



Inland salt lakes play crucial roles in wildlife survival and in the fish/shellfish farming (aquaculture) industry.

Artemia, harvested from inland salt lakes, is a vital source of live food in the larval rearing of over 900 billion fries of different aquatic species

Specific legislative measures are needed to safeguard the fate of terminal salt lakes and at least delay their terminal status.

The gene pool of Artemia species and strains occurring in salt lakes worldwide should be safeguarded.

**Join us on this initiative!**

**2 - 6 SEPTEMBER 2024**

# SAFEGUARDING SALT LAKE BRINE SHRIMP (ARTEMIA) RESOURCES FOR AQUACULTURE

hydrological, biological, ecological, aquaculture, wildlife and legislative aspects



Food and Agriculture  
Organization of the  
United Nations



NETWORK OF  
AQUACULTURE CENTRES  
IN ASIA-PACIFIC



Alliance of International  
Science Organizations



Royal Academy for  
Overseas Sciences

**AT FAO  
HEADQUARTERS**

Rome, Italy

Viale delle Terme di Caracalla

2-6 September 2024

## **Safeguarding salt lake brine shrimp (*Artemia*) resources for aquaculture hydrological, biological, ecological, aquaculture, wildlife and legislative aspects**

A Training Project organized by the Food and Agriculture Organization of the United Nations (FAO) and the Network of Aquaculture Centres in Asia-Pacific (NACA), with the financial support of the Alliance of National and International Science Organizations for the Belt and Road Regions (ANSO) and the Royal Academy for Overseas Sciences (RAOS), in cooperation with the International Artemia Aquaculture Consortium (IAAC).

**Summary** - Many salt lakes on different continents are under threat of drying up because of human interventions and/or climate change events. Different species of 1cm-long crustaceans, the brine shrimp *Artemia*, are the sole zooplankton developing in dense monocultures in these inland salt lakes and play crucial roles in wildlife survival and are an important resource to the global fish/shellfish farming (aquaculture) industry:

1) *Artemia* biomass is a crucial source of high-protein food for millions of migrating birds foraging in transit on *Artemia* during certain periods of the year.

2) Thousands of tonnes of *Artemia* cysts (0.5-mm inactive embryos) are harvested from salt lakes in North America and Asia annually for use as a vital zooplankton substitute in the larval rearing of over 900 billion larvae and fry of different aquatic species that eventually yield more than 10 million tonnes of seafood produced in the aquaculture industry.

In recent decades, a few terminal salt lakes have already dried up (e.g. Aral Sea in Uzbekistan, Urmia Lake in Iran, Owens Lake in the United States of America) with very significant impacts on wildlife and human health, as well as important economic losses (in the billions of USD). On the other hand, new salt lakes may emerge or be restored in new or dried-up locations due to climate change.

Multidisciplinary efforts to better understand hydrological, biological, and ecological events - with the Great Salt Lake in Utah as a unique test case - can deliver insights and allow the formulation of specific legislative measures to safeguard the fate of terminal salt lakes and at least delay their terminal status.

The gene pool of *Artemia* species and strains occurring in salt lakes worldwide need to be safeguarded and better characterized for use in aquaculture. The ecological heterogeneity and dynamics of salty lakes, influenced by climate change and human intervention, have left genetic signatures in the *Artemia* genome that require an integrated/coordinated approach.

Through this training session, the International Artemia Aquaculture Consortium (IAAC), a subject-oriented network of NACA, is following up on recommendation 16 of the 11th Session of the Sub-Committee on Aquaculture of the Committee on Fisheries (COFI:AQ) (Rome, May 2022) "...The Sub-Committee appreciated the work on *Artemia* and supported FAO efforts to explore development of technologies and sustainable management of *Artemia* resources" and paragraph 69 of the 12th Session of COFI:AQ (Hermosillo, May 2023) "... recommended the preparation of protocols on sustainable harvesting practices of wild resources, ... and certification of cyst products... furthermore, new initiatives are vital to conserve *Artemia* biodiversity, ...".

## Objectives of the Training

- Identify inland salt lakes with Artemia populations that either have disappeared in recent years, or that are under (short/long-term) threat, and in both cases try to identify the causes for their disappearance or threat with focus on hydrological, biological ecological and climate changing aspects.
- Evaluate methodologies that have been developed to safeguard lost habitats.
- Review the long-term approach taken by different organizations in the State of Utah (United States of America) to protect the Great Salt Lake habitat and its resources (for wildlife and for the aquaculture industry).
- Review similar approaches undertaken for the protection of other salt lakes in Asia.
- Review the characterization, monitoring and safeguarding of the gene pool of native and non-native Artemia species and stocks occurring in salt lakes, including guidelines for characterization of genetic resources and the establishment of an Artemia cyst bank.
- Brainstorm development of knowledge products that can enhance future management of inland salt lakes including protocols, suitable legislation and training programs, leading to improved water and nutrient management to protect the endemic Artemia gene pool and manage the resource effectively.

## Provisional agenda

1st DAY - 2 September 2024	
09:00 – 09:30	<b>Welcome</b>
09:30 – 10:30	<b>Opening Remarks</b> <ul style="list-style-type: none"><li>• <b>Xinhua Yuan</b>, Deputy Director, Fisheries and Aquaculture Division (NFI)</li><li>• <b>Philippe De Maeyer</b>, Permanent Secretary, Royal Academy of Overseas Sciences (RAOS)</li><li>• <b>Simon Wilkinson</b>, Network of Aquaculture Centres for Asia-Pacific (NACA)</li><li>• <b>Matthias Halwart</b>, Team Leader, Sustainable Aquaculture - Global &amp; Regional Processes</li><li>• Video message by representative of the Alliance of National and International Science Organizations for the Belt and Road Regions (ANSO)</li></ul>
10:30 – 11:00	<b>Group Photo and Coffee Break</b>
11:00 – 12:30	<b>Expert presentations on salt lakes</b> <ul style="list-style-type: none"><li>• Hydrology and climatology of salt lakes: development and use of appropriate models to safeguard water resources, impact of climate change - <b>Alishir Kurban</b></li><li>• Presence and role of Artemia in salt lakes: biology and ecology, use in aquaculture - <b>Patrick Sorgeloos</b></li><li>• Urmia Lake, Iran: example of terminal lake, fate of Artemia presence - <b>Naser Agh</b></li><li>• Aral Sea, Uzbekistan: example of terminal lake, fate of Artemia presence - <b>Ablatdyin Musaev</b></li></ul>
12:30 – 14:00	<b>Lunch break</b>
14:00 – 16:00	<b>Expert presentations on management tools for Artemia cyst and biomass harvesting</b> <ul style="list-style-type: none"><li>• History of the interdisciplinary approach by the State of Utah and stakeholder groups to develop strategy and policy to safeguard Great Salt Lake and its vital resources for wildlife and industry - <b>Thomas Bosteels and Tim Hawkes</b></li><li>• Management tools and quota systems for the exploitation of Artemia resources in China - <b>Gao Song</b></li></ul>

	<ul style="list-style-type: none"> <li>• Management tools and quota systems for the exploitation of Artemia resources in Siberia, Russia - <b>Liudmila Litvinienko and Marina Korentovich</b></li> </ul>
<b>16:00 – 16:30</b>	<b>Coffee Break</b>
<b>16:30 – 17:50</b>	<p><b>Expert presentations on management tools for Artemia cyst and biomass harvesting (Cont.)</b></p> <ul style="list-style-type: none"> <li>• Artemia of Great Yarovoye Lake (Siberia, Russia): characteristics of the population and Artemia resource development (video presentation) - <b>Galina Tsareva</b></li> <li>• Management tools and quota systems for the exploitation of Artemia resources in Kazakhstan - <b>Chingis Sossorbarmayev</b></li> <li>• Management tools and quota systems for the exploitation of Artemia resources in the Shivash salt lakes in Crimea (video presentation) - <b>Nickolai Shadrin</b></li> </ul>
<b>17:50 – 18:00</b>	<b>Close for the day</b>

<b>2nd DAY - 3 September 2024</b>	
<b>09:00 – 10:30</b>	<p><b>Expert presentations on Artemia biodiversity</b></p> <ul style="list-style-type: none"> <li>• AquaGRIS: the role it can play in characterising, recording and monitoring Artemia genetic diversity - <b>Graham Mair</b></li> <li>• World Artemia biodiversity - <b>Gonzalo Gajardo</b></li> <li>• Artemia biodiversity in China - <b>Sui Liying and Xuekai Han</b></li> <li>• Artemia biodiversity in Russia (video presentation) - <b>Elena Boyko</b></li> </ul>
<b>10:30 – 11:00</b>	<b>Coffee Break</b>
<b>11:00 – 12:30</b>	<p><b>Expert presentations on Artemia biodiversity (Cont.)</b></p> <ul style="list-style-type: none"> <li>• Artemia biodiversity in Kazakhstan - <b>Kamila Adyrbekova</b></li> <li>• Artemia biodiversity in Shivash salt lakes (video presentation) - <b>Elena Anufrieva</b></li> <li>• New techniques for genotyping of Artemia species and strains - <b>Parisa Norouzitallab</b></li> </ul>
<b>12:30 – 14:00</b>	<b>Lunch break</b>
<b>14:00 – 16:00</b>	<p><b>Group discussion on biological aspects of salt lakes</b> Moderator – <b>Fernanda Garcia Sampaio</b></p> <ul style="list-style-type: none"> <li>• models to estimate the role of Artemia as food source for the water birds;</li> </ul>

	<ul style="list-style-type: none"> <li>• sampling protocols and methodologies to estimate maximum sustainable yields for Artemia cysts (and/or biomass);</li> <li>• potential impacts of climate change, ecology, and pathogens on the Artemia population;</li> <li>• guidelines for establishing sustainable management protocols: harvesting quota, harvesting seasons, and measures to enforce/adjust during the harvesting season;</li> <li>• other measures for Artemia management;</li> <li>• protection/preservation and characterization of the unique Artemia gene pool from salt lakes</li> </ul>
<b>16:00 – 16:30</b>	<b>Coffee Break</b>
<b>16:30 – 17:50</b>	<p><b>Group discussion on policy needs and legislative strategy</b> Moderator – <b>Tim Hawkes</b></p> <ul style="list-style-type: none"> <li>• protect and manage terminal and emerging salt lakes</li> <li>• water resources</li> <li>• salinity regimes</li> <li>• nutrient intake</li> <li>• contamination</li> </ul>
<b>17:50 – 18:00</b>	<b>Close for the day</b>

<b>3rd DAY - 4 September 2024</b>	
<b>09:00 – 10:30</b>	<b>Continuation of group discussions</b>
<b>10:30 – 11:00</b>	<b>Coffee Break</b>
<b>11:00 – 12:30</b>	<p><b>Preparation of draft report</b> Moderator – Patrick Sorgeloos <b>Recommendations for future actions to ensure:</b></p> <ul style="list-style-type: none"> <li>• increased awareness among stakeholders,</li> <li>• more interdisciplinary R&amp;D,</li> <li>• specific training sessions,</li> <li>• international interaction and cooperation,</li> <li>• recommendations for specific international (UN) legislation</li> </ul>
<b>12:30 – 14:00</b>	<b>Lunch break</b>
<b>14:00 – 16:00</b>	<b>Videoconference discussion of the draft report</b>
<b>16:00 – 17:00</b>	<b>Coffee Break</b>
<b>17:00 – 17:50</b>	<b>Adoption of final recommendations</b>

<b>17.50 – 18.00</b>	<b>Close for the day</b>
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<b>4rd DAY - 5 September 2024 (possibility)</b>	
<b>07.30 - 09.00</b>	<b>Transport to Tarquinia Salt Works</b>
<b>09.00 – 11.00</b>	<b>Guided tour of the Tarquinia Salt Works</b>
<b>11:00 – 12:30</b>	<b>Transport back to Rome</b>
<b>12.30 – 17.00</b>	<b>Free afternoon</b>

<b>5th DAY - 6 September 2024 (possibility)</b>	
<b>09.00 – 10.30</b>	<b>Online conference with experts in Brussels</b>
<b>10.30 – 11.00</b>	<b>Coffee break</b>
<b>11:00 – 12:30</b>	<b>Continuation of the online discussion</b>
<b>12.30</b>	<b>End of training</b>