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From	Aral Fishing Committee AFC
To	All concerned

Keep Aral Fishing

Report from the Aral Fishing Committee AFC

Investigations into the fishery on the Aral Sea – Small Aral - in Kazakhstan September/October 2017. A report by The Danish Society for a Living Sea and the Aral Tenizi, Aralsk

By Jan Gruwier Larsen, Hanne Gruwier Mogensen, Makhambet Muktar, Aina Baimakhanova

From Kattegat to The Aral Sea
https://www.facebook.com/AralSeafishery/?fref=nf.

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1. Summary and main conclusions

The fishery in the Aral Sea has a long and glorious history. After an almost total collapse caused by saltification, an initiative in the mid-nineties by the Danish Association for a Living Sea has led to the recovery of the fishery in the northern part of Aral, the Small Aral. The fishery once again provides a livelihood for thousands of people.

In 2016 a delegation from the Danish Association for a Living Sea, Kurt Svennevig Christensen and Henrik Jøker Bjerre, revisited the Aral region. They became aware of the need to assess the sustainability of the Aral fisheries. Huge investments in fishery and fish processing have been made and are still being made, but there are signs, that the fishery at its present level is not sustainable.

Rather than passively awaiting impending collapse, local partners, the Akim of the Kyzylorda region and The Danish Association for a Living Sea agreed that a small group of experts would be sent by The Danish Association for a Living Sea to investigate and receive inputs from all parts and to propose development recommendations for the management of the Aral Sea fisheries. The plan is to be presented to the stakeholders in the fishery and the local authorities in Aralsk and Kyzylorda region in 2018. The results of this investigation are briefly summarized in the present report.

The objective of the investigations
The objective of this work is to investigate the state of fish populations in Small Aral, to assess the need for a biologically based management system and if possible suggest a provisional model for such a system for presentation to all stake holders in the fishery in 2018.

Recommendation
The main conclusion is that because of overfishing the commercial fishing in the Small Aral is declining and has probably already peaked. Within the next few years we expect a shift in population from commercially valuable fish to fish with les market value and maybe even a collapse.

The current fisheries administration is mainly a political and economic system for allotment and administrating licenses and quotas. There are no reliable data on fish catches in the Aral and no overview of the current management system presently exists.

The management system is complicated and unintentionally rewards black fishing and generates overcapacity.

We recommend the initiation and implementation of a new biologically based management system involving cooperation between European specialists, The Aral Fishing Committee, NGO Aral Tenizi, Danish Association for a Living Sea, The Akimat and other administrations, the KazNIIRH Institute and the fishing industry.

A new biologically based management system
A reformed fishery management system should be:

- discussed and accepted by representation from all stakeholders in the fishery, including fishermen, fish production plants and exporters, administration and local NGO´s.
- open to the public about methods and budgets to ensure public cooperation.
- based on TAC´s (totally allowable catch) for each species and for Small Aral as a whole
- and modelled on existing managements systems from other similar lake ecosystems, and common guidelines for fisheries management by the Ministry of Fisheries

It should additionally:

- provide scientific founded advise based on measurement of physical and chemical parameters and the application of modern methods to estimate fish populations in the Small Aral
- take other legitimate uses of the Small Aral and its ecosystem into consideration, such as tourism, sports fishing, birdwatching, scientific research.
- closely evaluate the presently questionable practice of stocking the Aral with fingerlings
- separate production from the license system and permit fishermen to obtain fishing rights directly
- subject fish to normal market conditions by allowing fish factories and exporters to buy fish directly from fishers
- consider the establishment of an auction system commonly owned by the fishermen for trading in fish
- monitor catches both in situ at landing sites and at production facilities
- develop a set of conservation methods, designed to promote the most valuable fish populations and suited to the Small Aral ecosystem, including quotas, geographical limitations and technical standards, such as mesh size, number of nets and restricted fishing periods.
- Reliably and strictly enforce fishing regulation regarding type of nets, mesh size, number of nets per boat etc., to minimize Ghost fishing with lost nets and by-catch of undersized fish.

How to start?
Much good work is being done in different parts of the present management system. On the levels of administration, the fishing industry and amongst the fishermen, there is knowledge and understanding of the basic problems regarding the Aral fishery. Both fishermen and fishing industry want a more open and understandable regulation system and better control with the black fishery (IUU = illegally, unreported and unregulated fishing). If the different parts of the current system could be brought together in a biologically based management, the fisheries on the Small Aral could be a model for a reformed system for all of the Kazakhstan.

The task of changing the fisheries management in the Small Aral is not simple. There is, however, an awareness that the current fishery is not sustainable and that the management system is not functionally optimal. Despite recent improvements in living conditions the Aral Sea disaster is still vividly remembered in Aralsk.

A workable solution could be the establishment of a temporary, coordinating organization in Aralsk, assisted by international experts, Aral Tenizi, The KazNIIRH and the various levels of the administration.

Responsible organizations
The report was developed by "The Aral Fishing Committee" AFC as second step in the overall plan "Keep Aral Fishing", a cooperation between The Danish Association for a Living Sea and Aral Tenizi. Chairman of the AFC is Jan Gruwier Larsen, contact +45 21202790, jangruwier@gmail.com

Project group
Henrik Jøker Bjerre, project leader, professor of philosophy, university of Aalborg

Kurt Svennevig Christensen, senior consultant, fisheries expert

Jan Gruwier Larsen msc Marine Biologist, Chairman of the Aral Fishing Committee AFC

Makhambet Muktar, biologist senior advisor, Almaty

Hanne Gruwier Mogensen, Senior consultant, EU legislation, fish production plants

Aina Baimakhanova, director of Aral Tenizi

Zhanna Tairova, PhD, ecotoxicologist

Erik Bjorn Olsen, msc, expert on fisheries legislation, regulation and administration

Researchers
The research and reporting was conducted by Jan Gruwier Larsen, Hanne Gruwier Mogensen, Makhambet Muktar, Aina Baimakhanova and Akmaral Utenisova – interpreter and local expert – with help and advice from several persons and institutions in the EU.

The work has been supported in Kazakhstan by the Akim of Kyzylorda Mr. Kusherbayev K. and Akim of Aralsk Mr. Orazbaev M. and in Denmark by Viggo Harboe and the Bodil Pedersen Foundation.

2. Method and sources

No overview of the current management system for the administration presently exists, nor are there reliable data on the catch of fish in the Aral. Our method has thus by necessity been to extract what data we could from written sources and subsequently to follow the flow of information and fish from the Aral Sea through the fishing industry and the administrative system, patching information gaps as we went along. On the way we had long interviews with all the involved parties. Most of them official while others were non-official. The interviews were primarily conducted in the presence of the entire research team and facilitated by our very competent interpreter Akmaral Utenisova. Notes from the interviews, transcribed into English, have been used as a reference source for this report and archived for background elucidation and documentation.

In this process we gained very good overall map of the structure of the management system and the currently best possible estimate of the total catch of fish from the Aral Sea.

Written sources

- A comprehensive study of the available relevant scientific literature pertaining to the fisheries, ecology, biology and hydrology of the Aral Region.
- The yearly reports from 2006 to 2017 from the local branch of the KazNIIRH institute in Aralsk. These reports represents a data series with samples of fish taken each year, using the same method. Only cursory machine translation of the material have been used as source material in the present project. Selected parts of this material should be made available in a good English translation.
- Reports and other papers from the IFAS, UNDP, and the Barsakelmes Biosphere Reserve
- The official government instructions to the management of fisheries

Interviews with individuals and institutions

- Interviews with the leading experts on the Kazak fisheries Henrik Jøker Bjerre and Kurt Svennevig Christensen

- Interview with director and personnel from the International Fund for Saving The Aral Sea (IFAS)
- Interview with the main office of the KazNIIRH in Almaty
- Interview with the Department of Nature Management Ressources, Kyzylorda,
- Interview with the Department of Fisheries Inspection in Kyzylorda,
- Interview with members of the board of the NGO Aral Tenizi in Aralsk,
- Interview with the Akim Orazbaev Mukhtar of the Aral region
- Interview with a number of fish production plants in Aralsk and around the Aral Sea
- Several interview and discussions with the local branch of the KazNIIRH institute in Aralsk
- Visit to The Fingerling production plant Batyrhan
- Information from The Fishery Museum and local Historical museum in Aralsk
- Interview with the local fisheries inspection in Aralsk
- Interviews with a number of fishermen from Aral region
- Field trips to Small Aral, the Kokaral and west coast of Big Aral

We want to thank everybody we met during our research for this report. Their great openness and willingness to discuss and to supply information about the complicated and sensitive issue of fisheries and fisheries regulation in the Aral Sea was invaluable.

Please note that the views expressed in this report may not coincide with those of the interviewed persons and institutions.

3. Biology of the Small Aral fisheries

Background

In the nineteen nineties, The Danish Association for Living Sea established a fishery in the Aral Sea to combat widespread poverty in the region. In 1998 a joint scientific expedition by the Danish Association for a Living Sea and the local branch of the KazNIIRH institute estimated the total population of the introduced flounder Kambala glossa to at least 20.000 ton. This estimate was based on trial fishery at a number of locations plus a backwards calculation from the area of the Aral Sea and an estimate of the primary production. At the time, there was no commercial exploitation of this huge resource.

In the years that followed, the Danish Association for a Living Sea and our sister organization the Aral Tenizi brought equipment into the region, educated fishermen, organizing them and mapping the resources.

The Aral Sea fisheries development has exceeded the wildest expectations of both The Danish Society for a Living Sea, Aral Tenizi and the local authorities. Today there is a large and growing

fishery on the Aral Sea. The entire Aral region has been transformed. Many new stakeholders have moved into the fishery and the production is still growing. The whole region has been transformed, and once again, thousands of people acquire their incomes in fisheries and associated industries. It is nothing less than a revolution.

Indicators of overfishing

According to the official data for the Aral fisheries, the only lake fishery in Kazakhstan, the total catch size are about 7000 tons and steadily rising. On the superficial level, this would seem to be good news, but information provided by fishermen as well as the Fisheries Control Agency indicate strongly that this catch level is obtained by using in excess 3000 meters of nets per boat with two fishermen; a threefold increase compared with 1000 meters five years ago. Additionally, the mesh size has decreased from 65 mm five years ago to at 45, 35 or even 25 mm to day. The total catch of 7000 tons has thus been obtained by a dramatic increase in fishing intensity.

Measurements of the average size of fish caught in the Aral Sea are unreliable and difficult to interpret, due to translation and methodological problems. Data from fish factories however, display a steady decrease in the size of commercial fish arriving at the plants, year by year. This reduction in the size of individual caught fish is illustrated by the fact that The Aral Service Center, which treats only Sander filleted, frozen and exported to the European market, has been regularly increasing the number of fillets for a given total catch weight. This decline in size has not been observed in the yearly reports from the KazNIIRH institute.

The latest report from by KazNIIRH 2016 using data independent on fishery concludes, “Stocks of valuable fish species such as pike perch, carp and asp in the Small Aral as a result of intensive fishing are depleted”.

These indicators do not stand alone. All parties involved in fishing and the fishing industry: fishermen, fish factories and other fish treatment plants, the NGO Aral Tenizi, plus the local fishery protection agency, agree unanimously that after a period of yearly increase the fisheries are presently stagnating for several species and declining for the most commercially valuable ones. This assessment is masked by the fact that the much cited but misleading total catch of approximately 7000 tons combines all of the caught species together in a lump sum.

Estimates of the black (IUU) fishery are remarkably consistent in all of the local Aralsk sources. It amounts to at least the same quantity as the legal catch but could be twice as much. According to this estimate, the total catch of fish from the Small Aral would be at least 14,000 tons compared to the official approximate reckoning of 7000 tons.

We conclude that overfishing has now driven the regions fisheries beyond the carrying capacity of the Aral Sea.

Causes of overfishing

The main cause of overfishing in the Small Aral is the management system itself, which unintentionally generates overcapacity. Excessive investment in fish plants and infrastructure will automatically increase pressure on the fish resources. When stocks of valuable fish are depleted, the pressure to make a return on investments is further amplified.

The Small Aral is divided into 18 economic zones. In order to bid for a single zone fishing license, ownership of a fish processing plant is a prerequisite requirement, which has led to the building of redundant plants. There are currently 14 license holders, some of whom have more than one zone. These plants process 6,934 tons of fish, closely conforming to the allowed catch. Aside from these however, at least 30 fish plants of different sizes operate in the Aral. These informal plants are not centrally registered and are not subject to systematic control. While these factories process fish from the licensed plants and other lakes to a certain extent, their main input is black (IUU) fish from the Aral. The described overcapacity generates a huge demand for black (IUU) fish. We estimate that the capacity of the production plants making fish products for domestic market, eastern Europe and EU is in the order of ten times allowed catch. One unlicensed plant alone (which is perfectly legal) has by its own estimate a capacity of 6000 tons. Some of the licenses plants report their own capacity to in excess of 20.000 tons. The processing plants are often idle, because the demand for fish exceeds the legal supply. When we visited the plants at the beginning of the autumn season 2017, we observed but little activity and a drastically reduced work force. This of course diminishes the total return of the investments.

We have tried to assess the amount of money invested in the fishing industry. It has not been possible but it is absolutely certain, that the investments are out of proportion with the resource.

Needless to say, nobody admits to fish black (IUU) fish or to process black fish in their plant (of course) but both fishermen and fishing plants operate indiscriminately in the licensed system as well as in the black market. Black fishing is a socially accepted and integrated in the management system. Any adjustment attempts must accept this fact. The fisheries inspection agency controls the licensed fisheries and reports catch, but it does not have the means of preventing black fishery.

Scientific advice

The local Aralsk branch of the fisheries institute KazNIIRH, makes separate yearly assessments of the fish stocks of all commercial fishes separately for each of the economic zones. The KazNIIRH institute is unique in being local, being present, having locally present offices and laboratories, having a good knowledge of the species in the Small Aral and having followed the development of the freshwater ecosystem in the lake from the start.

The principal method is trial fishing with standard nets and subsequently converting the catch to standing stock, using a standardized formula dating back to the Soviet management system. Additionally, measurements of fish, analysis of stomach contents and to some extent the food

base for the fish are performed. The analyses including a recommendation for the limit of catch for each species for the following year are published internally in a Russian language paper to the KazNIIRH main branch in Almaty.

The substantial local knowledge base and local human resources of the KazNIIRH could be optimized by relatively simple means including access to basic equipment for measuring and logging physical and chemical parameters, training in statistical methods, contact to international organizations and experts and a focused overall plan for managing the fisheries in the Aral.

If the institute were provided with resources to publish data about the Aral Sea´s nature and fisheries in accordance with the established standards for scientific literature, there would presumably promote great international interest. Most of the scientific literature on the Aral today is the result of isolated investigations performed by research teams from other countries. A long data series, based on high quality long term monitoring of the Aral Sea environment is much needed and would require the local presence of such instances as the KazNIIRH. An English summery of the best data in the reports from the last 10 years could provide an excellent point of departure. Participation of the KazNIIRH in an international cooperation could make it possible to extract much valuable information for the archives, which extend many years into the past.

Cooperation with external experts would be much improved if a fisheries biologist fluent in English could be attached to the institute.

Biological prognosis

After building the Kokaral Dam, separating the Small Aral from the southern Big Aral, most parts of the Small Aral have become less salty (less than 15 ppm) allowing fish from the Syr Darya River delta to recolonize this part of the delta. The commercial fish populations now include Pike (Esox Lucius), European Carp (Cyprinus carpio), Sander (Sander lucioperca), Asp (Aspius aspius), Crusian (Carassius carassius), Roach (Rutillus rutillus), Bream (Abramis bramis) Perch (Perca fluvatilis), Snakehaad (Channa arhus), Kaspian flounder (Kambala glossa), Saber Carp (Pelecus cultranus) and Amour carp (probably Cyprinus carpio haematopterus, but extensive hybridization of different subspecies have muddled the nomenclature a bit.)The fish population in the Aral now consists of both native fish and historically introduced species.

The top predator in the system is the Sander, followed by Pike and Perch. As the commercially most important fish, the Sander is selectively being removed, sizes are decreasing dramatically. Populations of all fish species, where data is available, follow this trend and sizes are decreasing across the board. On the basis of what has happened in other lakes we predict a further decrease in the size of both individual fish and of the population as a whole for all the major commercial fish. We also foresee a shift towards the perch displacing the commercially more interesting Sander as the top predator. Data from the other big scale lake fishery in Kazakhstan, lake Balkash, to support this conclusion, and data form this fishery should be reviewed in planning the future management of Small Aral.

A total collapse of fish populations in the Aral is unlikely at present, due to the biology of the fish species involved, but a shift to a system with perch as main predator and inflated populations of the smaller species of Cyprinids is an imminent risk. This degraded system will be much less economically interesting. If the huge investments already made induce the fisheries to react by trying to extract even more fish, a collapse of the Aral fisheries will become a realistic possibility. Overfishing has already brought The Aral Sea fisheries beyond the limit of the carrying capacity.

4. Administration

The present management system is mainly a system for selling and administering licenses for the Aral fishery. No general description of the system is available, and thus even the people who administer it are essentially uncertain about the structure, function or responsibilities of the offices and personnel involved. During our study tour of the fishery authorities, we met great openness and willingness to discuss possibilities for improvement.

License system

The Aral is decides into 18 commercial zones. License to fish in those are given by the vice Akim of the department of Natural Resources. The license is given for a specific zone. To get a license you have to own a fish plant in the Aral district. It is the plant that gets the license and it is not allowed to sell or lease the license to others. The license is given for 10 years, and is automatically prolonged if the license holder can fulfill certain demands about reporting, landing sites on shore and so forth. The obligations for the license holder is among others to keep this landing site in order, pay a fee to KazNIIRH for scientific advice, register how much fish are caught and how much is returned to Aral, keep lists of technical equipment, make investment plans and so forth.

Annually the permissible catch quantity for each species is distributed among the licensed plants. This is done jointly by a local branch of the Kazakh fishery organization, the Vise Akim, the department of Natural Resources and the fisheries ministry. The government sets prices for the tariffs that the plants pay for fishing rights. There is a quota for each species and fishing is terminated when the limit has been reached. If a species has reached its limit the license holder can take the fish to shore and have permission to sell the catc.

Fish plants and fishermen

Fishermen are engaged by license – holding Fish plants. A plant holding a license for a given economic zone enters into agreements with a brigade of fishermen, normally consisting of 15 – 20 fishermen working in teams of two to a boat. The plant then applies for each fisherman's permission, which is given by the vice Akim from the Department of Nature Resources. The plants must engage fishermen, and the fishermen must work for the plant. The fishermen have the official status of wage – earners and in theory the factory pays taxes, pension and so forth. In

reality however, the fishermen are often payed directly for the fish on the shore, circumventing the formal wage tariffs.

Thus, the factory pays taxes and other expenses, but must still compete with other actors when buying fish on the shore. In many cases the legal factories are at a disadvantage and fish are directed to the informal economy. This causes a shortage of fish and even the licensed plants must buy fish on shore, driving prices upwards and further rewarding the black fishing.
The obvious solution would be to remove the forced link between fish plants and fishermen, awarding fishing rights directly to the fishermen and letting them sell the fish to whoever they choose, under surveillance of the fish inspection authorities, either directly on shore or at a fisheries auction.

Meliorative fishing
The government can give licenses to so called meliorative fishing for small scale fishing and for fish spilling through the dam and into the delta that feeds the Big Aral, and are lost to the Aral fishery. Such licenses are limited to a few tons, but in reality often function as a loophole for selling much larger amounts of fish, not only from meliorative fishing but also from the Aral. If licenses to fish were given directly to fishermen, the need for this system would disappear, greatly simplifying the fishery inspection's task.

Rules and regulations
Aside from the fixed catch limitations, there are a number of rules and regulations that apply to fishing in the Small Aral. These include fishing seasons, mesh sizes and the kinds of nets to be used. We cannot enumerate these regulations comprehensively, as the information provided by our informants differed widely. Indeed, it is generally the case that fishing regulations are neither compiled nor accessible in one place and are thus not practically available to the fishermen. Even fishermen who actively desired to comply with the rules would find it difficult to track them down, except for the dates of the fishing season. Certain rules, such as the ones governing permissible net specifications are totally ignored by all.

Monitoring Control and Surveillance (MCS)
The Fisheries Inspection authority is locally based in Aralsk and has personnel who know the Small Aral and its fisheries very well. Improved legislation and authority plus better equipment for monitoring the fishery would enable them to perform a much better control. With better control and reporting of catch, the fish stocks can be estimated much more precisely than by trial fisheries alone.

Given better computer power and boats the fisheries control system could be effective in both enforcing a new set of rules for fishing and preventing black fishing. The Fisheries Inspection should be closely involved in developing the control system.

Demand for better regulation

It is remarkable that both local fishermen and fish factories complain about the situation and express concern about the state and sustainability of the fishery. There is no agreement as to what should be done. The researchers were presented with many good suggestions, but all of the local parties involved in the fishery agree that there is a lack of legislation, lack of control, a loss of fish through the dam, a loss of fish due to excessive focus on only a few species, a huge black market fishery, incomprehensible rules and insufficient scientific advice.

It is extremely important that all fishery actors who are concerned about fish stocks be heard, on equal footing with fishery inspection authorities and local administrations in the process of improving the management system.

5. Resource loss and conservation

We experienced the phenomenon of resource wastage on several occasions. Frozen fish lying in open boxes, old fish that had been in storage for what appeared to be a very long time and products of such inferior quality that their marketability was questionable can be mentioned as examples.

A more effective use of the natural resources should be taken into account when building a new fisheries system. Improved organization of fishing activities, decreased capacity, utilization of the existing overcapacity to make more refined and developed products, focus on quality demanding European and Asian markets, product development and last but not least, certification and control of plants all have the potential to optimize the fish plants methods and products.
The world market for wild saltwater fish is currently stagnating. At the same time, environmental problems have given fish farming a bad reputation in many markets. As a result, market opportunities for freshwater fish could arise in the coming years. Currently, the EU demands high management standards for saltwater fish stocks. This is not yet the case for freshwater fish, but it will certainly be so in the near future. Kazakhstan could get a head start on this market by creating a management system that can be adapted to future trading relations with the EU. The two lines of work - product development, including certification and traceability and the development of trade relations are equally important.
Improvement of access to revenue, reduction of overcapacity and the certification of existing industries for Asian and European markets could at least partly compensate for the foreseeable reduction in the Aral fishery. The aim of a new management system should be the maximum sustainable long term yield. This would involve toxicological monitoring, traceability, certification and the matching of production capacity to input supply.

Kokaral Dam

A substantial loss of fish resources seems to be taking place through the sluice at the Kokaral Dam. The western part of the Small Aral is still rather salty, and water probably flows along the short

stretch of eastern coastline from the Sur Darya to the Kokaral. There is some ameliorative fishing in waters immediately behind the dam, but the absolute quantity is unknown. It could well be quite significant, but the majority of fish going through the dam will probably be lost to fishery when they pass into the hypersaline waters of Big Aral. It is urgent to make an assessment of the situation, as fish loss could possibly be reduced by changing the regime of the sluice.

If the loss of fish is as big as the fishermen judge it to be, construction of a mechanical/electrical barrier to prevent fish loss might be a worthwhile investment.

Phase 2 of the dam project

There are plans for a Phase 2 hydrological project to ensure the long term survival of the Small Aral. This involves a reinforcement of the existing Kokaral Dam or the construction of a new dam in the Ushoky area, either of which would certainly lead to a change in the fishing situation in the Small Aral.

Realization of phase 2 will lead to changes both in the ichthyofauna of the reservoir and in the hydrological regime (changes in water volume, water currents, etc.) of the Small Aral. An important consequence of the new dam's construction will be the development of transport infrastructure around the Small Aral, which will positively affect fishing. However, these changes will not remove the main issue: the regulation of fish production and the ecological pressure of the fishery load on Small Aral.

As phase 2 might involve water from the Syr Darya entering Small Aral much further away from the Kokaral dam, it could possibly give rise to increased water circulation and thus reduced salt concentration in the western Small Aral, improving conditions for the fresh water fish. More data on the circulation, salt concentration, temperature profile, stratification and oxygen would be necessary to estimate the effects phase two would have on the fishery.

Fish death

There have been recent episodes of fish death in the parts of the Aral adjacent to the Kokaral Dam. Different explanations have been offered. Our investigation indicates oxygen deficiency. The mechanism could be as follows. In hot weather and low oxygen in the Aral the fish will concentrate in areas where water movement oxygenates the water – the water moving towards Kokaral would be obvious, as this is also river water and already well oxygenated. In summer, with low oxygen and great fish concentration, the closing of the dam to prevent water loss will lead to a rapid decrease in oxygen in waters full of fish, resulting in fish death. It has been confirmed to our team that episodes of fish death have occurred in periods when water flow through the dam was reduced.

Stocking the Small Aral

The Aral is stocked with fingerling fishes produced at the fishery plant by Lake Kamyshlybash. Fingerling fishes of European and Asian carp are produced in ponds and are introduced into the

Small Aral each year. The stocking of fish in lakes as a huge scale put and take project was a common Soviet practice, which continues in many lakes around the former Soviet Empire. The production of the fish is financed by the fishery license owners.

Information on the amount of fish and species vary quite a bit but could be in the order of five million.

The effect to which the practice of fingerling stocking affects the fish resources of the Aral is undocumented. The general opinion of the fishermen and fish plants is that the fingerlings die or are lost through the dam, but there is an urgent need for further research.
Investigations by the KazNIIRH indicate that wild spawning is reliable and fry of all commercially interesting fish species are sufficient. Before investing heavily in increased production of fry and fingerlings to supplement the decreasing populations of fish in the Aral, a management regime that preserves a greater number of big females and promotes natural spawning should be prioritized. No great lake fisheries outside of the former Soviet Union are so dependent on release of massive quantities of fingerlings.

Fish in the Big Aral
During our investigations we discovered a previously unknown population of fresh water fish in the big Aral. At a surface salinity of near 120 ppm, we found a beach littered with thousands of dead crucian carp. They were all fresh and could not possibly have originated in the Small Aral. The only possible explanation is, that there must be a subsurface source of fresh water from the plateau west of Big Aral establishing a lake of freshwater within the hypersaline Big Aral supporting a relict population of freshwater fish. The dead fish were probably overwhelmed by a rapid shift in salinity caused by weather conditions. Whether or not this could be a commercial fish resource is of course not known, but a further investigation would be of great scientific interest.

Conservation
Ichtyologically there are probably not many conservation issues in the management of the Aral fishery. The entire Aral was ecologically reset during a long period of hyper salinity where none of the native fish survived and where endemic species and genotypes totally disappeared and were replaced by the introduced flounder Cambala glossa.

Today the ichtyofauna consists of fish that have colonized the small Aral from their refuge in the delta and of introduced species. They are all very common and widespread generalists. We are still investigating whether any of the species red listed in the Kazakhstan should be present. With regard to freshwater invertebrates, the jury is still out, but they should not represent conservation conflict with the interests of the fisheries.

The delta of the Sur Darya is home to a big population of birds, mainly ducks and waders but also birds of prey. The status of these birds is not well known, but a management plan must include measures to protect these.

The main issue for conservation is to support a healthy self-reproducing ecosystem in the Aral, with due consideration for birds and other components of the ecosystem. There are plans to improve fishing accessibility in certain areas of the Small Aral by removing vegetation. This latter issue lies beyond the scope of the present report, but a project of this nature would probably be strongly counterproductive for the fisheries, as typical shallow water spawning grounds would be destroyed and hiding places for fry would disappear.

6. Scientific recommendations

Monitoring

There is an urgent need for ongoing production and availability of scientific knowledge about the Aral Sea fisheries. Even the most basic facts about the hydrography are mostly unknown. Temperature profiles, salinity, oxygen content, the extent or even existence of seasonal stratification and circulation patterns are among the parameters that require further investigation. Much more needs to be known about the physics and chemistry of the Small Aral before an acceptable management plan can be established. The good news is that this research could be performed mainly by local personnel. The KazNIIRH has personnel who could be capable of using modern monitoring systems and the local fishermen are skilled at navigating the Small Aral. Given the existence of a research program, some very basic equipment and improved data logging capabilities, great progress could be made.

Fisheries biological research

The current research is based on sampling and forecasting in each of the 18 commercial zones. The fish however, don't recognize the zone borders and their distribution and migration are totally independent of the zones. A new monitoring system must be established that characterizes the natural spatial distribution, so that management boundaries match the natural boundaries and temporal dynamics of the fish. In a small and relatively heterogeneous body of water as Small Aral this is no monster task. A beginning has been made by the KazNIIRH, mapping spawning areas and seasonal migrations, but this work must be put into an overall framework.

Remote sensing

When the fishery was first established by the authors from the Danish association on a project basis in the nineteen nineties, we estimated the fish population in cooperation with the KazNIIRH. We checked our estimates of fish stock by means of a backwards calculation from the assumed primary production in the Aral. We assumed there to be a loss of 90 percent at each trophic level and arrived at an estimate of the fish stock that was roughly in line with the one estimated by test fishing. Today we have much better methods of doing this. The research program for the Aral should include an estimate of primary production based on satellite data. This should be incorporated in a GIS (Geografical Information system). GIS is a computer based system used for the registration, modelling, store analysis and presentation of geographical data. It will also be

useful for mapping and documenting other resources in the Aralsk region. It is not known at present if any system is operational for the region.

Organization
The expertise necessary to assist in devising a basic program for both physical, chemical and fisheries biological research exists within our group. If sufficient funding becomes available, other experts can be involved. One option could be to establish a new organization with the sole purpose of establishing a research program in collaboration with the KazNIIRH and/or other local partners.

A few qualified studies do exist on the Aral in the international scientific literature. Those investigations were mainly performed by groups of international experts on a hit and run basis. As they come in, do their stuff and exit again, there is no transfer of knowledge, contacts or methods to the local scientists. A proper research program would have to include a protocol for getting Kazakhs involved in both fisheries research and basic science. The Aral must be reclaimed as intellectual property by the Kazakhstan. An initiative to promote this could be to formulate and attain funding for young Kazakh scientists to do qualified PhD projects on the Aral, supported by an European university and measuring up to European standards. In this way we might create a corps of Kazakh experts who might even become local residents of the Aralsk.

7. Towards a biologically based management system

It is not yet possible to propose a specific structure for a management system.

There are still too many scientific and administrative unknowns. On the other hand, the task at hand is far from impossible. Compared to oceanic fisheries the legal catch of 7000 tons constitutes a minor fishery, and it should be possible to make the necessary changes in a short period of time. Some very general recommendations have been made in the summary at the start of this report. But more can be said about what a fisheries managing system for the Kazakhstan must contain. A fisheries managing system is of course not made for the management of fish. A fisheries managing system is, on the contrary, designed to manage the actions of people, organizations, businesses and administrative entities.

A system consists of the integrated process of gathering information, analyzing, planning, the consultation of organizations and industry, decision-making, allocation of resources, formulation and implementation, with enforcement as necessary of rules and regulations which govern the fishery's activities in order to ensure the continued productivity of the resources and the accomplishment of other fisheries objectives. These objectives must be expressed in concrete management rules. Most of these elements are absent in the current system.

Managing the ecosystem as a whole

The current management system is very insecure. The small relative size of the Aral system makes it prone to fast fluctuations, and changes in the structure of the fish population will affect all of Small Aral. A decline in the population size of Sander, for example, will not be local but affect the entire sea. The Aral is so small that management must be holistic, risk-adverse and adaptive. As changes can occur rapidly, the management system's response time must be correspondingly short.

The goal of the management system should be to make the fish population self-reproducing. This means maintaining an "old growth" structure in fish populations, since big, old and fat females are by orders of magnitude the best spawners. Alas, it is precisely the big, old and fat females that are most susceptible to overfishing.

The management system must also encompass monitoring of the seafloor habitats to make sure that the fish's food base is adequate. This is done to some extent today, but needs to be systematized. The sea floor must also be monitored for dead and lost nets that in a system like the Aral will continue ghost fishing for years. They must be found and removed.

The ecosystems of relatively small bodies of water, like the Aral, will occasionally experience shocks, such as hard winters, changes in water flow and so on. The multi species structure of the system must therefore be maintained in order to be resilient when faced with natural fluctuations. The management system must identify critical food web connections, for instance the abovementioned relations between sander, perch and pike or the role of fry, both as a source of grown fish and as food for the population of adult fish.

In the long term the management system must also take into account changes that could result from possible variations in water level, changes in the delta of the Sur Darya, effects of Phase 2 of the dam project and evolutionary changes that will result from mortality caused by large – scale fishery combined with the selective removal of the bigger fish. Evolutionary changes might already account for some of the reduced size of sander.

Technical limitations

The technical limitations relate to the types of gear involved and how they are handled. We have taken part in discussions about the possibility of dragging active gear such as seines or trawls from bigger ships on the small Aral. This would, of course, require harbor facilities, but there are other, greater arguments against the idea. There is a current global movement away from trawling, which is generally very unselective and destructive of sea floor conditions, in favors of basing small scale fisheries on passive gear. Different types of net set at different times at different locations have a good potential for selecting fish and limiting the catch for certain age groups and sizes. Additionally, passive nets tend to provide fish of a higher quality than trawled fish. This does not mean, however, that the fisheries should not be developed technologically, and a total management plan should include trial fisheries and education for fishermen and workers.

Models for managing

Excellent descriptions of a number of actual management systems for similar small scale fisheries exist, which could to some extend be copied. While considering the preparation of a new management system we have studied information gathered from both positive and negative experiences about other fisheries from all around the world. Although none exactly match the Small Aral, there are many similarities. The management of the great African lakes, Greenland and New Foundland coastal fisheries are all examples, and coastal fisheries within the EU can be included.

A very good starting point would be for a group of international and Kazakh workers to look into "The fishery Managers Guidebook" by the FAO to develop a common language. They could then discuss which elements could fit the special needs of the Aral Sea. Then we could investigate whether elements of the current system could be included or if it would be more productive to start from scratch.

The first thing to be done is for everybody in the fisheries in Small Aral, fishermen, fish plants and administration, to agree that the situation is unstable and that something must be done. All stakeholders must then be involved in the work.

Greetings from Denmark and the AFC

We in the Danish Association for a Living Sea and the Aral Fishing Committee would be happy to continue to support this work, and to join forces with our long time Kazakh friends and partners to secure the sustainability of the fisheries in the Aral that we have all worked so hard to create.

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