l, considerably lower than we expected. The explanation is likely considerable inflow to the gulf of relatively fresh water from the plateau like highlands surrounding the water body (as evidenced by artesian springs of relatively low salinity water on the slopes) and inflow of relatively fresh water when spring discharges from the Small Aral to Large Aral via the Kok-Aral dam create a chain of shallow lakes south of the dam. Nick Aladin and Igor Plotnikov took the bottle of water back to their lab in St. Petersburg for further analysis and to see if there are interesting phyto or zoo plankton in it for culturing. We also looked over the abandoned hydrometeorological vessel "Otto Schmidt." Nikolay Aladin repeatedly sailed on board this ship in the 1980s to collect samples. An abandoned military vessel (number 99) is situated near this vessel.

The night of Sept. 8 we spent in Kulandy. Although some distance from the Small Aral this village appeared better off than when we visited in 2005 and 2007. Kulandy had been connected to the electric grid and that may have played a major role in its improved fortunes. Next morning (Sept. 9) we made our way southward to the long channel connecting the Western and Eastern basins of the Large Aral. This river-like artery continues to persist as the two basins grow farther and farther apart owing to the continuing desiccation of the Large Aral. Salinity as measured by the brine refractometer was 110 g/l, about what we expected. The day of our visit, there was no perceptible current, interpreted by us to mean the levels of the East and West basins were the same. There were many brine shrimp in the water and accumulations of their eggs along the shore. As the Large Aral has salinized and become more favorable for harvesting brine shrimp eggs, there have been pilot projects to see if a viable commercial industry is possible. So far the answer has been no. We also saw a number of flamingo and other smaller shore birds feeding on the shrimp.

We traveled all the way back to the Kok-Aral dam that day via Akbasty and the former Kok-Aral peninsula. Then we journeyed northward to the village of Bugun (Figure 1) where we spent the night in a rather nice private home. Some of us even slept in a Yurt that the owners use mainly for cooking purposes. The next morning (Sept. 10), we visited the shore of the Small Aral north of Bugun where Philip Micklin took more YSI-85 readings, Igor Plotnikov collected plankton, and Nikolay Aladin gathered benthos samples. On the way back to Aralsk, we visited a fish-hatchery and nursery on the shores of Lake Kamyslybas (Figure 1). The fish as they grow larger are progressively raised in a series of ponds and then released into the Lake, which has an important fishery. The hatchery is jointly funded by Israel and the United States (for the latter through USAID).

We arrived back in Aralsk the evening of the 10th and remained there until the 12th when the Western contingent took the train to Kyzylorda. All three Russian participants in the expedition went by train to Saint Petersburg and were not able to participate in the conference described below.

Post Excursion Conference in Kyzyl-Orda

The Executive Committee of the International Aral Sea Rescue Fund (IFAS) and its branch office in Kyzylorda, St. Petersburg Scientific Center of the Russian Academy of Sciences, Kyzyl-Orda Oblast Governor's Office and Korkyt-Ata Kyzylorda State University organized a mini-conference titled, "The Northern Aral Sea – 20 Years on the Way to Revival" held at the University on 15 September (See Figure 2 for the program). They invited the members of our expedition to participate and provide results of our expedition as they related to the present condition and future of the Small Aral Sea. Phillip Micklin was asked to give a report titled, "Aral Sea: Past, Present, and Future," which he delivered in his considerably less than perfect Russian. (Other non-Russian speakers gave their comments in English that were then translated into Russian by three quite good translators). Although of short duration, the conference was very well organized and informative on the key Aral Sea issues. The resolution from the conference is below in Russian followed by Philip Micklin's English translation .

We also met with the Rector of the University (Dr. Kylyshbay Bisenov) and the Pro-rector for scientific work and international relations (Dr. Urpash Shabalova). They stated their hope and willingness to develop cooperation and exchange programs with Western Universities. The University was impressive: new buildings, well equipped with computers and seemingly well-funded. Kazakhstan is quite oil-rich and some of the new fields are located in Kyzylorda Oblast, which may have helped the University's fortunes.

We had considerable free time in Kyzylorda as we arrived on the 12th. We visited a number of interesting historic sites around the city as well as the main hydrocomplex on the Syr Dar'ya that regulates flow and diverts water into the extensive irrigation systems in the district. The hydrocomplex also had a very interesting associated museum with information about and photos of the hydrocomplex, irrigation, and other water management issues. We also visited a large rice farm (this is the most important crop grown in Kyzylorda Oblast). It was a state enterprise the director told us, which surprised us as we thought most agriculture in Kazakhstan had been privatized. The director also honestly stated the farm was in poor condition (e.g. fields not leveled properly, drainage ditches filled with weeds and sediment) that caused excessive water use and poor yields. We want to thank Slamzhan Eskhozevich, head of the Kyzylorda branch of IFAS and Dr. Torekan Karlikhanov from Korkyt-Ata University for their hospitality to us when we were in Kyzylorda.

Kris White and Philip Micklin flew back to Almaty on the 16th and I flew home the next morning.

FIGURE 2. PROGRAM FOR KYZYLORDA CONFERENCE, PAGE 1

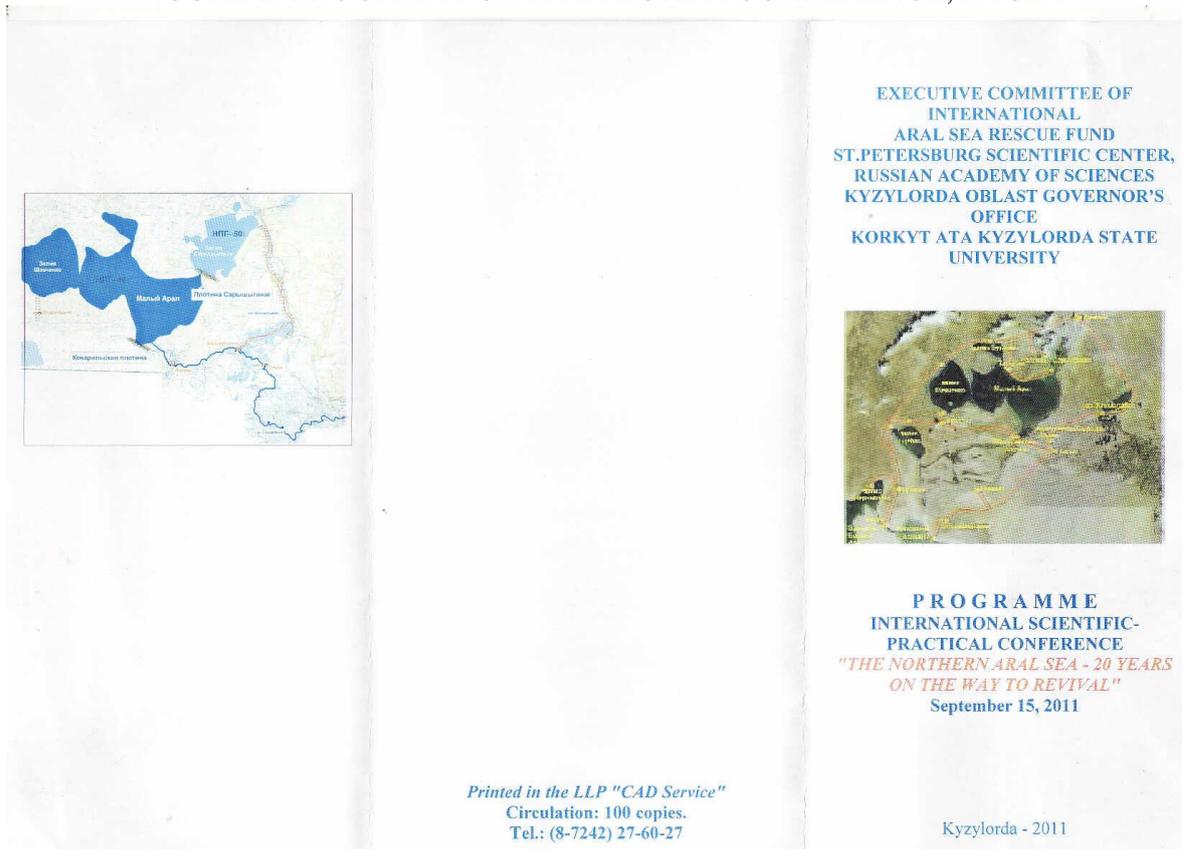


FIGURE 2a. PROGRAM FOR KYZYLORDA CONFERENCE, PAGE 2

Dear (Mr./Ms.)
Philip Micklin!

We cordially invite you to participate at the international scientific-practical conference "The Northern Aral Sea - 20 years on the Way to Revival."

The Conference will be held on September 15, 2011 at 10:00 a.m. at the Korkyt Ata Kyzylorda State University Academic Council session hall (29^a, Aiteke bi Street).

The conference work schedule:

9:30 – 10:00 - Registration of participants
10:00 – 13:00 - conference work

Speaking Time Limit:
Speeches - 3-5 minutes.
Reports - 7-10 min.

Organizing Committee

PROGRAMME
INTERNATIONAL SCIENTIFIC-
PRACTICAL CONFERENCE
"THE NORTHERN ARAL SEA - 20 YEARS
ON THE WAY TO REVIVAL"
Korkyt Ata Kyzylorda State University
Academic Council Session Hall
September 15, 2011, 10:00 a.m.

1. Opening ceremony of the conference.
Moderator: *Karlikhanov Torekhan Karlikhanovich* – Professor.

2. Welcome words and greetings.

1) *Nurtayev Rzakul Sadenovich* - Deputy Governor of Kyzylorda region.
2) *Shalbolova Urpash Zhaniyazovna* – Vice-rector for science and international ties, Korkyt Ata Kyzylorda State University, doctor of economical sciences, professor.

3. Reports:

1) *Philip Micklin* – professor (USA).
"Aral Sea: past, present and future"
2) *Nurmagambetov Demesin Sheralieovich* – Deputy chairman of the Executive Committee of International Aral Sea Rescue Fund, Ph.D., associate professor.
"On the Aral Sea Basin Program (ASBP-3)"
3) *Karlikhanov Torekhan Karlikhanovich* - Director of Applied Research Centre, Korkyt Ata KSU, doctor of technical sciences, professor.
"The integrated assessment of options for the second phase of the project" Control of the Syrdarya river bed and the Northern Aral Sea (RRSSAM-2)"

4. Speeches of "Aral-2011" scientific expedition participants

1) *Mihael Tomaz* – professor, limnologist (Slovenia). ✓
2) *Gunilla Bjorklund* – professor, geographer (Sweden).
3) *Kristopher White* – professor, specialist on Economic Geography (USA). ✓
4) *Peter Durtschi* – journalist (Switzerland). ✓
5) *Ospanov Medet* – director of Kazakhstan branch for International Aral Sea Rescue Fund.
6) *Alimbetova Zauresh* – director of Barsakelmes state reserve. ✓
7) *Ermakhanov Zaualkhan* – director of Aral fishery laboratory. ✓

5. Adoption of conference resolution.
6. Closing of the conference.

→ Same 2 days solution
→ SD M Saryshapal
→ 44 M more papers

Resolution of the International Scientific-Practical Conference “Northern Aral – 20 Years on the Way to Rebirth”

Kyzylorda
2011

September 15,

The Conference on the basis of the speeches, presentations, reports, and discussions:

1. Affirms the reality of the problems connected with the strengthening of the anthropogenic influence on the natural environment of the near Aral region, basin of the Aral Sea, and the planet as a whole.
2. Attests to the preservation of interest of the world academic community from a scientific point of view in the unique processes, which are occurring in the Aral Sea and near Aral region.
3. Establishes that the results of the expedition and the conference will become the basis of further cooperation of the International Fund for Saving the Aral, the Russian Academy of Sciences, Kyzylorda State University named after Korkyt Ata, and the Barsekelmes Nature Preserve with the World Academic Community.
4. Draws the attention of state management organs to the necessity to develop a practice of regular expeditions and conferences for accepting scientifically founded decisions for the further rebirth of the Aral Sea and sustainable social-economic development of the region.
5. Considers the real need for creation of an international scientific center to conduct eco-monitoring of the dried bottom of the Aral Sea within the framework of the branch program of the Ministry of Environmental Protection “Zhasyl damu” which is designated for the period 2010-2014.

Some Thoughts, Comments, and Conclusions

1. The Small (northern) Aral Sea appears to be in excellent ecological condition. Salinity (based on Philip Micklin's measurements, probably averaging 8-9 g/l) is ideal for the variety of fish found in the lake. Dissolved oxygen levels are high, at least during the day when he did his measurements. There is the potential for future eutrophication owing to nutrients accumulated in the sediments, but this is far from a certainty. The lake has developed into a major refuge for waterfowl, including migratory species. We saw large flocks of swans, flamingoes, and pelicans a number of places around the Small Aral. Careful, regular monitoring of ecological conditions of the lake is essential to document the evolution of this restored water body, which could serve as a more general model of what is possible in terms of restoring such damaged aquatic ecological systems elsewhere in the world (e.g., Salton Sea in California and Lake Chad in Africa).
2. Philip Micklin's measurements indicate salinity is relatively even around the sea, except for the isolated Butakov Bay where levels are higher. This indicates good water circulation, no doubt owing to the Kok-Aral dike and dam that has forced the fresh water input from the Syr Dar'ya to circulate throughout the lake rather than just flowing south and out of the Small Aral as it did prior to the emplacement of the dike and dam. Also, 2011 has so far been a dry year with diminished inflow to the Small Aral from the Syr Dar'ya. Yet, the level has not dropped that much (about 1/2 meter as indicated by high water evidence along the shoreline) and salinity has remained surprisingly low. This suggests the sea can probably withstand the periodic cycles of low flow years without major level drops, major salinity increases, and significant ecological deterioration.
3. The fishery recovery is an amazing success story. Most of the major indigenous species have made a dramatic comeback providing bountiful catches that have led to new employment, higher incomes, enhanced local and regional food supplies, and foreign currency earnings through the export of the most valuable species abroad. The new fish processing/freezing plant in Aralsk is the most dramatic sign of this. The Fishery Institute in Aralsk is doing impressive work to study and monitor the fishery in order to keep the catch at a level that does not threaten the long-term sustainability of the bioproductivity of the lake. As demand for fish increases and catch capabilities grow, it will be important for this organization to resist inevitable pressures to raise the catch limit above what is scientifically justified.
4. The government of Kazakhstan wants to institute a 2nd phase of the North Aral Restoration Project. Two options have been put forward. One is to raise the level of water only in the Gulf of Sary Shaganak (Figure 1) to 50 meters from its current nominal level of 42 meters. This would be accomplished by placing a new dam at the Gulf's mouth where it is connected to the main part of the Small Sea and diverting part of the flow of the Syr Dar'ya northward into Sary Shaganak to maintain the new reservoir. The project would bring the sea back to the former port town of Aralsk. The other project would rebuild the Kok-Aral dike and dam, raising the level of the entire lake to 48 meters. The 2nd project would likely provide more overall benefits, but the concern is that there is not sufficient water available from the Syr Dar'ya on an annual average basis to maintain this level. However, calculations by Philip Micklin based on the estimated inflows to the Small Aral from the Syr Dar'ya for 1992-2010 indicate there probably is sufficient water. There are strong supporters of each of the variants. Recent reports are that President Nazerbayev of Kazakhstan has selected the Sary Shaganak variant. Cost of the project could run to \$200 million USD. The World Bank is supportive of the project and would be asked for a loan to cover part of the cost.

TABLE 1. DATA FROM 2011 EXPEDITION AROUND SMALL ARAL AND NORTH PART OF LARGE ARAL TAKEN BY YSI-85 AND GPS

LOCATION (at or near)	DATE	GPS COOR. (deg-min-sec)		SALINITY	TEMP	DISSOLVED O ₂		comment
	(mon/day/year)	latitude	longitude	(mg/l)	(celsius)	mg/l	% sat.	
1. Kamyslybas Lake bridge	9/1/2011	N 46-08-21.4	E 61-25-10.9	3.5	20.4	6.9	82	bridge between lakes
2. Kok-Aral Dam (channel below)	9/1/2011	N 46-06-45.8	E 60-46-18.9					
a. reading 1 (shallow water)				5.6	20.2	5.4	63	small flow thru gate
b. reading 2 (shallow water)				6.5	21.8	5.36	64.3	
3. Kok-Aral Dam (above dam)	9/1/2011	N 46-06-45.8	E 60-46-18.9					
a. reading 1				6.2	20.5	8.97	106.8	1:21 in afternoon
b. reading 2				6.4	22.3	9.48	107.8	4:29 in afternoon
4. Syr Dar'ya delta (south side)	9/1/2011	N 46-06-7.3	E 60-51-51.7	0.9	20.1	5.26	60	near where we camped in 2005
5. Syr Dar'ya delta (north side side)	9/3/2011	N 46-05-23,2	E 60-58-40.7					Very hot and dry (37 C and 16.2% humidity)
6. Tastubek	9/5/2011	N 46-36-33.6	E 60-46-53					30 C; 14% humidity
a. reading 1 (shallow water)				8.3	24.7	7.65	100	
b. reading 2 (about 1/2 meter)					24.6	9.06	121	lots of bottom rooted vegetation
c. reading 3 (from boat ~ 2 meters depth)				7.7	24.6	10.91	137	
7. Butakov Bay by barge	9/6/2005	N 46-46-32.4	E 60-37-08.7					
a. reading 1 (shallow water)				11	23.1	8.61	101.5	salinity < than half 2005 (24-25 g/l)
b. reading 2 (shallow water)				11.1	23.3	8.56	107	
7.Artesian well E. of B. Bay nr Aksepe	9/6/2005			20	45-50 C			new fountain, pool, and swimming basin
8. Shevchenko Bay along west side	9/6/2005	N 46-36-42.5	E 60-05-14.6					early afternoon
a. reading 1 (shallow water)				7.9	26.2	9.98	129.1	salinity less than 2005 (11.7 and 12.9 g/l)
b. reading 2 (shallow water)				7.9	25.3	9.12	126	
9. Ak Basty		N 46-22-24.6	E 60-11-33.6					
a. reading 1 (shallow water)	9/7/2011			7.9	19	8.8		
b. reading 2 (shallow water)	9/8/2011			8	22.1	6.53	78.3	air temp = 23.2 C; humidity = 45%
c. reading 3 (shallow water)	9/8/2011			8	22.1	6.41	76.9	several km south of gps coordinates
10. Tshche-Bas Bay	9/8/2011	N 46-17-47.8	E 59-31-14.8	84/85				optical refractometer
11. Channel from W. to E. Large Aral basins (Uzunaral)	9/9/2011	N 45-41-46.4	E 59-14-59.5	110	21.1	5.79	98.8	optical refractometer
12. Beach north of Bugun	9/10/2011	N 46-12-18	E 61-06-11.5					
a. reading 1 (shallow water)				7.7	17.5	7.32	80.1	
a. reading 1 (shallow water)				6.8	17.4	7.8	74.7	

Annex 1

ANNOTATION TO VIDEO MATERIALS

Tape 1		
From	To	Description
00:00:08	00:05:32	Aralsk, former harbor
00:05:32	00:06:52	Aralsk, former harbor; museum of fishery under construction
00:06:52	00:07:45	Aralsk, former harbor; Z. Ermakhanov are telling about museum of fishery
00:07:46	00:10:24	Aralsk, old fish-processing factory
00:10:25	00:12:00	Aralsk, modern fish-processing factory
00:12:00	00:15:10	Aralsk, ruins of military base
00:15:11	00:16:15	Aralsk, Monument to fishermen of Aral
00:16:16	00:17:35	Aralsk, railway station
00:17:36	00:20:46	Aralsk, ruins of airport
00:20:47	00:22:00	Aralsk, radars
00:22:00	00:25:57	Aralsk, monument of independence
00:25:57	00:28:00	Aralsk, park and a monument at stadium
00:28:01	00:30:06	Aralsk, stadium
00:30:07	00:30:21	Aralsk, monument with the text of letter from Lenin to fishermen of Aral
00:30:21	00:40:01	Aralsk, railway station – arrival of other members of expedition team
00:40:01	00:43:20	Aralsk, at hotel reception
00:43:20	01:02:29	Aralsk, our team is visiting local administration

Tape 2		
From	To	Description
00:00:20	00:04:10	Aralsk, our team is visiting local administration
00:04:10	00:05:33	Aralsk, our team after visit to local administration
00:05:34	00:20:19	Aralsk, excursion to one of fish-processing factories
00:20:19	00:34:48	Aralsk, in the office of Barsakelmes wildlife reserve
00:34:49	00:45:34	Aralsk, our team is visiting Aral branch of Kazakh Research Institute of Fishery
00:45:35	00:47:39	Aralsk, former harbor
00:47:40	00:50:34	On the bridge at Kamyslybas Lake
00:50:35	01:02:30	Aklak control structure on Syrdarya

Tape 3		
From	To	Description
00:00:20	00:10:25	Kok-Aral dam
00:10:25	00:14:19	Small Aral Sea at the dam
00:14:20	00:16:26	Philip Micklin is measuring water salinity
00:16:27	00:19:03	At Syrdarya
00:19:04	00:25:06	A tower by the way to former Barsakelmes island
00:25:06	00:30:00	At a barrier on the road to former Barsakelmes island
00:30:01	00:33:50	Entry to former Barsakelmes island
00:33:51	00:34:16	At the house of Barsakelmes wildlife reserve on former island
00:34:17	00:39:35	Ruins of buildings of Barsakelmes wildlife reserve and the rests of camions, tractors etc.
00:39:36	00:41:05	In the western part of former Barsakelmes island
00:41:06	00:42:41	We are going to Butakov Cape
00:42:42	00:44:04	On Butakov Cape; monument to Butakov expedition

Tape 3		
From	To	Description
00:44:05	00:44:22	On the cliff of southern coast of former Barsakelmes island
00:44:22	00:48:13	Interview of Alfred Diebold
00:48:13	00:50:10	View from the cliff of southern coast of former Barsakelmes island
00:50:10	00:50:59	Michael Toman
00:51:00	00:58:32	In the closed hydrometeorological station on former Barsakelmes island
00:58:33	01:00:09	Part of expedition are leaving Barsakelmes
01:00:10	01:02:30	At the house of Barsakelmes wildlife reserve on former island

Tape 4		
From	To	Description
00:00:20	00:00:30	Barsakelmes, ants
00:00:31	00:00:57	At the house of Barsakelmes wildlife reserve on former island
00:00:57	00:01:22	Barsakelmes, dead beetle and ants
00:01:22	00:01:36	Signboard on the house of Barsakelmes wildlife reserve on former island
00:01:36	00:04:15	At the house of Barsakelmes wildlife reserve on former island
00:04:16	00:15:13	At Syrdarya
00:15:13	00:19:00	Syrdarya and Aklak control structure
00:19:01	00:25:39	Remains of vessels on the bottom of dried up Birlestik Bay of Small Aral
00:25:40	00:29:20	Takyr
00:29:21	00:30:31	We are going to Tastubek village
00:30:31	00:31:21	On the Small Aral coast not far from Tastubek village
00:31:22	00:32:28	M. Toman with dried up flatfish
00:32:29	00:37:03	Camels on the shore
00:37:04	00:37:24	Fishermen's boats
00:37:25	00:38:46	Birds on the sea
00:38:47	00:43:28	Dinner
00:43:28	00:43:51	M. Toman
00:43:52	00:45:01	Fishermen are preparing their nets
00:45:02	00:47:43	Fishermen are going to the sea
00:47:44	00:48:01	Boats with fishermen
00:48:02	00:48:34	Fishermen are preparing their nets
00:48:35	00:50:02	Preparation for fishing
00:50:03	00:52:20	Putting of nets
00:52:21	00:53:18	Haul
00:53:19	00:58:36	Putting of nets
00:58:37	00:59:42	Boat with fishermen
00:59:43	01:02:28	Igor Plotnikov is sampling plankton

Tape 5		
From	To	Description
00:00:03	00:02:09	Coming back to the coast
00:02:09	00:03:43	View to the coast from the boat
00:03:44	00:06:04	Sunset
00:06:05	00:06:24	Moon
00:06:25	00:07:38	Kettle, gas-cylinder and burner
00:07:40	00:10:53	Coming back with caught fishes
00:10:54	00:11:06	Nets
00:11:06	00:11:36	Bird
00:11:36	00:17:43	Interview of Michael Toman

Tape 5		
From	To	Description
00:17:44	00:18:47	Transportation of nets from boat to the coast
00:18:47	00:19:39	Caught fishes
00:19:40	00:24:18	Ichthyologists are analyzing fishes
00:24:19	00:26:27	Cliffs at Butakov Bay
00:26:27	00:26:37	Gypsum
00:26:37	00:27:11	Cars of expedition
00:27:12	00:28:48	Cliffs at Butakov Bay
00:28:49	00:29:33	Gypsum
00:29:34	00:32:46	Cliffs at Butakov Bay and view to it
00:32:47	00:33:56	Stone with fossil shells
00:33:57	00:35:36	Cliffs at Butakov Bay
00:35:37	00:37:06	A boat on the shoreline of Butakov Bay
00:37:07	00:38:52	Pier and boat at Butakov Bay
00:38:53	00:42:43	Hot-water well near Akespe village
00:42:44	00:43:30	Dunes near Akespe village
00:43:31	00:46:34	Camels in Akespe village
00:46:35	00:52:14	Akespe village, interview with old fisherman
00:52:14	00:55:27	Interview with Wilfrid Humbert
00:55:28	00:55:39	Akespe village, our cars are crossing a dune
00:56:12	00:56:21	Our cars crossed a dune
00:56:44	00:57:47	Cliffs at Shevchenko Bay
00:56:44	00:57:47	Horses on the coast of Shevchenko Bay
00:57:52	00:59:41	Sunset on Shevchenko Bay

Tape 6		
From	To	Description
00:00:16	00:06:06	Fishermen on Shevchenko Bay; haul
00:06:06	00:17:17	Interview with Philip Micklin
00:17:17	00:20:32	Dunes and mausoleums near Akbasty village
00:20:33	00:23:39	View from cliff to Tshebas Bay of Large Aral
00:23:40	00:24:00	Road, view from car
00:24:00	00:25:17	View from cliff to Tshebas Bay
00:25:18	00:27:26	House of herdsman
00:27:27	00:32:48	Descending to Tshebas Bay by road from cliff
00:32:48	00:36:21	Tshebas Bay, pier and remnants of dredger and vessels
00:36:21	00:37:41	O.Schmidt – a vessel of hydrometeorological service on dried up bottom of Tshebas Bay
00:37:48	00:42:38	Interview with Gunilla Bjerklund
00:42:39	00:42:58	Shells on dried up bottom
00:42:59	00:45:14	Navy ship on dried up bottom of Tshebas Bay
00:45:15	00:47:05	View from this ship
00:47:06	00:48:55	Well by the way to Kulandy village
00:48:56	00:49:17	Flamingo on the canal between Western and Eastern Large Aral
00:49:17	00:57:52	Interview with Kristopher White
00:57:53	00:58:38	Igor Plotnikov with sampled Artemia
00:58:39	01:01:18	Interview with a man from Kulandy village
00:01:19		Canal, birds, spume

Tape 7		
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From	To	Description
00:00:19	00:02:11	Igor Plotnikov is sampling on the canal between Western and Eastern Large Aral
00:02:12	00:05:43	Philip Micklin is bathing in this canal
00:05:44	00:05:53	Philip Micklin and a bird
00:05:54	00:05:00	Flamingo on this canal
00:06:00	00:07:03	Our team before to leave this place
00:07:04	00:10:26	Kulandy peninsula, various landscapes
00:10:27	00:10:35	View to Tschebas Bay
00:10:35	00:12:37	Southern cliffs of Kok-Aral
00:12:37	00:18:40	Interview with Zaualkhan Ermakhanov
00:18:41	00:23:21	Interview with Zaualkhan Ermakhanov
00:23:21	00:24:09	Small Aral and boats
00:24:10	00:24:35	A kettle
00:24:36	00:24:42	A bird
00:24:42	00:25:45	Reeds
00:25:46	00:28:25	Fishermen
00:28:25	00:30:25	Camp of fishermen
00:31:38	00:32:08	Children in Koszhar village
00:32:09	00:34:53	Interview with Christopher Pala
00:34:53	00:37:25	Interview with director of Kamyslybas fish hatchery in Koszhar village at Kamyslybas Lake
00:38:04	00:40:31	Philip Micklin is measuring water salinity in pond of fish hatchery
00:40:32	00:42:17	Ponds of Kamyslybas fish hatchery
00:42:17	00:51:30	Test fishing
00:51:31	00:52:02	Incubatory of Kamyslybas fish hatchery
00:52:03	00:54:53	In the incubatory of Kamyslybas fish hatchery
00:54:54	01:00:52	Director of Kamyslybas fish hatchery is telling about the incubatory inside it
01:00:53	01:01:27	Director of Kamyslybas fish hatchery is telling about the incubatory outside it

ANNEX 2.

Table 1. Species composition of the Aral Sea aboriginal ichthyofauna.

Species	Years				Status
	1950	1960-1979	1980-1990	1991-2004	
	Acipenseridae				
Ship sturgeon <i>Acipenser nudiiventris</i> Lovetsky	+	+	-	-	C-, E
	Salmonidae				
Aral trout <i>Salmo trutta aralensis</i> Berg	+	+	-	-	C-, E
	Esocidae				
Pike <i>Esox lucius</i> Linnaeus	+	+	-	+	C-
	Cyprinidae				
Aral roach <i>Rutilus rutilus aralensis</i> Berg	+	+	-	+	C
Orfe <i>Leuciscus idus oxianus</i> (Kessler)	+	+	-	+	C-
Asp, zherekh <i>Aspius aspius iblioides</i> (Kessler)	+	+	-	+	C
Rudd <i>Scardinius erythrophthalmus</i> (Linnaeus)	+	+	-	+	C-
Turkestan barbel <i>Barbus capito conocephalus</i> Kessler	+	+	-	-	C-, RB
Aral barbel <i>Barbus brachycephalus brachycephalus</i> Kessler	+	+	-	+	C-, RB
Bream <i>Abramis brama orientalis</i> Berg	+	+	-	+	C
White-eye bream <i>Abramis sapa aralensis</i> Tjapkin	+	+	-	+	C-
Aral shemaya <i>Chalcalburnus chalcoides aralensis</i> (Berg)	+	+	-	+	C-
Sabrefish <i>Pelecus cultratus</i> (Linnaeus)	+	+	-	+	C-
Crucian carp <i>Carassius carassius gibelio</i> Bloch	+	+	-	+	C-
Carp <i>Cyprinus carpio aralensis</i> Spitshakow	+	+	-	+	C
	Siluridae				
Wels <i>Silurus glanis</i> Linnaeus	+	+	-	+	C-
	Gasterostidae				
Nine-spined stickleback <i>Pungitius platygaster aralensis</i> (Kessler)	+	+	+	+	NC
	Percidae				
Pike perch, zander <i>Stizostedion lucioperca</i> (Linnaeus)	+	+	-	+	C
Perch <i>Perca fluviatilis</i> Linnaeus	+	+	-	+	C-
Ruff <i>Gymnocephalus cernuus</i> (Linnaeus)	+	+	-	-	NC

Note: + present; - absent; C – commercial; C- – commercial but low stocks; NC – not commercial; RB – in Red Book; E– extinct.

Table 2. Introduced fish species in the Aral Sea.

Species	Years of introduction	Source	Way	Status	Impact	Status in the 2000s
Acipenseridae						
Stellate sturgeon <i>Acipenser stellatus</i> Pallas	1927-1934	Caspian Sea	A	-	-	-
	1948-1963	Caspian Sea	A	C-	0	-
Clupeidae						
Caspian shad <i>Alosa caspia</i> (Eichwald)	1929-1932	Caspian Sea	A	-	0	-
Baltic herring <i>Clupea harengus membras</i> (Linnaeus)	1954-1959	Baltic Sea	A	N, C-	-	R
Mugilidae						
Golden grey mullet <i>Liza aurata</i> (Risso)	1954-1956	Caspian Sea	A	-	0	-
Leaping mullet <i>Liza saliens</i> (Risso)	1954-1956	Caspian Sea	A	-	0	-
Cyprinidae						
Grass carp <i>Ctenopharyngodon idella</i> (Valenciennes)	1960-1961	China	A	C	+	C-
Silver carp <i>Hypophthalmichthys molitrix</i> (Valenciennes)	1960-1961	China	A	C	+	C-
Spotted silver carp <i>Aristichthys nobilis</i> (Richardson)	1960-1961	China	A	R	+	C-
Black carp <i>Mylopharyngodon piceus</i> (Richardson)	1960-1961	China	A+	C	0	C-
Syngnathidae						
Black-striped pipefish <i>Syngnathus abaster caspius</i> Eichwald	1954-1956	Caspian Sea	A+	N, NC	-	?
Atherinidae						
Caspian atherine <i>Atherina boyeri caspia</i> Eichwald	1954-1956	Caspian Sea	A+	N, NC	-	R, NC
Gobiidae						
Bubyr goby, transcaucasian goby <i>Pomatoschistus caucasicus</i> Berg [= <i>Knipowitschia caucasica</i> (Berg)]	1954-1956	Caspian Sea	A+	N, NC	-	NC
Sand goby <i>Neogobius fluviatilis pallasii</i> (Berg)	1954-1956	Caspian Sea	A+	N, NC	-	NC
Round goby <i>Neogobius melanostomus affinis</i> (Eichwald)	1954-1956	Caspian Sea	A+	N, NC	-	NC
Syrman goby <i>Neogobius syrman eurystomus</i> (Kessler)	1954-1956	Caspian Sea	A+	R, NC	-	NC
Tube-nose goby <i>Proterorhynchus marmoratus</i> (Pallas)	1954-1966	Caspian Sea	A+	R, NC	-	NC
Bighead goby <i>Neogobius kessleri gorlap</i> Iljin	1954-1956	Caspian Sea	A+	R, NC	-	NC
Channidae						
Snakehead <i>Channa argus warpachowskii</i> Berg	1960s	Kara-Kum canal	A+	C	0	C
Pleuronectidae						
Black Sea flounder <i>Platichthys flesus</i> (Linnaeus)	1979-1987	Sea of Azov	A	N, C	+	N, C

Way of introduction: A – acclimatization, A+ – incidentally at planned introduction.

Status: R – rare, N – numerous, C – commercial, C- – commercial but low stocks, NC – not commercial.

Impact: – negative, + positive, 0 no effect.

Annex 3
Free-living invertebrates of the Aral Sea

Small Aral

Zooplankton

Rotatoria

Synchaeta vorax

S. cecilia

Brachionus angularis

B. calyciflorus

Notholca squamula

N. acuminata

Keratella tropica

Cladocera

Podonevadne camptonyx

Evadne anonyx

Copepoda

Calanipeda aquaedulcis

Halicyclops rotundipes aralensis

личинки Bivalvia

Abra ovata

Cerastoderma isthmicum

Zoobenthos

Bivalvia

Abra ovata

Cerastoderma isthmicum

Gastropoda

Caspihydrobia spp.

Polychaeta

Hediste diversicolor

Ostracoda

Cyprideis torosa

Eucypris inflata

Decapoda

Palaemon elegans

Insecta

Chironomidae gen. sp. larvae

Large Aral

Zooplankton

Infusoria

Fabrea salina

Branchiopoda

Artemia parthenogenetica

Copepoda

Apocyclops dengizicus

Zoobenthos

Infusoria

Frontonia marina

Ostracoda

Cyprideis torosa

Insecta

Chironomidae gen. sp. larvae