

**Report of the**

**FAO/WB/UNDP/GEF/FCK Regional Training Workshop on Sturgeon Hatchery Practices and Management**

**Atyrau, Kazakhstan, 14–19 April 2009**



## ACKNOWLEDGEMENTS

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## PREPARATION OF THIS DOCUMENT

This is the final version of the report of the United Nations Food and Agriculture Organization (FAO) Regional Training Workshop on Sturgeon Hatchery Practices and Management held in Atyrau, Kazakhstan, from 14 to 19 April 2009. The Workshop was jointly organized by the FAO Fisheries and Aquaculture Department, the FAO Subregional Office for Central Asia, the World Bank, the United Nations Development Programme–Global Environment Facility (UNDP-GEF) and the Ministry of Agriculture of the Republic of Kazakhstan (Atyrau Oblast) in the framework of the FAO Technical Cooperation Programme (TCP) project TCP/INT/3101 “Capacity building for the recovery and management of the sturgeon fisheries of the Caspian Sea”. Mr Mohammad R. Hasan has compiled this report on behalf of the technical Secretariat of the Workshop.



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## 1. BACKGROUND

In recent years, the Governments of the Caspian Sea littoral States have indicated in various occasions in recent years that sturgeon rehabilitation and management in the Caspian Sea is a priority issue for them. A number of national and international activities are carried out to support recovery of sturgeon stocks in the Caspian Sea. Examples of these activities include amongst others:

- Studies, stakeholder consultations and workshops organized by the multi-donor Caspian Environment Programme (CEP) funded by Global Environment Facility (GEF), the United Nations Environment Programme (UNEP), United Nations Development Programme (UNDP), the World Bank, the United Nations Office for Project Services (UNOPS) and the European Union (EU).
- The new regional United Nations Development Programme–Global Environment Facility (UNDP–GEF) project “The Caspian Sea: Restoring Depleted Fisheries and Consolidation of a Permanent Regional Environmental Governance Framework” (CaspEco), due to become effective in early 2009.
- Capacity building activities in fisheries management by the World Bank Trust Fund for Environmentally and Socially Sustainable Development (TFESSD).
- Training activities by the UNDP-GEF project “Integrated Conservation of Priority Globally Significant Migratory Bird Wetlands Habitat: a Demonstration on Three Sites”.
- Workshops organized under the United Nations Food and Agriculture Organization (FAO) Technical Cooperation Programme (TCP) project “Capacity building for the recovery and management of the sturgeon fisheries of the Caspian Sea (GCP/INT/3101).

The Caspian Fisheries Technical Workshop, jointly organized by the above mentioned FAO TCP project and the World Bank, and held in Rome, Italy, from 28 to 30 April 2008, indicated an urgent need for training in sturgeon hatchery operations. Similarly, the 2008 work programme of UNDP-GEF project “Integrated Conservation of Priority Globally Significant Migratory Bird Wetlands Habitat: a Demonstration on Three Sites” listed among its activities the conducting of training workshops on development of alternative livelihoods and business, including the organization of training workshops on fish farming. In order not to duplicate activities, but reinforce each others strengths instead, the UNDP-GEF project, FAO and the World Bank have teamed-up with the Ministry of Agriculture of Kazakhstan to provide high quality, targeted training to hatchery staff from the Caspian Sea littoral countries.

## 2. SCOPE AND ORGANIZATION

### 2.1 Objectives

The Workshop was organized with the following objectives:

- to introduce technical guidelines on advanced, innovative sturgeon hatchery practices and management;
- to share experiences, to review information and build capacity on hatchery measures to improve restocking efficiency (e.g. size of fingerlings at release, place and timing of release, tagging, non-lethal egg extraction methods); and
- to increase awareness and build capacity on financing hatchery operations, costs and benefits, ownership models, and marketing of hatchery production.

### 2.2 Expected outputs

- Increased awareness and capacity built amongst senior and mid-level sturgeon hatchery staff of Caspian Sea littoral countries on modern sturgeon hatchery practices and management.
- Final draft technical guidelines on sturgeon hatchery practices and management.
- A workshop report including recommendations for follow-up activities.

### 2.3 Participation and workshop venue

The Workshop brought together acknowledged international experts in the relevant fields, including experts from Caspian Sea littoral countries and experts from government agencies, research institutions, international and regional organizations and private industries and organizations. The Workshop was attended by 41 participants (names and contact details of the participants are listed in Appendix B). The Workshop was hosted by the Ministry of Agriculture of the Republic of Kazakhstan, and was held at the Ak Zhaik Hotel in Atyrau from 15 to 18 April 2009. The Workshop was opened by Mr B. Daukenov, Deputy Chief of Atyrau Oblast Akimat. Other speakers during the opening ceremony were Mr K. Mussabayev (Fishery and Hunting Committee of the Ministry of Agriculture of Kazakhstan), Mr D. Sadykov (Senior Specialist of the Fishery and Hunting Committee), Ms V. Baigazina (Coordinator of Ecology and Energy efficiency Department of UNDP Kazakhstan), Mr G. Van Santen (World Bank) and Mr. R. Van Anrooy (Fishery Officer at FAO Subregional Office for Central Asia).

### 2.4 *Modus operandi*

A number of documents including the draft technical guidelines on “Sturgeon hatchery practices and management” were circulated among the participants prior to and during the workshop. The guidelines covered the complete production cycle from broodstock selection until fingerling release and were of practical nature, simple to understand and apply. Special emphasis was given on restocking practices for hatcheries to improve biotechnical practices. Genetic variability issues, occurring when operating with very limited numbers of brood fish, were discussed as well.

The Workshop convened both in plenary and in working groups. Both country status papers and technical presentations were given in plenary with the objective of providing an orientation of regional commonalities, differences and issues pertaining to the sturgeon hatchery practices and management. The Working Group mechanism was used as a platform for discussing the draft technical guidelines.

The Workshop served to address the following thematic areas and other issues of significance emerging from the country status paper:

- sturgeon hatchery design including site selection;
- hatchery management operation including fingerling production and release;
- institutional and financial options of sturgeon hatchery management and culture;
- genetic management in sturgeon hatcheries;
- broodstock management in sturgeon hatchery;
- marketing techniques for hatchery production; and
- sturgeon restocking programme.

During the working group session, the participants were divided into three main working groups to address the following broad topics of the technical guidelines; 1) broodstock management and genetics; 2) fingerling production and release; and 3) hatchery site selection and operations. Each working group was tasked with reviewing draft technical guidelines and to recommend necessary revisions and improvement for each of the broad topics assigned to them. Following several working group deliberations and subsequent reporting to plenary, the workshop agreed on necessary revisions and improvements to be done for the Technical Guidelines.

The agenda and timetable is given in Appendix A and list of participants in Appendix B Appendix C contains a summary of statements made during opening and closing ceremonies, Appendix D description of field visit to sturgeon hatchery and Appendix E summaries of country status papers and technical presentations. A technical Secretariat composed of Dr. Raymon Van Anrooy, Mohammad R. Hasan (FAO Aquaculture Management and Conservation Service), and Dr Marmulla Gerd (FAO Fisheries Management and Conservation Service) was responsible for technical coordination.

## 2.5 Languages

The Workshop sessions were conducted in Russian and English and the background documentation were provided in both languages. Simultaneous interpretation was made available.

## 3. SUMMARY OF PRESENTATIONS AND DISCUSSIONS

All speakers during the inaugural session made reference to the critical situation of sturgeon in the Caspian Sea, to ongoing efforts to reverse this situation, and to the need for further concerted efforts to rescue the sturgeon. The great importance of sturgeon conservation in the Caspian Sea in the context of the efforts to preserve global biodiversity was emphasized. Also, reference was made to a recent meeting of the Presidents of the Islamic Republic of Iran and of the Republic of Kazakhstan where the Caspian Sea sturgeon issue was discussed.

After the inaugural session, the background, objectives and expected outputs of the Workshop were reviewed by Mr Raymon Van Anrooy. Subsequently, the status papers from four countries (Azerbaijan, Islamic Republic of Iran, Kazakhstan and the Russian Federation) and several overview presentations on technical, economic and management aspects of sturgeon hatchery operations were presented.

Mr Van Anrooy made a presentation on the background, objectives and expected outputs of the Training Workshop. In view of the recent release of the FAO State of World Fisheries and Aquaculture 2008<sup>1</sup> (SOFIA), which was published for the first time in Russian language, he started the presentation with a world review based on SOFIA. He described the status of inland capture fisheries, aquaculture and fish consumption. He then referred to the current situation in terms of sturgeon production, by using the latest available data from FAO FishStat+<sup>2</sup>. He noted that the People's Republic of China showed the largest growth in recent years and that its sturgeon production was around 22 000 tonnes in 2007. In contrast, the sturgeon production in the Caspian Sea basin shows a decreasing trend (figure 1).

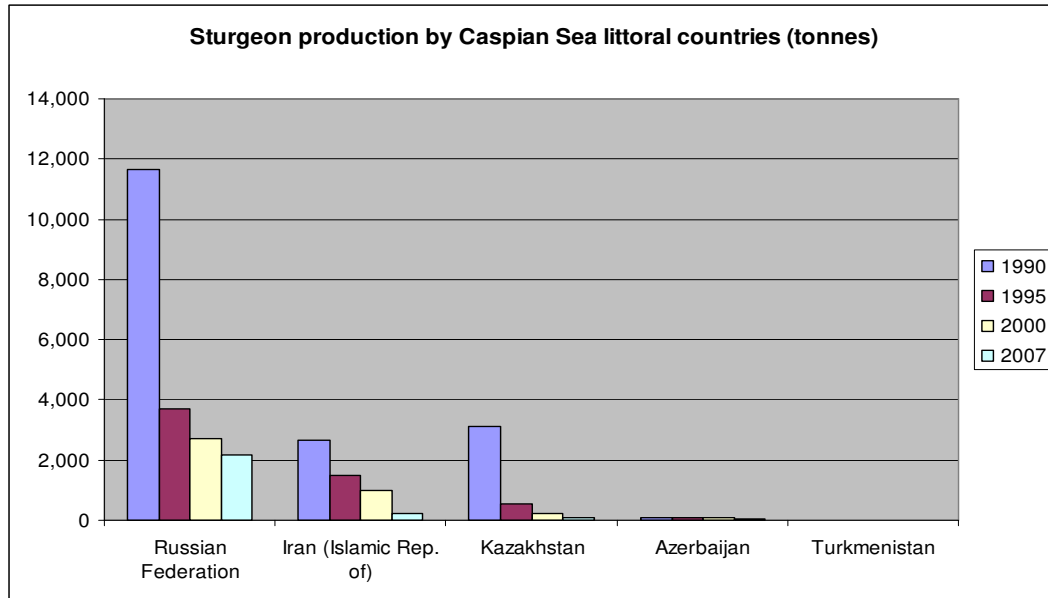
Mr Van Anrooy provided various reasons for the decline, such as continuous overfishing of the stocks, illegal catches, limited focus on aquaculture, ineffective restocking practices, water pollution, destruction of spawning habitats and invasive species that reduce the feed biomass of sturgeons. He noted also that the data presented were the official government data and do not reflect Illegal, Unreported and Unregulated (IUU) fishing activities.

Mr Van Anrooy then presented the background and justification for organizing the Training Workshop and elaborated the objectives of the Workshop and the expected outputs of the Workshop. Mr Van Anrooy stressed that the main tools for the improvement of sturgeon hatchery practices and management are the people involved. He added that the Training Workshop succeeded to bring together sturgeon hatchery staff and other experts from four of the five Caspian Sea littoral countries, FAO, UNDP and World Bank staff involved in fisheries and aquaculture in the Caspian region, and some key international specialists in sturgeon hatchery management and restocking practices. He concluded his presentation by emphasizing that FAO and the other international partners are able to advice and technically support also after the Workshop but that clear conclusions and recommendations for follow-up would be required in order to do so effectively.

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<sup>1</sup> SOFIA 2008 in 5 languages (including Russian) is available at:  
<http://www.fao.org/docrep/011/i0250e/i0250e00.htm>

<sup>2</sup> FishStat+ software and databases are available at: <http://www.fao.org/fishery/statistics/en>



**Figure 1 Sturgeon production by the five Caspian littoral countries.**

The participants from Azerbaijan (Mr Z. Salmanov), the Islamic Republic of Iran (Mr M. Pourkazemi), the Russian Federation (Ms M. Mikhailova) and Kazakhstan (Ms Y. Anatolyevna) presented the country reviews concerning the situation of sturgeon hatcheries in their countries. Interesting information was provided about *inter alia* the number of hatcheries in the countries, their structure and management objectives, main target sturgeon species (varying according to geographical situation), production figures (including fingerling production for release and caviar production, if relevant), future management aims, perceived challenges, as well as information about stocking/release methods.

The following presentations were given to set the scene for further discussions on improving hatchery operations for both fingerling and caviar production, and sturgeon stocking/releasing techniques”:

- “Modern sturgeon hatchery management operations” by Mr M. Chebanov;
- “Sturgeon release for restocking – best practices” by Mr M. Pourkazemi;
- “Fish production in Atyrau and the Atyrau region” by Mr E. Kadimov;
- “Measures taken by the Wetlands Project in fishery resources conservation sphere in the Ural delta” by Ms N. Selayninova;
- “Modern sturgeon hatchery management operations, with emphasis on financing options for investment” by Mr G. Van Santen;
- “Stocking and sturgeon habitat assessment” by Mr G. Marmulla;
- “genetic management in sturgeon hatcheries” by Ms P. Doukakis.

Important points raised in the presentations and/or in the ensuing discussions included, *inter alia*, severe decline in sturgeon stocks, IUU fishing and poaching, insufficient hatchery management approaches for production of healthy and strong fingerlings, absence of broodstocks, cryotechniques and sperm banks, insufficient fingerling survival rate after release, need for tagging programmes, need for comprehensive monitoring programmes for released fingerlings/juveniles, importance of caviar production in hatcheries for easing stress on wild fish, acceptance/success of “cultured” caviar, impacts of dam construction on quality/availability of spawning grounds, and legal frameworks for sturgeon production.

A very important part of the Workshop was dedicated to the presentation, discussion and improvement of the draft technical guidelines on “Sturgeon hatchery practices and management” that were prepared collaboratively by the international experts Mr M. Chebanov (the Russian Federation), Mr M. Pourkazemi (the Islamic Republic of Iran) and Mr P. Williot (France). After Mr M. Chebanov had presented the draft guidelines, the participants formed three working groups (on respectively broodstock management and genetics, fingerling production and release, and hatchery site selection and operations) with the aim of commenting on and improving the presented draft. Improved versions of the relevant chapters were presented in the plenary by the working group rapporteurs. It was agreed that the key responsible experts would draft a new version in close cooperation with the participants. This draft should then be presented to, and discussed with, selected key experts in a Side Event to be organized by FAO in connection with the 6<sup>th</sup> International Symposium on Sturgeon in Wuhan, China, October 2009.

## **4. CONCLUSIONS AND RECOMMENDATIONS**

### **4.1 Conclusions**

The participants acknowledged the valuable training received in sturgeon hatchery management practices as facilitated by some world renowned experts, FAO, World Bank, UNDP-GEF and the State Fishery Committee of Kazakhstan. It was recognized however that there is a need to organize similar training sessions more frequently and for a wider audience in the Caspian Basin.

The participants reaffirmed the conclusions and recommendations of the FAO-CITES Technical Workshop on Stock Assessment and TAC Methodologies, held in Rome, Italy, from 11 to 13 November, 2008, and noted that current stock assessment methods continue to contribute to overfishing of the sturgeon stocks.

The draft Technical Guidelines on “Sturgeon hatchery practices and management” as prepared with support of FAO TCP project “Capacity building for the recovery and management of the sturgeon fisheries of the Caspian Sea (TCP/INT/3101)” were appreciated by the participants. The participants discussed the draft and made suggestions to further improve the document.

IUU fishing on sturgeon continues to be a major factor which makes any efforts towards restocking and rehabilitation of the Caspian Basin sturgeon stocks insignificant.

The participants recognize that without sturgeon aquaculture production increase it will be impossible to satisfy world-demand for caviar and sturgeon meat.

Deriving from the current practices presented at the Workshop it was concluded that:

- Capacity building in hatchery design and construction is urgently needed.
- Ongoing fingerling release practices are far from optimum, resulting in limited success of restocking and low recruitment in the sturgeon stocks.
- Hatchery practices (including lack of development of broodstock, lack of non-invasive sex determination, stress-causing activities, lack of proper feeding regimes for larvae, lack of fingerling training before release), are not appropriate in many sturgeon hatcheries.
- Many hatcheries operators are not aware of differences in approaches for the production of fingerlings for either release/restocking, or broodstock formation/aquaculture purposes; the latter requiring domestication in contrast to the former.

The participants agreed that the technical guidelines on “Sturgeon hatchery practices and management” should be based on some key principles, which include, among others, the:

- conservation of the natural gene pool of Caspian sturgeons;

- increase of the efficiency of hatchery-based stock enhancement practices in the Caspian Sea basin;
- acceleration of broodstock formation (for fingerling production and aquaculture) with a long-term perspective; and
- restocking considering local habitat conditions and species peculiarities.

The implementation of the above principles requires, *inter alia*:

- genetic monitoring, including DNA-technology, of wild breeders used for artificial reproduction and establishment of captive broodstocks, and development of optimal crossing protocols (mode of mating) to prevent inbreeding and outbreeding depression of populations;
- creation of live gene banks and sperm cryobanks of sturgeons from different river basins;
- application of optimal technology for reproduction, so to support genetic biodiversity, including different intra-population ecological forms;
- implicit use of non-lethal methods of egg obtaining from wild sturgeon females;
- reduction of stressors, risk minimization during all handling, rearing and health management operations of breeders;
- systematic ecological and morphological, physiological and ethological monitoring of reared fingerlings and harmonized mass tagging;

The participants recognize that the technical guidelines provide current best practices, which sometimes cannot (yet) be implemented by the hatcheries due to various constraints. This should not withhold the sturgeon hatcheries to strive towards implementation of those provisions of the Technical Guidelines which can already be put into practice.

#### **4.2 Recommendations**

In making the following recommendations, the participants recognized that the implementation will require substantial incremental funding from national public and/or international financial resources which in the past have not been sufficiently made available.

The recommendations by the participants to Governments were:

1. to hold an Expert Consultation on IUU fishing in the Caspian Basin, with particular emphasis on sturgeon issues, followed by a Technical Intergovernmental Consultation to agree on joint measures proposed by the experts;
2. to develop an appropriate Action Plan for conservation and sustainable use of sturgeon in the Caspian Sea;
3. to establish a Caspian Sea basin-wide tagging programme which should include a protocol on regional collaboration for reporting of tagged fish caught, with the aim to improve monitoring that is critical for further management decisions;
4. to take action towards increasing hatchery performance, which should include, *inter alia*, the domestication of broodstocks and increasing their efficiency, and to work on increasing larvae and fingerling survival rates;
5. to instruct sturgeon hatcheries so to introduce, under their responsibility, tagging of broodstock to avoid inbreeding, to increase heterogeneity and to conserve genetic diversity;
6. to implement the provisions of the technical guidelines on “Sturgeon hatchery practices and management” as soon as possible;
7. to recognize the respective and quite different roles of hatcheries that produce fingerlings for enhancing wild stocks, or supply fingerlings for purposes of sturgeon culture; hatchery functions supporting wild stocks should only be considered for privatization if long-term quality control, funding and effective management can continue to be guaranteed by the national governments;
8. to facilitate that the private sector is able to establish sturgeon hatcheries and to develop sustainable and economically sound sturgeon culture, through provision of enabling legal and policy frameworks that transparently define the future structure of the industry and the objectives

and specific roles of the public sector, including standards of production and quality control, and direct and indirect development support, and by supporting access to financial and technical services;

9. to increase efforts for rehabilitation and restoration of sturgeon habitats and the access to those habitats; and
10. to monitor and improve the ecological condition of the Caspian Sea in order to minimize the negative human impact (e.g. pollution) and to create the appropriate condition for sturgeon recovery and growth.

The recommendations by the participants to the international agencies and the private sector were:

1. to develop a training programme so to introduce harmonized stock assessment approaches in the Caspian Basin;
2. to carry out a comparative analysis between western countries and the Caspian basin countries in sturgeon stock assessment methods;
3. to support the development of technical guidelines on tagging techniques and restocking practices;
4. to provide training in tagging techniques, including radio telemetry, in an integrated manner;
5. to facilitate the establishment of public-private partnerships in sturgeon hatchery and sturgeon aquaculture development; and
6. to document lessons learned and success stories of restocking of sturgeon for awareness raising and capacity building on best practices in the Caspian Basin.

## **5. CLOSING**

Mr. Mohammad R. Hasan presented the next steps and follow-up activities to be undertaken in the coming months. Agreement was reached on all points presented. Mr Van Anrooy thanked the participants for their constructive contributions and expressed the hope that further steps could be taken to improve the situation of the Caspian Sea sturgeon. The Workshop was closed on Saturday 18 April 2008 at 18.00 hrs.

## APPENDIX A

## Agenda and Timetable

TIME	ACTIVITIES
<b>14 April</b>	
	<ul style="list-style-type: none"> <li>• Arrival of the participants</li> </ul>
<b>15 April – Workshop day 1</b>	
09.00–09.30	<ul style="list-style-type: none"> <li>• Registration</li> </ul>
<b>Session I: Opening and welcome remarks</b>	
09.30–10.00	<ul style="list-style-type: none"> <li>• Welcome–S. Kemalov, Deputy of Akim of Atyrau oblast</li> <li>• Opening remarks <ul style="list-style-type: none"> <li>○ K. Suleimenov – Chairman of the Fishery committee of the Ministry of Agriculture of the Republic of Kazakhstan/ D. Sadykov – Senior specialist of the Fishery Committee of the Ministry of Agriculture of the Republic of Kazakhstan</li> <li>○ R. Van Anrooy – Fishery and Aquaculture Officer</li> <li>○ V. Baigazina – Head/Coordinator of the Ecology and Energy Efficiency Department, UNDP, Kazakhstan</li> <li>○ Kh. Mussabayev – Deputy Chairman, Fishery and Hunting Committee of the Ministry of Agriculture of the Republic of Kazakhstan</li> </ul> </li> <li>• Introduction to the participants</li> </ul>
10.00–10.20	<ul style="list-style-type: none"> <li>• Background, Objectives and Expected Outputs of the Training Workshop- Raymon Van Anrooy</li> </ul>
<b>Session II: Country Presentation</b>	
Chair: Rapporteur	
10.20–11.15	<ul style="list-style-type: none"> <li>• Azerbaijan- Z. Salmanov</li> <li>• Islamic Republic of Iran- M. Pourkazemi</li> </ul>
11.15–11.30	Coffee break (including group picture)
11.30–12.30	<b>Country presentation-contd.</b> <ul style="list-style-type: none"> <li>• Kazakhstan- Ms. Y. Anatolyevna</li> <li>• Russian Federation- Ms. M. Mikhailova</li> </ul>
12.30–13.30	Lunch
<b>Session III: Technical presentations</b>	
13.30–15.15	<ul style="list-style-type: none"> <li>• Modern sturgeon hatchery technologies-Mikhail Chebanov, FAO consultant</li> <li>• Modern sturgeon hatchery design-</li> </ul>
15.15–15.30	Coffee break
<b>Session III: Technical presentations-contd.</b>	
15.30–16.10	<ul style="list-style-type: none"> <li>• Modern sturgeon hatchery management operations, with emphasis on financing options for investment-Gert Van Santen, The World Bank</li> <li>• A brief review of future investment strategy and institutional organization options-Gert Van Santen</li> </ul>
16.10–16.45	Discussion
16.45–17.20	<ul style="list-style-type: none"> <li>• The modern condition of the fishery resources of the Ural-Caspian basin- Kim Yuliya Anatolyevna, KAPE Atyrau Branch of Scientific Research</li> <li>• Enhancement of sturgeon hatchery in Kazakhstan- A. Dzhakishev, manager of the “Caspyi” SEC (Social Enterprise Corporation)</li> </ul>
<b>16 April – Workshop day 2</b>	
<b>Session VI: Technical presentations</b>	
09.00–10.00	<ul style="list-style-type: none"> <li>• Sturgeon habitat assessment for restocking- G. Marmulla</li> <li>• Sturgeon release for restocking: best practices- M. Pourkazemi, consultant</li> </ul>

10.00–10.15	Coffee break
<b>Session V: Presentation and discussion on technical guidelines</b>	
10.15–10.45	<ul style="list-style-type: none"> <li>• Introduction of the technical guidelines on sturgeon hatchery practices and management-Mikhail Chebanov</li> </ul>
10.45–12.15	Working group discussions on specific chapters of the draft technical guidelines
12.15–13.30	Lunch
13.30–14.15	Working Group Presentation <ul style="list-style-type: none"> <li>• Presentations of changes proposed to draft technical guidelines</li> </ul>
14.15–15.30	Discussion of the changes proposed in plenary
15.30–15.45	Coffee break
15.45–17.00	Continuation of discussions in plenary
<b>17 April – Workshop day 3</b>	
Field visit to Sturgeon hatchery (30 km from Atyrau) and visit to the historical monument- museum Khan Ordaly Sarichik (60 km from Atyrau)	
<b>18 April – Workshop day 4</b>	
09.00–09.30	<ul style="list-style-type: none"> <li>• Genetic considerations in hatchery management of Caspian Sea sturgeons- Phaedra Doukakis, World Bank</li> </ul>
10.00–10.30	Discussion
10.30–10.45	Coffee break
10.45–11.30	Discussion continued
11.30–12.15	<ul style="list-style-type: none"> <li>• Changes to the draft Technical Guidelines on sturgeon hatchery practices and management- Mikhail Chebanov</li> </ul>
12.15–13.15	Lunch
13.15–14.45	Discussion on next steps
14.45–15.00	<ul style="list-style-type: none"> <li>• Recommendations for follow-up activities- Mohammad R. Hasan, FAO</li> </ul>
15.00–15.30	<ul style="list-style-type: none"> <li>• Wrap up and closure - Raymon Van Anrooy</li> </ul>
16.00	Participants depart from Atyrau

## APPENDIX B

## List of participants

	Country	Name	Institute	Function/title	Telephone	E-mail
1	Azerbaijan	Zaur Salmanov	Khilly Sturgeon Hatchery	Director		z_salmanoglu@yahoo.com
2	Azerbaijan	T. Zarbaliyeva				<a href="mailto:rustamova_k@yahoo.com">rustamova_k@yahoo.com</a> ssalamova@hotmail.com
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7	Russian Federation	Mikhail Chebanov	South Branch Federal Center of Selection and Genetics for Aquaculture	Director	Tel./Fax: +7-861-262-25-59	Chebanov@sturg.kuban.ru; MChebanov@gmail.com; MChebanov@rambler.ru
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9	Russian Federation	Protsenko Alexander Ivanovich	Sevkasprybvod	Chief of 6 hatcheries in Astrakhan region	Tel. 7-8512-38 79 89	
	Russian Federation	Marina Mikhailova	Federal State Enterprise "VNIIPRKH"	General Director		
10	Turkey	Ömer Murat Tufek	Directorate General of State Hydraulic Works 06100 Yücepe, Ankara	Head of Fisheries Section	Tel. : +90 312 4182404	<a href="mailto:omtufek@dsi.gov.tr">omtufek@dsi.gov.tr</a>
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19	Kazakhstan	Kemalov Saifolla Nasyrovich	Atyrau oblast Akimat	Deputy Akim of Atyrau oblast		
20	Kazakhstan	Mussabayev Khairbek Shakhvaliyevich	The Forestry and Hunting committee of the Ministry of Agriculture of the RK	Deputy of Committee chairman	Astana Tel 8(7172) 74 33 26	
21	Kazakhstan	Sadykov Duisenbay Magzumovich	Fishery committee of the Ministry of Agriculture of the RK	Senior specialist	Astana 8 (7172) 74 27 03	
22	Kazakhstan	Erbulekov Sagiden	AGIP KCO	Engineer ecology		
23	Kazakhstan	Serik Temirkhanov	Kazakh Agency of applied ecology	Consultant		stimirkhanov@mail.ru
24	Kazakhstan	Kalidullin Rashiden Musayev	Atyrau sturgeon factory	Director	(87122)23-30-47	
25	Kazakhstan	Kametov Bakhyt Khabidullaevich	Ural-Caspian interregional basin inspection of Fishery department of Fishery committee of the MA of RK	The head of inspection	(87122)21-31-50	Monty08@mail.ru
26	Kazakhstan	Kadimov Erbolat	The Agriculture department	Deputy head on fishery	(87122)27-19-39	kadimover@mail.ru

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27	Kazakhstan	Muskhanov Abikhair Mutieyovich	KazNIIIRH Ltd	Director	(87122)24-44-00	AFILKAZNIIRX@rambler.ru
28	Kazakhstan	Ilyasov Elaman Kauanovich	The nature resources and nature management control department of Atyrau oblast Akimat	The head of the department	(87122)32-45-49	atr_priroda @ mail.ru
29	Kazakhstan	Abdrakhman Marat Gunaytovich	Atyrau oblast territorial inspection of forestry and hunting department of the Forestry and Hunting committee of the MA of the RK	The head of inspection	(87122)28-04-35	lesohothoz@mail.ru
29	Kazakhstan	Kim Yuliya Anatolyevna	KAAE Atyrau Branch Scientific Research Department, Kazakh Agency of Applied Ecology		(87122)58-61-14	y.kim@ kape.kz
30	Kazakhstan	Shokay Bolat Куанышевич	Atyrau nature conservation prosecutor	Prosecutor	(87122)24-15-00	Atr.op@mail.onlain.kz
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40	Kazakhstan	Mass media		On coordination		
41	Kazakhstan	Mass media		По согласованию		

### Opening and closing remarks

#### Welcome address by Atyrau Oblast (Daukenov)

Dear participants of the international Workshop,

I am pleased to welcome the officials of the Caspian states and Russia as well as all other participants of the Regional Training Workshop on Sturgeon Hatchery Practices and Management held by FAO, UNDP/GEF/Kazakh national project “Integrated Conservation of Priority Globally Significant Migratory Bird Wetland Habitat: A Demonstration on Three Sites” together with the World Bank and attended by the Fishery Committee and Oblast Akimat in the land of Atyrau Oblast.

In 1997, Kazakhstan launched its 2030 Development Strategy which said that by the year of 2030 Kazakhstan should become a clean and green nation, with clean air and water. One of the instruments for achieving these objectives is to establish a sound system of regional nature conservation by way of an integrated network of protected areas. Biodiversity conservation is recognized as one of key universal issues just as climate change, desertification and ozone depletion.

I should note that our state places highest emphasis on sturgeon conservation. During recent negotiations between Kazakhstan’s President, Nursultan Nazarbayev, and Iranian President, Mahmoud Ahmadinejad, the parties declared the need to set a 10-year moratorium on sturgeon fishing that will allow for conserving the population of many valuable fish species.

About 60 percent of the overall fish caught in Kazakhstan is caught in the water bodies of Atyrau Oblast. The oblast administration is strongly interested in the fish conservation and restocking. Sturgeon hatcheries have been operating for over 10 years in the region; these hatcheries release about 6 million of fingerling per annum to the Ural River. Fish restocking activities are performed as funded from the republican budget to increase fish productivity of the fishery water bodies.

The oblast administration initiated limiting the shipping regime to create favourable conditions for migrating sturgeon breeders and for sturgeon fingerling migrating down from the spawning grounds. Every year the regional conservation fund allocates money for cutting hard vegetation which enhances hydrochemical and hydrological regime.

Significant efforts are made in the region to arrange sturgeon fisheries that will help to reduce the burden on the natural sturgeon populations. We hope that this regional training workshop will become a good basis for the sturgeon conservation and restocking.

I wish this international Workshop every success.

**Welcome address by FAO (Raymon Van Anrooy)**

Dear workshop participants,

It is my pleasure to welcome you all, on behalf of the Subregional Office for Central Asia of FAO and my FAO Headquarters colleagues Gerd Marmulla and Mohammed Hasan, to this Regional Training Workshop on Sturgeon Hatchery Practices and Management.

I am very pleased that you have accepted to participate in this Training Workshop, and I would also like to express my thanks to your Organizations and Governments that have agreed to your participation.

As you can see from the Prospectus and the Agenda, this Workshop was jointly organized by the UNDP-GEF project, the World Bank, the State Fishery Committee of the Ministry of Agriculture of the Republic of Kazakhstan, the Atyrau Oblast Akimat, and the FAO.

Apart from the Islamic Republic of Iran, which has been a member of FAO since 1953, the Caspian Sea countries are all relatively new Members of FAO, and FAO has until now only engaged in few fisheries and aquaculture related projects in the Caspian Sea region. However, with the recent establishment of Subregional offices for Central Asia and the Near East based in respectively Ankara and Cairo, this situation is about to change, and we will be able to better serve your countries.

It was regional concern over the rapidly dwindling sturgeon stocks in the Caspian Sea that prompted your countries to seek the advice from FAO on how to improve the regional capacity to manage the fisheries. That request led to FAO's approval of a regional project on "Capacity building for the recovery and management of the sturgeon fisheries of the Caspian Sea". Due to limited responses from the Caspian Sea countries, the project only organized one "Caspian Fisheries Technical Workshop" in Rome last year, in close collaboration with the World Bank. Some planned activities had to be cancelled because of only one or two of the Caspian Sea littoral countries confirmed their participation.

I am therefore very happy that at this Training Workshop we have participants from four of the five Caspian Sea countries, namely Azerbaijan, the Islamic Republic of Iran, Kazakhstan and the Russian Federation.

We all know that sturgeon species are threatened worldwide and the Caspian Sea is home to the most significant sturgeon populations in the world. There is not only regional but also international alarm over the sturgeon situation and growing worries that entire stocks, and possibly species, could become extinct. Not long ago the Caspian Sea accounted for 95 percent of the world's caviar production and the legal caviar trade had a value of about US\$90 million annually, making it one of the world's most valuable wildlife resources. If the economic potential of the sturgeon fishery could be restored and maintained, there would be no other regional economic activity that would have the same potential to create employment at especially the level of the fishers.

Artificial reproduction of sturgeon species will enable the Caspian Sea countries to rehabilitate the sturgeon stocks in the sea through stocking. Furthermore, aquaculture of sturgeon can probably reduce fishing pressure on the stocks as caviar and sturgeon meat from aquaculture could fill part of the market demand. Sturgeon culture is widely considered as essential in the rehabilitation process of stocks.

In this respect I would like to inform you that recently FAO approved a sturgeon rehabilitation project for Turkey, which will try to bring back sturgeon species in the Black Sea Rivers of Turkey. Mr Omer Tufek from Turkey is here to learn from your experiences.

The Caspian countries have different levels of institutional and technical expertise in sturgeon reproduction and culture, and several of the countries have for historic reasons had little exposure to international approaches to sustainable and responsible aquaculture.

This Training Workshop will provide an opportunity to share experiences and lessons learned on sturgeon hatchery practices and management. It is hoped that the workshop will also significantly contribute to the development of technical guidelines for sturgeon hatchery management. These can then later this year be finalized and published, so that the information can be widely distributed in the region and benefit the sector.

Moreover, I would like to take this opportunity to emphasize the important framework that the FAO Code of Conduct for Responsible Fisheries provides to Governments world-wide in terms of promoting sustainable fisheries and aquaculture. Some copies of the Code are available here today. FAO urges the countries of Central Asia and the Caucasus to work on the implementation of the Code in their fisheries and aquaculture sectors.

I am sure that this Workshop is not the end of FAO's support to sustainable sturgeon management in the region. You can rest assured that FAO is willing to continue to provide advice on this subject including aquaculture, like we are providing currently technical- and legal advice in the establishment process of a regional inter-governmental commission or network for fisheries and aquaculture in Central Asia and the Caucasus. You can count on the support of FAO and particularly the Subregional Office for Central Asia (SEC).

I would like to end this short welcome statement by thanking especially Ms Aksaule and Mr Talgat of UNDP, and the Ministry of Agriculture of Kazakhstan, World Bank and FAO staff for their efforts in making this Workshop possible. I also would like to thank Dr Chebanov, Dr Williot and Dr Pourkazemi for their work on the draft technical guidelines that will be discussed in this Workshop. Finally I would like to thank all of you for travelling from far away to this Workshop venue and dedicating your precious time to this important effort.

Thank you for your attention and wish you all a fruitful Workshop.

**Opening remarks by UNDP, Kazakhstan (V. Baigazina)**

Dear participants of the Regional Workshop,

Since the UNDP Country Office was opened in Kazakhstan in 1993, it has implemented over a hundred of projects and provided assistance to the Government of the Republic of Kazakhstan in drafting a number of strategic documents, including the National Environment Action Plan, Capacity Building Programme for Sustainable Development and others.

In the biodiversity conservation area the scope of UNDP activities in the Republic of Kazakhstan has been consistently expanding. A series of international projects are being implemented in this focus area.

The project “Integrated Conservation of Priority Globally Significant Migratory Bird Wetland Habitat: A Demonstration on Three Sites” is the largest UNDP contribution into elaboration of new socioeconomic approaches to the conservation and sustainable use of biological resources. By the example of three largest wetlands in Kazakhstan—Tengiz-Korgalzhyn Lake System, lakes of the Alakol basin and Ural River Delta with adjacent Caspian coast, activities are performed, through effective partnerships with government, business and community entities, for enhancing legislative framework; for improving management in the protected areas; for demonstrating practices of sustainable use of biological diversity and for establishing the Biodiversity Conservation Fund of Kazakhstan.

Under the project activities, the project as supported by the Committee for Forestry and Hunting had two important achievements for the Ural River Delta project site in February 2009. First, the Akzhaiyk Nature Reserve was established. Secondly, the Ural River Delta with adjacent Caspian coast was included into the list of internationally important wetlands under the Ramsar Convention.

The wetlands of the Ural River Delta and adjacent Caspian coast are essential wetlands in the Eurasian continent, which provide support to millions of waterfowl and semi-aquatic birds during nesting and moulting seasons, seasonal migrations and winter.

The work for preparing documents for nominating the wetland as a Ramsar site was started in 2005 by the Wetlands project. This was primarily caused by extensive fishing practices, increasing navigation and continuous oil exploration in the northern Caspian. These are the threatening factors that can destabilize the environment in the region aggravating the situation not only for the nature but for human health as well.

The project is also using a group of activities to interact with local communities; one of the key areas is assistance in financing projects aimed to develop alternative livelihoods as a way to reduce adverse impact on the biodiversity and to improve living standards of local communities.

Thus, instead of extensive unsustainable fishing the project proposes local communities to develop sturgeon culture. In the context of drastic reduction of fish stocks, sturgeon culture is a good option for people to draw income and to reduce the pressure on the Caspian and Ural River biological resources. The international practice demonstrates that this activity can be successful and self-sustained.

In conclusion, I would like to note that the project activities in the Ural river delta project site are driven not only by the priority of unique wetland biodiversity conservation but also by the focus on local community capacity building, assistance to them in applying best business practices as well as technical and financial support through pilot resource saving projects.

I hope that this workshop will help to elaborate actions for all stakeholders to conserve sturgeon stocks and to facilitate development of sturgeon culture as an alternative livelihood.

Thank you for attention.

**Opening remarks by Ministry of Agriculture of the Republic of Kazakhstan (Kh. Mussabayev)**

Distinguished participants of the international Workshop,

On behalf of the Committee for Forestry and Hunting, I would like to thank everyone who participated in establishing the first nature reserve in Atyrau Oblast and to congratulate all of us with the inclusion of the Ural River Delta and adjacent Caspian coast into the Ramsar list of wetlands of international importance. This is the second site in Kazakhstan included into this list. Kazakhstan joined the Ramsar Convention in May 2007, and thus committed to conserve internationally important national wetlands for the humanity. These are remarkable events in the history of Atyrau region.

With the assistance of the Global Environmental Facility's Wetlands project and local authorities on 6 February 2009, Akzhaiyk Nature Reserve was established in the Ural River Delta and northern water area of the Caspian Sea by the RoK Government Resolution No. 119. The nature reserve's area is 111 500 ha. It is located at the land under the jurisdiction of Atyrau City and Atyrau Oblast Makhambet Region Administrations. Despite of the impact of the world crisis the Government assigned 86 staff for protecting and studying the biodiversity in the nature reserve.

The studies performed under the project in 2004-2005 explicitly demonstrated that at present the Ural river delta and adjacent Caspian coast are inhabited by various, including rare and unique animals and plants. But this most valuable area heavily requires protection and effective management.

In general, over 460 vertebrate species, including 76 fish, 20 reptile, 292 bird and 48 insect species inhabit the newly established Akzhaiyk Nature Reserve. The reserve's area is an important nesting and moulting site for many migratory birds. In addition, the Ural River Delta is the primary spawning ground for Caspian sturgeons.

The earlier mentioned resolution was issued in order to conserve the unique biodiversity and to fulfil the commitments made by Kazakhstan after it ratified the Ramsar Convention. Thus, Kazakhstan again demonstrated its commitment to the conservation policies.

I hope that we will be in position to be proud in front of the future generations that through the efforts of all stakeholders we are making a significant contribution into the conservation of the Caspian Sea and deltas of the rivers flowing into it.

I should note that our state places highest emphasis on sturgeon conservation. During recent negotiations between Kazakhstan's President, Nursultan Nazarbayev, and Iranian President, Mahmoud Ahmadinejad, the parties declared the need to set a 10-year moratorium on sturgeon fishing that will allow for conserving the population of many valuable fish species.

In conclusion of my speech I would like to express a hope that the international Workshop will facilitate elaboration of policies for sturgeon restocking to conserve sturgeon natural gene pool, capacity building of government authorities in protecting and managing fish resources and application of best practices for fishery management and development.

Thank you for attention.

**APPENDIX D****Visit to the Erkin Kala sturgeon hatchery in Atyrau**

On Friday 17 April, the participants visited the Erkin Kala sturgeon hatchery in Atyrau (under the Ministry of Agriculture). The annual production capacity of this hatchery is about 6 million of sturgeon fingerlings. Since this plant was operationally merged with another plant on the other bank of the Ural River in 2007, the joint production capacity is 7 million fingerlings per year. In 2009, the Ministry of Agriculture allocated 125 millions Tenge for the production of 7 millions of fingerlings which are expected to be released into waters of the Atyrau region. This hatchery is not yet equipped with broodstock holding facilities but there are plans to upgrade the hatchery structures, including construction of new ponds for growing up to 12 million of fingerlings. Technical assistance for the design of the new hatchery facilities is urgently needed.

### Summaries of country reports

#### The Republic of Azerbaijan

*Zaur Salmanov, Director, Khilly Sturgeon Hatchery, Baku, Azerbaijan*

The Republic of Azerbaijan has an area of 86 600 square kilometers, 12 percent of which is covered by forests and woodlands, 16 percent by water reservoirs, 52.3 percent by arable lands, meadows and pastures and 34.1 percent by other lands. The Republic of Azerbaijan is one of the Caspian littoral states located in the south-eastern extension of the Greater Caucasus and the eastern part of the Lesser Caucasus. The Republic borders with Russia in the north for 289 km along Samur River, with Georgia for 340 km in the north-west, with Armenia for 766 km in the west and south-west, with Turkey for 11 km with Turkey in the east, and 618 km with Iran in the south. The Caspian Sea coastline stretches for 825 km from the Astara River to Samur River.

The Caspian Sea is the largest inland water body in the world. It plays the key role in the biological diversity of the Azerbaijan fauna. The Caspian Sea fauna comprises five distinct genetic groups separated on the basis of the origin. The Caspian fauna exhibits high endemism. A large percentage of endemic to the region species belongs to Crustaceans (90 species), Bivalvia (46) and fish (63 species and subspecies). The prime native fish families are as follows: Clupeidae (3 species), *Alosa* (18 species and subspecies), Gobiidae (35 species and subspecies), Acipenseridae (7 species). Endemic diversity of the fauna has been built on the basis of the forms originated from brackish waters.

There are 8 359 rivers of various lengths within Azerbaijan. Only two of them, Kura (Kur) and Araks (Araz) are over 500 kilometers long. The length of 22 rivers is within the range 100-500 km, while that of 40 rivers is 51-100 km. 5 141 rivers belong to Kura system and 1 177 to Araks water reservoir system. The rivers flowing directly into the Caspian Sea amount to 3 218 (with tributaries).

Table 1. Assessment of water resources of transboundary rivers flowing into Azerbaijan

River	Total flow(km <sup>3</sup> )	Transboundary flow (km <sup>3</sup> )	Local flow (km <sup>3</sup> )
Kura (before Araks)	17.0-19.0	12.0-13.0	5.0-6.0
Ganykh (Alazan)	3.8-4.4	2.4-2.8	1.4-1.6
Gabirli (Iory)	0.5-0.6	0.49-0.58	0.01-0.02
Khrami	1.8-1.9	1.8-1.9	-
Injasu (Ingesu)	0.028-0.03	0.022-0.024	0.004-0.006
Agstafachay	0.39-0.42	0.34-0.36	0.05-0.06
Akhinchay	0.15-0.20	0.12-0.16	0.028-0.038
Araks (Araz)	9.0-9.5	7.2-7.8	1.6-1.8
Arpachay	0.44-0.54	0.36-0.45	0.08-0.09
Okhchuchay	0.30-0.32	0.27-0.29	0.02-0.025
Bazarchay	0.59-0.69	0.53-0.63	0.05-0.06
Samur	2.36-2.40	2.36-2.40	-

The overall capacity of operating water reservoirs in Azerbaijan amounts to 20.6 km<sup>3</sup>, the net storage volume is 12.4 km<sup>3</sup>, the total area is 877.1 km<sup>2</sup>, and the integral capacity of hydroelectric power stations is 978 500 kilowatt.

No	Name	Area km <sup>2</sup>	Capacity km <sup>3</sup>
1	Mingechevir	605.0	16.07
2	Shamkir	116.0	2.68
3	Yenikend	23.2	1.58
4	Varvara	22.5	0.06
5	Araz Water junction	145.0	1.35
6	Sarsang	14.2	0.565
7	Jeyranbatan	13.9	0.186
8	Khanbalanchay	24.6	0.052
9	Sirab	1.54	0.013
10	Agstafachay	6.3	0.12
11	Khachinchay	1.76	0.02

The catches of the fish on the territory of the Republic of Azerbaijan is performed in the Caspian Sea in the Kura River and in the water reservoirs. Sturgeons are the prime object of the fisheries in the Kura River.

Table 3. Catches of high-value sturgeon species (years 2001–2008)

Year	2001	2002	2003	2004	2005	2006	2007	2008	Total
Catch (t)	61.02	56.62	94.50	72.0	69.8	8.68	73.5	71.9	508.02

The sturgeon capture in the Kura River has been performed primarily using sweep nets. The above-mentioned average catches of marine products in the Republic, excluding import, amounts to about 9 000 tonnes. The main commercial fish species is kilka (*Clupeidae*), 80 percent of which serve as source of fish flour production.

As a result of the recovery measures sturgeon stocks were restored in mid 1960s, after the prior considerable drop in 1930s. According to Legeza (1973) sturgeons reached their peak abundance of 113.2 million Russian sturgeon specimens (1968) and 90.0 million stellate sturgeon specimens (1969). However, from the late 1970s, the sturgeon stocks in the Caspian Sea experienced a new decline, and in the year 2005 the overall number of Russian sturgeon amounted to 33.3 million specimens, while stellate sturgeon 6.3 million specimens (Karpyuk, Mazhnik et al., 2006). Thus, the stellate sturgeon population suffered the more dramatic decline (12.5 times) over 40 years, as compared with Russian sturgeon. Undoubtedly, the Caspian Sea and its ichthyofauna are unique and require special approaches. Thus, application of alien seas methods is highly undesirable, due to their inadequacy as regards the Caspian Sea specific. The study of valuable commercial fishes, aimed at rational catches and sustainable management of Caspian Sea stocks has about a century background. Regular studies on the sturgeon biology and catches were initiated in Azerbaijan by Derzhavin in the year 1912 (1922).

During a decade, starting from the year 1960, annual sea expeditions, directed by Legeza, M.I. (Azerbaijan Fisheries Research Institute, AzerNIIRH) had been conducted, in connection with the drop in sturgeon catches, caused substantially by alteration in fish stocks, but by decrease in catches intensity. Along with the collection of ichthyological material (sturgeon), environmental factors (depth of trawling, soils, salinity, pH, oxygen content, temperature, sea currents) related data were gathered. The species dependent differences in terms of these fish response to environmental conditions had been revealed and specific role of each factor in the sturgeon life cycle shown. The prime objective of conducted activity was evaluation of sturgeon stocks in the Caspian Sea, associated with the participation of hatchery-bred sturgeon in captures.

Now, in Azerbaijan, 11 fish hatcheries are involved in fish stock enhancement and replenishment. Four hatcheries are engaged in sturgeon fingerling rearing, while three enterprises in trout culture. The total staff of these hatcheries comprises 450 persons (Table 4).

The Khilly sturgeon hatchery is the leading hatchery centre of the Republic of Azerbaijan. This modern and well-equipped hatchery was established in October 2003. The complete tank method was applied for rearing of sturgeon larvae and fingerlings for the first time at Khilly sturgeon hatchery. Incubation unit and facility designed for holding of breeders is equipped with three recirculation systems, with controls on physical and chemical water parameters. The incubation is performed in a modified Osetr system and in a MacDonald jar. The traditional method of gametes production implying female sacrificing has been used so far, but it should be noted that in some cases (10 percent), eggs are collected using oviduct incision technique. The high loss of eggs (over 50 percent of total amount) proved to be the prime disadvantage of this method hampering the wider application of this method. The Khilly hatchery has its own food production mill and a special pool for live food breeding. The capacity of artificial food production is also proved to be high: about 30 kg of live food organisms per day. The *Artemia* section is equipped with 10 incubators of 500 L capacity each. The larval and fry rearing facility comprises 252 plastic tank of 2 m diameter and 196 tanks of 4 m diameter. This layout ensures effective control of the process. At present, more than 4000 different age group specimens are held in the hatchery, serving as the base of the broodstock. The operation with rainbow trout and golden carp has been also initiated in order to use hatchery infrastructure to full extend.

Table 4. Summary on sturgeon hatchery industry in Azerbaijan

Name of sturgeon hatchery	Location	Year of construction	Ownership	Reproduction and rearing technology
Kura experimental sturgeon hatchery	Neftechalla region, 170 km to the south of Baku, on the left Kura bank	1954	State-owned with private capital share	combined method
Ust-Kura sturgeon hatchery	Neftechalla region, 180 km to the south of Baku, in the mouth of the north-east Kura branch	1956	State-owned with private capital share	combined method
Shirvan sturgeon hatchery	120 km south-west of Baku, Shirvan	1957	State-owned with private capital share	combined method
Khilly sturgeon hatchery	Neftechalla region, Khilly settlement, 160 km to the south of Baku, on the right Kura bank	2003	World bank credit in the frame of the Urgent Environmental Investment Project	tank method

The sturgeon hatcheries are involved in raising of four sturgeon species: beluga (*Huso huso*), Russian sturgeon (*Acipenser gueldenstaedtii*), ship (*A. nudiventris*) and stellate sturgeon (*A. stellatus*). The rearing of fish fry under hatchery condition is regulated by the related biotechnology norms. Annual release of mentioned above sturgeon fingerlings into the Caspian Sea through the Kura River amounts to 15-20 million specimens. The average weight of released sturgeon fingerlings is ranged from 1.5 to 2.5 g.

Table 5. Annual production capacity of Azerbaijan sturgeon hatcheries

Name of sturgeon hatchery, Azerbaijan	Eggs, million specimens	Fingerlings, million specimen
Kura experimental sturgeon hatchery	2.12	1.1
Ust Kura sturgeon hatchery	11.25	6.02
Shirvan sturgeon hatchery	6.38	3.5
Khilly sturgeon hatchery	30.0	15.0

Table 6. Actual production capacity of Azerbaijan sturgeon hatcheries in 2006–2008

Name of sturgeon hatchery, Azerbaijan	Year 2006, million specimens				Year 2007, million specimens				Year 2006, million specimens				Total
	Russian sturgeon	Stellate sturgeon	Beluga	Ship	Russian sturgeon	Stellate sturgeon	Beluga	Ship	Russian sturgeon	Stellate sturgeon	Beluga	Ship	
Kura experimental sturgeon hatchery	0.720	0.064	-	-	0.746	0.179	-	-	0.621	0.110	-	-	2.44
Ust Kura sturgeon hatchery	3.208	0.994	-	-	2.061	0.360	-	-	2.270	0.955	-	-	9.848
Shirvan sturgeon hatchery	2.214	0.851	-	-	1.231	1.805	-	-	0.417	-	-	-	6.518
Khilly sturgeon hatchery	6.055	2.191	-	-	3.632	1.028	-	0.275	5.668	2.417	-	-	21.266
Total	12.197	4.1	-	-	7.67	3.372	-	0.275	8.976	3.482	-	-	36.59

## **The Islamic Republic of Iran**

### **Sturgeon restocking programs in the Islamic Republic of Iran**

*M. Pourkazemi, International Sturgeon Research Institute, P.O. Box 41635-3464, Rasht, Iran*

#### *1. Caspian sea fishery management in the Islamic Republic of Iran*

Caspian Sea, the largest landlocked lake in the world, is located in Northern Iran. There are over 120 fish species found in the southern part of the Caspian Sea and as a result the fishery activities in the Caspian Sea are divided into sturgeon fisheries, bony fish fisheries and kilka fisheries.

Iranian fisheries has put great emphasis on the development of sustainable fisheries. In order to prevent illegal fishing, marine guards control fishing activities in the Caspian Sea. Fishing efforts are monitored to prevent overfishing and damage to fish stocks. For example beach seine is the only allowed fishing method for licensed fishing cooperatives to catch bony fish and kilka. A variety of management controls are imposed on commercial fishers. The purpose of these controls is to ensure that fishing is sustainable, both in terms of the fish that is taken as well as the effects of fishing on the aquatic environment. The management controls commonly imposed are: closed areas, closed seasons and size limits.

The Supreme Commission is responsible for appointing annual policies within the framework of the five year economic plans. The fishing management committee is responsible for the survey and approval of procedures and fishing legislations such as the determination of fishing seasons and closed seasons, place of catch, number of fishermen, catch amounts for each species, control on fishing gear and standards of fishing gear, handling of catch and other controls to develop responsible and sustainable fishing activities.

A data and information collection system has been established for sturgeons, bony fish and kilka. This data are recorded and analyzed by statistical software programs. This is achieved through a random sampling of fish species at different fishing zones.

Totally 11 355 fishermen are engaged in bony fish catch in different fishery cooperatives during a six month period. About 500 fishermen work on 80 kilka fishing vessels (In the past five years, because of the *Mnemiopsis leidyi* invasion the Iranian Fisheries Organization (IFO) has launched a buy-back scheme for vessels engaged in kilka fishing activities).

The Iranian Government has effective control over the catch, processing, transport, and trade of sturgeons. There are 48 catch stations for sturgeons and the catch quotas at each station are decided at the Commission of Aquatic Bioresources of the Caspian Sea (CAB). Implementation of decisions is controlled and monitored regularly.

All efforts addressing conservation of aquatic resources in the Caspian Sea, wetlands, their rivers and estuaries and also precautionary measures taken against crime and to arrest prosecutors are carried out in coordination and collaboration with the disciplinary forces and juridical body. Other responsibilities of the Iranian Fisheries also include control of illegal fishing and illegal trade, regulation and control fishing vessels in the sea and in the coastal regions, protection of catch station as well as protection of habitats and migratory routes of aquatic organisms. The Iranian Fisheries aims at reaching its targets by developing its financial and human resources in the management and sustainable use of its aquatic bioresources.

#### *2. Conservation and protection methods of marine resources*

Protection and conservation of aquatic resources is under the responsibility of the Iranian Fisheries and is carried out by adhering to international regulations, laws on conservation and sustainable use of aquatic resources of the Islamic Republic of Iran, and the constitutional laws of the Iranian Fisheries Company. According to these laws security guard forces of the Iranian Fisheries are posted in the center of provinces and are assigned with specific duties and responsibilities.

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habitats and migratory routes of aquatic organisms. The Iranian Fisheries aims at reaching its targets by developing its financial and human resources in the management and sustainable use of its aquatic bioresources.

### *3. Sturgeon restocking in Iran*

Artificial reproduction of and fingerling release into suitable habitats has also been practiced for the rehabilitation of fish stocks. Artificial breeding of farmed spawners of sturgeons has also been successfully attempted in Iran. The first sturgeon hatchery in Iran was established in 1969. At present there are five sturgeon hatcheries with a total surface area of 1 000 hectares operating in the three Northern coastal provinces of Iran, which produce and release sturgeon fingerlings belonging to five sturgeon species. In the past a maximum of 24.5 million fingerlings were produced and released in these hatcheries. The Iranian Fisheries strictly controls the number and quality of fingerlings produced and so also their weight at the time of release into the sea. Endangered species like the beluga sturgeon and ship sturgeon are released at higher body weight (10-15 g). About 6 000 beluga fingerlings with an average weight of 1480 grams were released into the sea through a joint project conducted by the International Sturgeon Research Institute under the Matched Small Grant Program awarded by the World Bank.

Tagging and tracking sturgeon fingerlings (100 000 fingerlings on an average every year) is another effective measure carried out by Iranian fisheries Research Organization to calculate the fishery return coefficients of sturgeons under the prevailing conditions in the Caspian Sea. Four other hatcheries annually produce and release 300 million fingerlings of other commercially important species to enhance the declining aquatic stocks and increase the income of the coastal dwellers.

The Iranian Fisheries Organization invested USD102.4 million in 2008 to address conservation and management of fish stocks in the Caspian Sea. A total of 7 407 340 fingerlings belonging to different sturgeon species were produced and released into the sea in 2008, while this figure for the commercially important bony fishes was 248 953 000 fingerlings in 2008.

To encourage and develop aquaculture the Iranian Fisheries has issued permits for the establishment of farms in the coastal provinces and other appropriate regions, with the aim to alleviate fishing pressure on aquatic resources. At present there are about 49 sturgeon farms throughout the country which have the potential to produce 2 575 tonnes of sturgeon meat and 72 tonnes of farmed caviar.

### *4. Future plans and strategies*

To address comprehensive marine conservation the Iranian Fisheries focus on approaches which are appropriate and which promote the sustainable use of marine resources. These approaches include:

- breeding of endemic species and observing environmental issues;
- transferring some activities of stock enhancement to NGOs and cooperatives;
- involving stakeholders especially fishermen and NGOs in conservation programs;
- training and promoting public awareness on stock enhancement; and
- developing aquaculture and creating job opportunities for fisher communities.

The Iranian Government has approved comprehensive plans for protection and rehabilitation of bioresources and the management of fishing activities in the Caspian Sea with consideration to results of previous research. To improve and develop aquaculture in water resources basic facilities have been installed and developed in small dams and other water resources. The most effective and efficient means for conserving biological resources is to prevent the loss of important habitats and to manage resources for their long-term productivity of goods and services. Measures are also being taken to restore natural habitats and enhance ecologically conditions in rivers to provide suitable grounds for the migration of anadromous species. One of the most effective strategies to protect species is to decrease fishing pressure. To achieve this the Government is creating non-marine fishery job opportunities in the coastal regions to provide alternative income and livelihood to coastal fishing communities, thereby defraying pressures on illegal fishing and poaching.

## Kazakhstan

### Current status of sturgeon populations in the Ural-Caspian basin

Kim, Yu., A., DSc., R&D Director of "KAPE-Atyrau" branch

The Caspian Sea is traditionally considered as the sea of the sturgeons. Through all the history of the fisheries in the Caspian Sea, variations in abundance of sturgeon population were recorded many times. The annual commercial catch in the former USSR peaked at 20-27 thousand tonnes in 1975-1986. According to FAO data, sturgeon catches in Iranian littoral sector ranged from 1 500 to 2 600 tonnes in those years. In 1994, also according to FAO, the world sturgeon catch was 8 100 tonnes, the Caspian share represented 5 660 tonnes or 70 percent of this total.

Six sturgeon species inhabit the Caspian Sea basin: beluga (*Huso huso*), stellate sturgeon (*Acipenser stellatus*), Russian sturgeon (*A. gueldenstaedtii*), sterlet (*A. ruthenus*), Persian sturgeon (*A. persicus*) and ship sturgeon (*A. nudiiventris*).

Practically all the Caspian sturgeons ascend the Ural river for spawning, while three of them, beluga, Russian and stellate sturgeon have high commercial value.

A ban on commercial fishing of ship in the Ural was imposed in 2002 due to very low abundance of these Caspian sturgeon species, with the exception of the catch for restocking and research purposes.

The sharp decline in abundance and harvest of sturgeons in the Caspian Sea appears to be the vital characteristic of the current period. During the past decade, the commercial potential of sturgeons in the Ural and Caspian fishery basin has been on the stable low level with slight variations, excluding stellate sturgeon. A considerable decrease in commercial catches biomass of stellate sturgeon, from 800 to 500 tonnes has been recorded from the year 2005. For Russian sturgeon this range has been at 175-180 tonnes level, while for giant sturgeon at 220-250 tonnes.

The evaluation of sturgeon distribution and abundance certainly should be given for all the Caspian basin. At present, each littoral Caspian state conducts fishery research within the sector of its competency, in accordance with the Regional Research Programme on assessment of distribution, abundance and food potential, as well as on determination of total allowable sturgeon catches in the Caspian Sea. But more comprehensive and vivid information exchange is needed.

In 2002, the most full trawl survey of the Caspian Sea, including coastal line of Islamic Republic of Iran, was conducted by experts from the Caspian Fisheries Research Institute (CaspNIIRKh, Astrakhan, the Russian Federation), with joint participation of all Caspian littoral States. The survey data on the total abundance and biomass of sturgeons are given in the table.

Beluga		Russian sturgeon		Stellate sturgeon	
Abundance, (thousands specimens)	Biomass, (thousands tonnes)	Abundance, (thousands specimens)	Biomass, thousands tonnes)	Abundance, (thousands specimens)	Biomass, thousands tonnes)
5759.2	146.76	141.35	80.81	9.29	22.55

From the 1980s, the dramatic decrease in abundance and catches of all sturgeon species had been recorded. The number of sturgeon breeders ascended for spawning also had been decreased, causing a decline in their natural reproduction.

Despite the construction of 13 sturgeon hatcheries in the Caspian basin (incorporating the advances of sturgeon culture theory) and the fact that annual release of sturgeon fingerlings reached 92-102 million specimens (Erbulekov, 2004), the artificial reproduction of sturgeons has not been able so far to compensate losses associated with the drop in natural reproduction.

## The Russian Federation

### Reproduction status of sturgeon at fish culture enterprises of the Russian Federation

*Marina Mikhailova, General Director, Federal State Enterprise "VNIIPRKH", Russian Federation*

The first large scale sturgeon breeding program was implemented in the Caspian Sea in the mid of the past century. From the moment of its establishment (year 1954) about three billion of hatchery-reared fingerlings have been released into the Sea. Now, the percentage of such specimens in the catches of beluga, Russian sturgeon and stellate sturgeons amounts to 98 percent, 60 percent and 40 percent respectively. More than 2.2 billion of sturgeon fingerlings or 73 percent of the total basin number have been raised in Russia.

At present the list of suppliers involved in sturgeon production comprises 20 enterprises from four littoral Caspian state: nine in the Russian Federation, two in Kazakhstan, five in the Islamic Republic of Iran and four in Azerbaijan with overall target capacity up to 135 million sturgeon fingerlings. Functioning in the Russian Federation (on the territory of the Astrakhan and Volgograd regions and Dagestan Republic) enterprises, involved in reproduction of high-value fish species, were established more than 30-35 years ago. Now, they are included in the structure of the Federal Agency for Fisheries and have a status of state federal enterprises or unitary federal state enterprises.

Six sturgeon hatcheries and one R&D centre, located in the delta of the Volga, are as follows:

- Federal State Enterprise "Lebyazhinsk" Sturgeon Farm.
- Federal State Enterprise "Bertulsk" Sturgeon Farm.
- Federal State Enterprise "Zhitnensk Sturgeon Farm".
- Federal State Enterprise "Sergiev" Sturgeon Farm.
- Federal State Enterprise "Alexandrov" Sturgeon Farm.
- Federal State Enterprise "Kizan" Sturgeon Farm.
- Federal State Unitary Enterprise "BIOS" (in 2008 was included in Federal State Unitary Enterprise "KaspNIIRKH").

One extra enterprise, Federal State Enterprise "Volgograd" Sturgeon Farm, is situated in the tailwater of Volgograd hydro power station and one more, Federal State Enterprise "Sulak" Sturgeon Farm, to the north-west of the Caspian region

The structure of state hatchery complexes comprises:

- units for short and long-term holding of breeders (Kurinsky' ponds and cages, Kazansky' ponds, plastic and metal tanks of 16-48 m<sup>3</sup> capacity and recirculation systems);
- incubation units with "Osetr" incubation systems;
- tank units for larvae holding and rearing of fingerlings, equipped with air conditioning systems;
- grow-out ponds, total area 1200 ha;
- brood fish holding units (tanks, ponds, cages);
- units for live and artificial food production.

The total annual production capacity of the hatcheries in terms of incubated embryos number (at one-time loading of all incubation systems) amounts to 3 tonnes, while in terms of fingerlings production about 85-90 million specimens. (including 80 million in pond and extra 6-10 million in tanks).

The hatcheries activity in stocking of natural pastures has been financed from the federal budget at the annual rate established by the Federal Agency for Fisheries of the Russian Federation

The participation of private enterprises in the government order on fingerling production are conducted through a process of competitive bidding. The contracts on joint rearing of fingerlings have signed between state hatcheries and private companies. The participation of private farms in development of commercial sturgeon culture in the region via building of broodstocks of valuable fish species and their hybrids also should be noted.

The prime objects of artificial propagation are beluga, Russian and stellate sturgeon. These species overall production (years 2006–2008) amounted to 170 million specimens. About 90 percent of which

was reared at hatcheries of the Astrakan region (Table 1). In addition, two hatcheries (“Lebyazhinsk” and “Volgograd”) have been engaged in rearing of sterlet and annually released 0.5-0.8 million sturgeon fingerlings into the Volga.

Table 1. Release of fingerlings by sturgeon hatcheries of the Astrakhan region (million fingerlings) (Federal State Enterprise “Sevkasrybvod” data)

Year	Species (fingerlings)				Total
	Beluga	Russian sturgeon	Stellate sturgeon	Sterlet	
2006	1.024	50.792	2.654	0.061	54.531
2007	2.201	42.977	5.664	0.1	50.942
2008	2.849	42.279	1.729	0.162	47.019
Total	6.074	136.048	10.047	0.323	152.492

Pond culture has been the basic method of sturgeon raising, with the use of natural food potential, which is stimulated by organic and mineral fertilizers application.

Over past three years, the actual target weight of released into the Northern Caspian Sea to grazing beluga fingerlings ranged from 3.9-4.6 g, while the weight of Russian, stellate sturgeons and sterlet fingerlings was 3.2-3.5 g, 1.8-2.4 g, 4.3-5.9 g respectively, at normative range 2-3 g. (Table 2).

Table 2. Weight of sturgeon fingerlings reared in sturgeon hatcheries of Astrakan region (“Sevkasrybvod” data)

Year	Weight of fingerlings, g			
	Beluga	Russian sturgeon	Stellate sturgeon	Sterlet
2006	3.9	3.2	2.1	5.9
2007	4.3	3.3	2.4	5.5
2008	4.6	3.5	1.8	4.3

During the last decade, the drop in number of brood fish entering the river for spawning and illegal catch on their migration routes to natural spawning grounds led to insufficient supply of hatcheries by breeders. The total number of released fingerling decreased in more than 20 percent.

Nowadays, the essential elements of traditional biotechnology should be considerably updated in order to increase the efficiency of sturgeon rearing.

The activity aimed at reduction of breeders and their effective exploitation, as well as at minimization of losses during the biotechnology process and increase in viability of released stocking material and allocation of fingerlings at optimal for grazing sites.

Activity intended for most efficient exploitation of breeders has been performed using methods of live eggs obtaining and broodstocks establishment under artificial conditions, including use of the fish of initial poor quality in the hatchery process.

In relation with the decrease in number of spawners entering the Volga, the period of brood fish capture for hatcheries has been extended. At present, the collection of different biological forms of sturgeons, associated with long holding in specialized facilities, has been performed

The measures, aimed at centralized capture of breeders to enhance the existing economic and technology potential, have been undertaken.

In the Russian Federation, there are not any legislative restrictions on hybridization of aquaculture sturgeons. Hybrids between beluga and sterlet, sterlet and beluga, Russian sturgeon and Siberian sturgeon, Siberian sturgeon and sterlet have been widely used in aquaculture for commercial production. But, the release of sturgeon hybrids into natural water bodies falls under prohibition. This is strictly regulated by state authorities.

The escape of artificial hybrids into natural water bodies is possible. Anyway, the mentioned above hybrids, on the one hand, and pure species, on the other hand, can be easily visually identified by the morphological signs. In case of such hybrids capture during collection of breeders, they should not be

used for artificial reproduction. In ambiguous cases hybrids can be accurately identified with the use of molecular and genetic analysis.

In theory, participation of highly productive hybrids (bester or Russian sturgeon x Siberian sturgeon) in natural spawn is admissible. The part of sturgeon natural propagation in the Azov-Black Seas and Volgo-Caspian basins has been insignificant. In this case, reciprocal hybrids can be distinguishable on the morphology basis and are the subject of removal from artificially propagated spawning stocks.

The evaluation of risks caused by natural or artificial hybridization (between Russian and Persian sturgeon) is associated with solving the question of specific status of the Persian sturgeon. The limit variants of this sturgeons exhibit clear morphological dimorphism and can be easily identified. Anyway, there exists a great deal of intermediate, in terms of morphotype, forms. Thus, identification of their specific status is evidently impossible. This problem has not been solved also on the molecular and genetic levels. The mitochondrial DNA differences between Persian and Russian sturgeons of Ural population have not been recorded so far. And due to low level of nuclear DNA content divergence, the Ural form of Persian sturgeon has been considered as a subspecies of the Russian sturgeon.

It is urgent to perform a comparative molecular-genetic and karyological analysis of Persian and Russian sturgeons samples from the whole areal of these species. These studies require joint efforts of experts from all the Caspian littoral states.

While working with breeders on commercial scale (from the year 2000), the method of live progeny obtaining (via oviduct incision and eggs stripping or partial dissection of the body cavity with further suturing) has been applied, thus allowing repeated use of females. In 2008 (according to "Sevkasrybvod" data) 5 856 million fingerlings (or 12 percent of total number of hatchery-bred ones) were obtained from recurrently mature domesticated breeders.

In addition, broodstock establishment by using method "from eggs" has been actively conducted at Low Volga hatcheries.

Application of measures to minimize production losses during the hatchery process by monitoring of all biotechnology stages, and implementation of novel technology of *saperolegnia fungus* elimination (egg incubation phase) etc. are important resources of fish hatcheries efficiency increase.

Minimization of losses during long-term holding of breeders at hatcheries can be performed at sufficient level of technical equipping of the hatchery process by systems of hydrothermal regime control (thermoregulation systems and turbojets simulating current and required water velocity regimes).

Along with the use of existing potential for increasing of fingerlings production capacities (at combined approach) towards the problem of sturgeon conservation, the matters of adaptive capabilities increase have been solved. One of the possible ways in this course is to increase the target capacity of fisheries production using different rearing methods.

To assess efficiency of fishery enterprises, the state control of production capacity and quality of released into natural water bodies fingerlings has been performed.

In order to increase the sturgeon culture efficiency, the optimization of hatchery fingerlings distribution at environmentally friendly pastures using live fish vessels, which can increase survival rate of hatchery-bred fingerlings, and, hence, in 2.5-3.0 times performance of annual progeny.

During the years 2006–2008, 10.8 million of fingerlings were transported to the fattening cites in Northern Caspian Sea ("Sevkasrybvod" data) by "Rybovod Alexander Meshcheryakov" vessel. Extra 8 million beluga, Russian and stellate sturgeons fingerlings were transported by special wooden boats (well-boats) and distributed along the river waterway.

The significant research efforts and practical measures intended for conservation of endangered sturgeon species and populations have been conducted in Russian Federation.

Live banks of almost all sturgeon species inhabited Russian waters have been created in several places. Broodstocks are also being used for sturgeon propagation, rearing of fingerlings and their release into natural water bodies. Due to decrease in wild stocks, hatcheries have applied live method of eggs collection and creation of own captive broodstocks. Such stocks also can be considered as pedigree ones. The building of domesticated broodstocks hampers the direct threat of such commercial species extinction as beluga, kaluga, Russian, Siberian, Amur sturgeons and their population range.

Anyway, there still exist the problem of preservation of genetic diversity, complex population and race structure of domesticated sturgeon stocks. Whereas, the maintenance of genetic diversity is prerequisite of the restoration of commercial sturgeon stocks in the natural water bodies.

At building of sturgeon broodstocks, all the enterprises face the complicated question: how to maintain high genetic diversity. Firstly, the effective population size can hardly be provided under artificial conditions, especially for such large fish, as beluga, kaluga or Russian sturgeon, those have the latest age at sexual maturity. Secondly, the selection aimed at adaptation of the fish to new uncommon life conditions, will likely be successful already for the first domesticated generation. Hence, the genetic structure of domesticated stocks could undergo considerable changes.

The urgent measures of initial genetic diversity preservation imply creation of cryobanks network and collection of cryopreserved sperm samples from different species, races and populations of wild breeders and spawners at initial stages of domestication. Other methods of sturgeon biodiversity status quo preservation are not available. For the first time, such cryobank was created in VNIIPRH (Moscow region). Now it possesses hundred samples of sperm collected from wild breeders of various species and populations. In VNIIPRKH and other institutions, the methods of cryoconservation have been developed and modified.

This problem can be resolved using method of dispermic androgenesis, associated with such features of sturgeons as presence of several micropyles in eggs and physiological monospermia (lack of intracellular mechanisms hampering super-numerary spermatozoa). If genotypes of androgenetic individuals have been built by the chromosome sets of spermatozoa from two different male donors, the level of genetic variability in the offspring would be the same as for the common crossing.

The method of dispermic androgenesis in sturgeons was firstly elaborated in Russia, by joint investigation of Institute of Developmental Biology, Russian Academy of Sciences, All-Russian Research Institute of Freshwater Fisheries and South Branch Federal Centre of Selection and Genetics for Aquaculture.

Aquaculture methods of genetic and hormonal sex regulation in sturgeons have been elaborated by VNIIPRKH. These methods simplify the building of monosex female broodstocks.

The following norms and methods have been elaborated and applied:

- norms of broodstock holding and exploitation (use) for designing of standard facilities for domestication of breeders;
- ecological and hormonal methods of gamete collection during non-conventional periods;
- biotechnology of standard fingerlings rearing in cages;
- methods of recovery of grow-up hatchery ponds reproduction.

The requirements on genetic certification of breeders and marking of released fingerlings have been introduced.

In order to increase production capacity and commercial return from released fingerlings it is needed:

- to perform reconstruction of ponds in the hatchery systems;
- to put into operation additional capacities for breeders and broodstocks;
- to construct new live fish transportation vessels.

Implementation of preplanned efforts enables the development of existing hatchery capacities involved in sturgeon fingerlings reproduction. Novel rearing technologies application allows to increase fingerlings release and reach the target figure (not less than 100-120 m specimens), which is adequate to ecological capacity of the water body.

Nevertheless, along with the increase in hatchery releases and fingerling survival performance, it is urgent to ensure natural reproduction as a basis of gene pool management and broodstock replenishment by wild breeders. In this connection, it is essential to facilitate fish passage to natural spawning grounds and ensure their optimal use.

Moreover, the conservation of unique and most abundant Caspian sturgeon population has proved to be an international problem and its solving requires joint efforts of both Caspian littoral states and financial institutions of other countries (The Convention on International Trade of Endangered Species (CITES), the World Bank etc.).

## APPENDIX F

### Summaries of Technical Presentations

#### **Modern sturgeon hatchery technology**

*Chebanov Mikhail Stepanovich (Dr.Sc.), Prof. South Branch Federal Centre of Selections and Genetics for Aquaculture, FAO Consultant*

The sharp decrease in sturgeon population in the Caspian Sea basin has posed the necessity of sturgeon culture development strategy under the current geopolitical, economical and ecological conditions.

Though hatchery technology used for artificial sturgeon reproduction were based on the results of multidisciplinary research of various aspects of sturgeons biology, it was associated with the breeding of wild broodstock, captured in the rivers of the Caspian Sea basin

The dramatic decline in abundance of wild sturgeon brood fish intended for hatchery stock enhancement, has posed a need of farmed broodstock establishment in the basins of the Caspian Sea.

Shortages of the existing biotechnology are as follows:

- focus on the quantitative characteristics of release, not associated with viability and population structure of the released fingerlings;
- poor development of heterogeneous domestic broodstocks; unsystematic selection of mating pairs from not genetically tested broodstocks due to the lack of wild breeders;
- high stressors influence on the larvae and fingerlings and breeders during all the period of rearing and breeding; lack of non-invasive sexing and staging techniques;
- simplified strategy of traditional large-scale and simultaneous release of “standard” size and age untagged juveniles during short period, reared without formation of conditioned reflexes necessary for survival in the wild;
- technical base of some state hatcheries does not match requirements of modern equipment aquaculture.

Moreover, intensive development of commercial sturgeon culture has led to development of some new elements of breeding biotechnology, those may be used in practice of sturgeon hatchery enhancement. First of all, these are non-lethal methods of ovulated eggs extraction, non-invasive technique for early gender and maturity stage determination, effective use of artificial dry feeds for rearing juveniles, recruits and domestic breeders and new technical elements including recirculation systems. In addition, application of these achievements should be based on the comprehension of the cardinal differences between commercial and conservation sturgeon culture that frequently has not been considered in the current sturgeon hatchery practice.

New strategy should presuppose implementation of the latest achievements and tools of the molecular and genetic analysis, population genetics, endocrinology and medical functional diagnostics.

The following necessary changes of the biotechnology are recommended:

- genetic monitoring, including DNA-technology, of wild breeders used for artificial reproduction and establishment of farmed broodstocks, and development of optimal mode of mating to avoid inbreeding and outbreeding depressions of populations;
- creation of living gene banks and sperm cryobanks of sturgeons from different river basins;
- use of non-lethal methods of ovulated egg extraction from wild and farmed sturgeon females;
- use of non-traumatic methods of ultrasound diagnostics (early sexing and maturity staging, detection of anomalies of reproductive system and inner organs etc.);
- minimization of stressors effect during all handling operations; reducing of antibiotics application (in case of their application, the recovery therapy is needed);
- use of methods of temperature-controlled conditioning and spawning to allow technological shifting of the reproductive cycle of sturgeon breeders of different intra-population ecological forms to earlier or later date for extended hatchery period and release of juveniles;

- ecologically friendly fingerlings rearing operations to avoid adaptation to hatchery conditions (low stocking density, natural photoperiod, increased swimming activity, noise, light; obligatory use of live feeds);
- international ecological and morphological, physiological and ethological monitoring of fitness indices of sturgeon progeny, obtained from farmed and wild broodstocks;
- mandatory training and adaptation of fingerlings to natural conditions prior to the release;
- disperse release of different age and weight graded fingerlings and harmonized mass tagging.

All elements of modern technology of sturgeon hatchery reproduction, including optimization of heterogeneous farmed broodstock building has been considered in detail in this presentation.

It is necessary for the biotechnology to form a sturgeon homing, during the transition of larvae to active feeding, to incorporate obligatory administration not only live feed but also special treatment thus enabling increase in the level of thyroid hormones, stimulating olfactory imprinting.

The wider implementation of ultrasound method in sturgeon culture is needed. This technique is not limited by sex and maturity stages determination, but also can be successfully applied for noninvasive broodstock monitoring by evaluation of inner organs state, including detection of anomalies in development, diseases diagnostics, calculation of gonadosomatic index, fecundity, maturity duration prognosis, timing of full eggs ovulation (especially beluga) etc. The ultrasound monitoring of broodstocks enables timely correction of basic broodstock holding parameters, including feeding regimes and norms. This will allow to diminish the shortages of technological techniques.

Hence, it is essential to develop unified environmental responsible and technologically effective strategy capable to integrate into one system both sturgeon stock enhancement and commercial sturgeon culture, based on the principles of mutual benefit while using most effective elements of biotechnology. At this, as it has been mentioned above, these approaches should be completely different in terms of genetic and ecological criteria.

In addition, adaptive management and international coordination in the Caspian Sea, including creation of integrated network concerning genetic sturgeon resources data (international data bank of sturgeon breeders genotypes) and planning and data processing of juvenile tagging are needed in order to increase efficiency of the hatchery stock enhancement.

### **Sturgeon release for restocking - the best practices**

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Out of 27 sturgeon and paddlefish species, six are living in the Caspian Sea and its drainage basin. The total harvest of Caspian sturgeon dropped from 28 500 tonnes in 1985 to less than 1 000 tonnes in 2008. Subsequently the population estimates reduced from 105 million specimens to less than 38 million in 2007. The main factor for such declines in resources are illegal catch, poaching, over exploitation as well as pollution, destruction of nature habitats and spawning ground, invasive species (*Mnemiopsis leydii*) and hydrobiological changes of the Caspian Sea.

Sturgeon resources are sustained by natural and artificial reproduction. Dam construction on several rivers, prevent and/or minimize migration of anadromous species for spawning and only limited spawning grounds remain in some rivers. The volume of natural spawning reduced in the Volga by 20 times (Burtsev, 2005). In the last decades, sturgeon stocks in the Caspian Sea have been maintained mainly by rearing fish in hatcheries and releasing them into the Caspian Sea, which causes the loss of genetic integrity of wild stocks.

Totally 19 sturgeon hatcheries are constructed in the four Caspian countries including, the Russian Federation (10 hatcheries), Azerbaijan (3 hatcheries), Islamic Republic of Iran (5 hatcheries) and Kazakhstan (1 hatchery).

Based on statistics of sturgeon fingerling releases and brood stocks abundance, in the Caspian Sea, sturgeon restocking practices can be divided into two groups:

- a) high abundance group (Russian sturgeon, Persian sturgeon, and Stellate sturgeon)
- b) low abundance group including, Beluga and Ship sturgeon.

Up to now, no genetic criteria have been implemented on fingerling production on all sturgeon in the Caspian Sea.

Ship sturgeon (*A. nudiventris*) is listed in the Red Book of the Russian Federation, Azerbaijan and Turkmenistan. Only in Kazakhstan and in the Islamic Republic of Iran fingerling are being produced by natural and artificial reproduction. Apparently there is a shortage of beluga (*Huso huso*) brood stocks in the most hatcheries around Caspian Sea, where in some countries the total number of brood stocks used for artificial reproduction was less than 6-10 specimens per year.

According to statistics (not confirmed) the four Caspian range states (excluding Turkmenistan), annually release from 85 million (year 2000) to 96 million (2006) fingerlings, 1-3 g. of weight in the Caspian Sea. In comparison to such relatively high numbers of fingerling release with its abundance in the sea, it appears that either sturgeon abundance in the Caspian Sea is not properly estimated, or there is high mortality due to illegal catch, over fishing or there is uncertainty in statistics provided by some Caspian range state on the number of fingerling .

There was an initiative in the Caspian Sea Aquatic Bioresources Commission (CAB) to establish a working group to discuss the possible way of increasing sturgeon brood stock efficiency, survival rate of larvae and fingerling in the rearing tanks and ponds, minimize the abnormality and diseases and finally optimize the size and weight of fingerling at the time of release. Unfortunately, despite its high priority such working group have not been established yet.

### **What is the best practice for sturgeon fingerling release in the Caspian Sea?**

- According to Ovenden et al., 1990, Shaklee et al., 1990, stocks is defined as a Panmictic population of related individuals which are reproductively isolated and genetically distinct from other such populations. For each of the five sturgeon species in the Caspian Sea, there are probably between 2 to 4 populations, therefore genetic population identification of shared resources is a prime importance for long-term sturgeon management and restoration.

- Highest priority should be placed on sturgeon population perceived to be extirpated and then on populations exhibiting little, if any natural reproduction.
- Consider genetic principle of broodstocks for artificial reproduction. The minimum generation effective population size of broodfish should be determined (e.g. for each low abundance species, it would be equal to 100 with inbreeding rate of 0.5 percent).
- Increase the genetic variability by designing appropriate crosses within and between broodstocks (e.g. applying half sib crosses).
- Establish appropriate strategy for the size of sturgeon fingerling, whether it should be 0.5 g. of 3-5 g. With special consideration of live food availability in river sites and in the first year growing season.
- Despite huge investment on sturgeon rehabilitation in the Caspian Sea, there is no assessment on success status of such practices, therefore, there is immediate need to evaluate, current practice on sturgeon fingerling production and releases, using various tagging methods.
- It is highly recommended that the Caspian Sea sturgeon hatcheries practice "soft release" mode, where the appropriate preparation and training of fingerling should be in place, enable fingerlings to become accustomed to new environment in terms of temperature, chemical parameters, familiarity with new local area and recovery of transportation.
- Due to shortage of broodstocks, uncertainty of access to such adults in future, it is highly recommended that the Caspian hatcheries establish a "gene bank" for sturgeon (live gene bank, cryopreservation, cell line, tissue and DNA).

Finally, since most sturgeon in the Caspian Sea are considered as shared stocks, development of an "Action Plan" for sturgeon conservation and sustainable management is in the highest priority. In such plans, range States should consider both the conservation of wild native sturgeon populations as well as aquaculture development by regional and international scientific cooperation.

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**Oogenesis and selection of Siberian sturgeon breeders for spawning**

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Mastering artificial reproduction is a key issue for sturgeon species because the most part is endangered and also because of their biological characteristics (long life fish, non-yearly oogenesis, etc.). Therefore, even presentation has been focused on Siberian sturgeon, principles and methods described might be applying to any sturgeon species.

Sturgeons in captivity cannot spawn spontaneously. They need some external hormonal stimulation. The normal development of gametogenesis might be perturbed by artificial conditions of stocking, in particular for females. A description of the main steps of oogenesis as well as the main concerned endocrine phenomena is given.

The females able to respond positively to a hormonal stimulation must be selected in order to obtain ovulated eggs of good quality. Then the hormonal stimulation must be done in optimal conditions.

Broodfish must be farmed in the best conditions (environmental factors, feeding, density, water temperature regime). Ovarian follicles must have been reached their maximum development, evaluated by size and color. They must be supple and resistant to crushing between fingers. A marbled feature is a sign of fragility as a result of over-maturation. The position of the germinal vesicle has to be determined. The more advanced its migration toward the animal pole, the better the maturation. Finally we have to evaluate the competence of the oocyte to mature. To do so, samples ovarian follicles are incubated in vitro, in presence of the progestin. The medium must have specific characteristics: composition, pH, osmotic pressure and temperature. If the maturation occurs, the Germinal Vesicle Break Down (GVBD), i.e. the breakdown of the envelope of the nucleus takes place, and then the trace of the nucleus vanishes. The higher rate of GVBD, the better the maturation, the better quality gametes will have.

When pituitaries (sturgeon or carp) are used for hormonal stimulation, injection is placed below the pituitary in the nervous central system-pituitary-gonad axis. If GnRH analogues are used, the induction is placed above the pituitary. The latter are now recommended as well as for males.

Ovulated eggs might be obtained by repeated abdominal stripping or by laparotomy. Sperm is obtained via a polypropylene tube. It should be non-contaminated by water or urine. Spermatozoa, under microscope, must be immobile and moving only after dilution of the sperm with water. Sperm exhibiting the more active spermatozoa are retained.

Fertilization and anti-adhesive treatment are performed according the currently accepted practices. The embryogenesis must be paid great attention. It allows us to determine the rates of fertilization, embryonic success until hatching through characteristics stages of embryogenesis.

Hatching and further behavior of hatchlings have to be carefully observed as these must be in accordance with the standard for the species.

## **Genetic considerations in hatchery management of Caspian Sea sturgeons**

*Phaedra Doukakis, Consultant to the World Bank Group*

Hatcheries designed for both commercial culture and wild population supplementation should be managed with genetic considerations in mind. Maintaining sufficient genetic variation in captive culture populations is important in promoting long-term survival and providing material for selecting desirable traits. Captive stocks bred for wild population supplementation should, to the extent possible, be managed to capture and maintain the genetic variation of the wild population. For wild populations, genetic variation is the foundation for continued survival, allowing adaptation to changing environments. Low genetic variation and inbreeding will decrease fitness and survival. Reduction in variation can occur through both breeding and release practices.

Given the poor and declining status of sturgeons in the wild and ongoing legal and illegal fisheries, captive populations of sturgeons are vital to conservation, serving as the reservoir of genetic variation for future supplementation and even reintroduction. With this in mind, even captive populations used only for aquaculture should use practices that safeguard natural genetic forms and variation. This could be accomplished by working cooperatively with supplementation hatcheries or setting aside some individuals for breeding through practices that minimize inbreeding and promote random crosses.

In all types of hatcheries, it is imperative that a) sturgeons are externally and internally tagged; b) genetic samples from each individual fish are collected and archived; and c) a database is created describing existing broodstock that can be shared among hatcheries. Detailed records should be kept on all breeding practices.

Additional specific recommendations to manage hatchery populations to be used for hatchery supplementation include the following:

1. In the best case scenario, the broodstock used in establishing the hatchery should originate from the same river where supplementation will occur. Broodstock should be captured at maturity given that subadult sturgeons may stray to non-natal rivers for feeding. Broodstock should always be from the same genetic population. Supplementation should not occur if broodstock has originated in another basin unless it is proven that the broodstock is from the same genetic population. Additional study is needed on the Caspian and Black Sea sturgeons because there is only limited understanding of genetic population structure, which makes decision-making difficult.
2. For localized population within a species, the minimum effective population in a hatchery should be maintained at more 100-200 per generation (0.50 percent inbreeding). This means that 100-200 different individuals must effectively breed over the course of a generation (generation time is equivalent to the number of years for females to reach first maturity) with an equal number of males and females and no individuals used more than once. If the hatchery population represents the only remaining population within the species, the effective population size is 500. This target should be refined to be more specific to the species considered as accomplished through modeling and genetic studies. In any case, long-term breeding and release programs will be needed to achieve the effective population size goal.
3. Fingerlings produced through effective mating of less than 6 individuals in a given year (year class effective size <6) should not be released to supplement wild populations as this may negatively impact the wild populations.
4. Milt from multiple males should not be mixed to fertilize one female because result is then unclear regarding parents. Only single crosses should be conducted.
5. Release practices should ensure that no bias is introduced through the release of more individuals from one mating as opposed to another. A policy should be adopted so that the number of fingerlings released from individual crosses is within 50 percent of other individual crosses. This will likely require enhanced traceability in hatchery practices to track the juveniles produced through individual crosses.

These basic recommendations may be difficult to implement at the present time given the situation with the Caspian Sea hatcheries and the limited availability of broodstock. There is a great and immediate need to work with hatcheries on an individual level to coordinate their practices with those

managing for genetic considerations. This would include a basic, detailed manual on breeding practices. A further need exists for higher level for research on the genetic structure of Caspian Sea species and creation of a system wherein breeding strategies can be coordinated across the basin through exchange of milt and eggs if biologically and genetically appropriate.

Lastly, it is stressed that hatchery populations should not completely replace wild populations and every effort should be made to conserve wild populations and wild breeding while promoting captive breeding. Many scientific studies now show that wild populations are more fit and better adapted to the natural environment. Whether this has a genetic basis is unclear but suggests caution nonetheless.

### **Sturgeon hatchery and culture management: overview of future institutional and financial options**

*Gert van Santen, Fisheries development and management specialist, the World Bank*

#### **Introduction**

Managing a sturgeon hatchery has never been simple, but has become more complicated over the past 50 years. Traditionally Government owned and operated, producing and releasing large quantities of sturgeon fingerlings, management of late has become more complex. Hatcheries now have to maintain brood-stock due to the declining availability of wild breeders. Demand for sturgeon juveniles of various sizes and a growing research and extension agenda have expanded the hatchery “product mix” The institutional status and funding arrangements of some hatcheries has also changed. While the future will not be similar for all hatcheries around the Caspian, the poor state of the wild sturgeon stocks in the Caspian and the potential growth of sturgeon culture is likely to fundamentally change the future role of hatcheries, their financial structure, and possibly their ownership and management.

Farmed sturgeon and caviar may well already exceed total wild production; potential culture production from planned investment is likely to far exceed current and particularly projected wild production. In such outlook four basic development scenarios may apply to different hatchery operators in different countries.

1. Public companies or state owned institutions currently operating hatcheries may expand their activities of stocking fingerlings and start sturgeon culture. Public funds will be used to make long-term investments; marketing of cultured caviar and sturgeon meat may continue to use traditional channels.
2. Publicly owned hatcheries will enter into supply contracts with private sturgeon culturists and invest public and/or private funds to expand capacity, including extension to private out-growers who may develop new marketing strategies.
3. Publicly owned hatcheries become part of a public/private partnership. The State may continue to contract the hatchery for the production and release of fingerlings, and scientific community for experiments and research.
4. Public hatcheries would be privatized or may be sold to private parties involved in sturgeon culture. Private investment would support necessary expansion of the production facilities. The hatchery may continue to honor contracts to supply fingerlings for release in the wild, and may continue to engage in public scientific research.

Each of these scenarios may demand increasingly sophisticated management. The financial feasibility and risk profiles of the hatchery operations will also vary substantially. The culture of sturgeon in most cases appears a high-risk, long-term investment, with the potential for considerable long-term profits, but also for losses and failure. It requires relatively high up-front expenditure; a positive net cash-flow may start at best after several years of operation, while the probability of benefits, in terms of production volumes, meat and caviar demand and prices, remains essentially uncertain in most markets.

Hatchery involvement in arms-length or direct sturgeon culture requires knowledge, investment funds, and a far more flexible and quality conscious workforce and management style. Public ownership will only partly shield hatcheries from the quite substantial risks of sturgeon culture, even if, as in scenario 2, such culture itself is in private hands. While being in public hands has drawbacks: it limits access to flexible investment financing, and public institutions are mostly too much regulated to enable the

operational flexibility private sector institutions usually have public ownership may well remain desirable in the first phases of development of a sturgeon culture industry, and to ensure restocking wild populations. The early stages of development of the sturgeon culture in France received considerable public support. Ultimately, a successful private sector sturgeon industry will likely require close control over all aspects of production, including hatchery operations.

The French example suggests that some Government support may well be critical for the development of a viable sturgeon culture industry in addition to rebuilding wild sturgeon stocks. Such support should not only, or even predominantly, focus on direct financial support. It will be critical that the Government defines its policy concerning sturgeon culture development, and specifically its own role. It appears equally critical that it should, through its policy, give direction or facilitate the development of a healthy industry.

Any investor in sturgeon culture, public or private, needs to analyze the current and potential future structure of the international caviar markets, and the current and potential role of cultured caviar. Analysis of the present and future markets may suggest the 'best' most profitable or least risky marketing and distribution option, but such analysis will not be able to exclude all marketing risks, the proof of the pudding remains in the eating, and past experience may not apply in the future.

The high-risk and relatively long-term nature of sturgeon culture investments will influence the structure of its financing. Public financing may be feasible in scenario 1, but the size and nature of the investment may make it difficult for decision makers to give it priority over other long-term infrastructure investments with faster and more dependable payback. The uncertainties and the multitude of options for the ownership structure of the ultimate venture(s) – public, private, mix – and the system of marketing will probably limit the number of banks willing to consider a loan. Except in the case of scenario 1, private investors will be the likely source of most of the investment and operating funds needed to start a sturgeon culture operation.

While technical ability and experience used to determine who could work at a hatchery, any involvement of a hatchery in sturgeon culture will substantially broaden the need for technical, financial and management skills. Improving productivity and quality will become far more important, cost-effective production a must. This will require a change of culture, no pun intended, in many hatcheries, and may change the formerly technocratic and bureaucratic approach to its management. Many will need professional managers to thrive.

### **“Stocking and sturgeon habitat assessment”**

*Mr Gerd Marmulla, FAO*

In his presentation entitled “Stocking and sturgeon habitat assessment”, Mr Marmulla first briefly made reference to the FAO Code of Conduct for Responsible Fisheries (CCRF) and the CCRF Technical Guidelines No. 6 “Inland fisheries”, and No. 6.1 “Inland fisheries: Rehabilitation of inland waters for fisheries”. Then he mentioned the different fisheries management options in freshwater and stressed that the modern approach to conservation and management of inland fishery resources, as outlined in the FAO CCRF and the related Technical Guidelines, comprises three components, i.e. management of the fisheries, management of the fishery resources and management of the environment. Management of the fishery resources includes all the enhancement techniques, including fish stocking. Reference was made to the various definitions of “stocking” and the different levels of details and complexity of these definitions. It was stressed that stocking can be done for various purposes, e.g. compensation for habitat-related or human-induced deficits in the species composition; re-construction of fish populations; re-introduction of originally present indigenous species; or maintain fisheries productivity of a waterbody at the highest possible level. The different objectives necessitate different approaches, and examples were provided. Mr. Marmulla also presented a simple decision-support scheme that was tested in Germany. It works basically in three steps, i.e. (a) compilation of facts about the existing and potentially natural fish populations as well as data about the target waterbody, (b) the formulation of conclusions about status of species and a problem analysis and (c) the formulation of recommendations for stocking (or not stocking), taking into consideration the existing environmental and legal frameworks. He furthermore elaborated on the importance of the careful selection of stocking material.

Mr Marmulla also listed the different sturgeon species occurring in the Caspian Sea and presented some information on their biology and behavior that is relevant in planning stocking operations. He stressed that an optimized stocking strategy will have to take into consideration the life history of the species concerned (e.g. seasonality of reproduction, age and size of juveniles/fingerlings), the weather/climate conditions and variations, the status of development of the food items, as well as an extended time frame and geographical range of waterbodies/areas to be stocked. Locations for release of juveniles/fingerlings have to be chosen according to the species characteristics. When planning for the stocking, it is necessary to establish an exact protocol that complies with the relevant rules and regulations and that addresses important questions such as, *inter alia*, “Which of the sturgeon species is/are to be used?”; “Should fish be marked before release, and what is the objective of tagging?” and “Which tagging method should be used?”; “Which stocking technique will be used?”; “Is fish well adapted to local natural conditions?”. Care has to be taken that an appropriate number of staff with the necessary specialized equipment and means of transport is available to carry out the stocking in an optimum manner. Before the transport of the living material, details such as best day time, shortest possible access, transport capacity, appropriate transport conditions, sun/heat protection have to be addressed. It was also stressed that there could be risks associate with stocking and that it was therefore utmost important to carefully evaluate these risks beforehand. In concluding, Mr Marmulla emphasized that stocking was a very complex thematic. The stocking operations have to follow the strict general principles that are well developed but also have to be fully and well adapted to the prevailing local conditions. Care needs to be taken that indigenous biodiversity and the local environment are not put at risk. Often, stocking does not live up to the expectations that may have been too high due to wrong or incomplete assumptions. It is therefore recommended to clearly analyze motivation and objectives well beforehand, get the objectives right, properly design the measures to be taken, establish sound protocols for all steps, carry out control and monitoring, prepare comprehensive catch statistics, and if necessary adapt measures over the following years.

Before ending, Mr Marmulla made reference to various relevant publications, including FAO publications, dealing with stocking.