



International Artemia Aquaculture Consortium

Conservation, management and sustainable utilisation of *Artemia* biodiversity



NETWORK OF
AQUACULTURE CENTRES
IN ASIA-PACIFIC

Artemia Side Event

Organized at the occasion of the 12th session FAO COFI Subcommittee on Aquaculture, Hermosillo (Mexico) May 16, 2023

- **Opening remarks:** Octavio Alberto Almada Palafox, Commissioner of Fisheries and Aquaculture and Matthias Halwart, COFI SCA Technical Secretary.
- **History of Artemia use in aquaculture since the Kyoto FAO Conference in 1976 – need and opportunities for new action:** Patrick Sorgeloos, IAAC facilitator and advisor
- **Presentation of the International Artemia Aquaculture Consortium IAAC:** Eduardo Leano, IAAC host
- **Recommendations as formulated by the IAAC membership:** Yeong Yik Sung, IAAC chair
- **Short video to showcase the recommendations by IAAC members:**
 - Pond production of Artemia: Nguyen Van Hoa, Vietnam and Meezanur Rahman, Bangladesh
 - Artemia resources and use in China: Liying Sui, China
 - Sustainable harvesting of inland salt lakes: Thomas Bosteels, USA
 - Potential for improved use of Artemia in fish and shrimp hatcheries: Philippe Léger, Belgium and David Garriquez, USA
- **Production interests for Africa:** Betty Nyonje, Kenya
- **Use of Artemia biomass as human food:** short video by Shahina Syeda, Bangladesh
- **Discussion with member states participants**
- **Concluding remarks**



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brine shrimp ARTEMIA

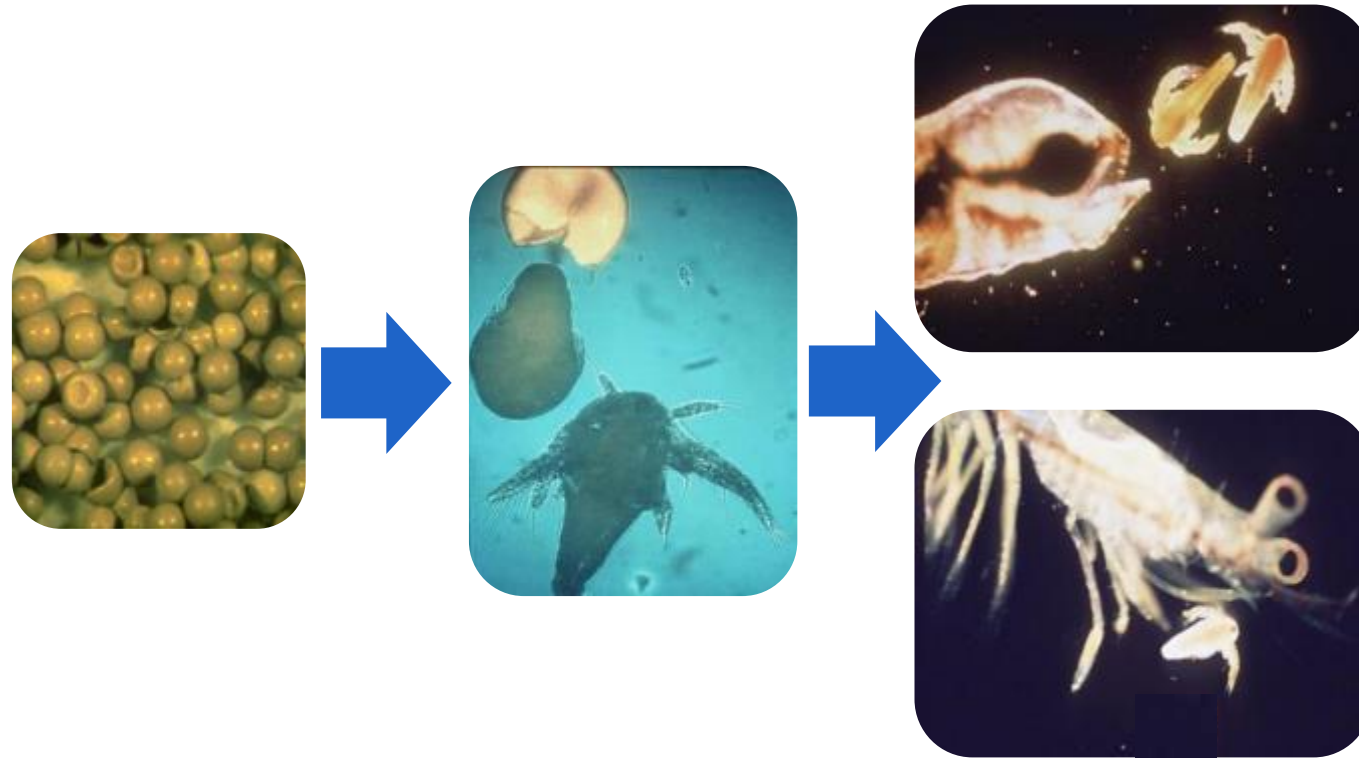


**extremophile – living in high salinity waters (up to 10 times seawater concentration)
where others cannot survive**



unique biological characteristics to adapt to this extreme environment

Artemia = crucial live food in the commercial
production of fish and crustacean species





San Francisco Bay, California

Great Salt Lake, Utah

First commercial sources of *Artemia* cysts in the 1960s
main market = aquarium hobbyists <100 kg per year

1st FAO Technical Aquaculture Conference, Kyoto, Japan - 1976

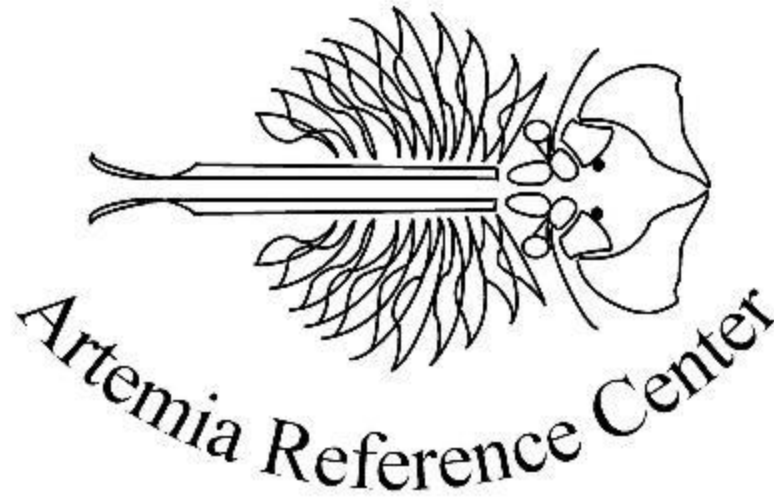
Experience Paper
FIR:AQ/Conf/76/E.77

Sorgeloos, P.

The brine shrimp Artemia:
a bottleneck in mariculture?

POTENTIAL IMPROVEMENTS FOR CRITICAL ARTEMIA SITUATION

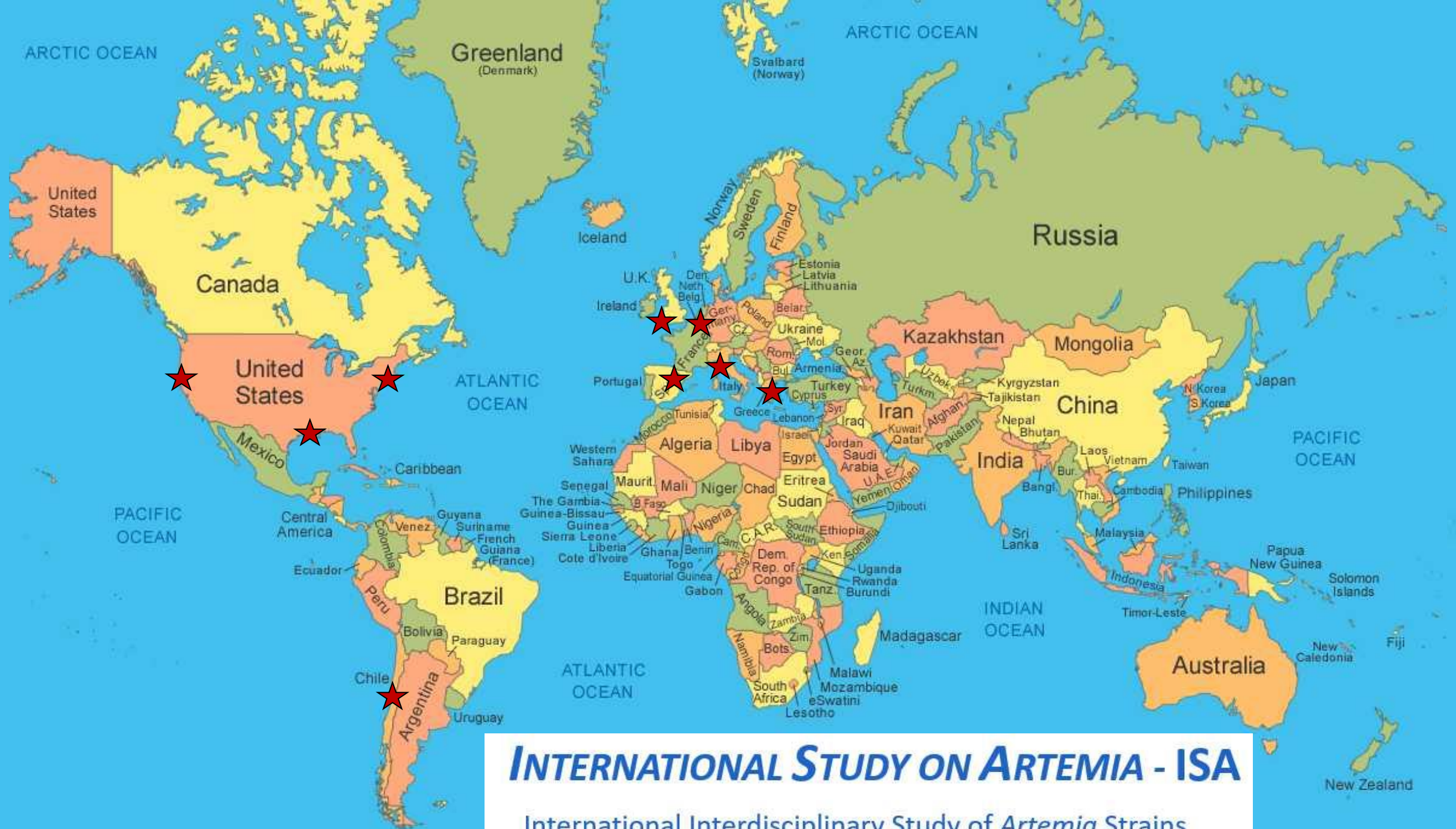
- exploitation of more natural resources
- transplantation and inoculation of suitable habitats
- improved techniques for cyst
 - harvesting
 - processing
 - storage
 - hatching
- use of juvenile/adult Artemia biomass as food source



established in 1978 at Ghent University upon suggestion of the FAO

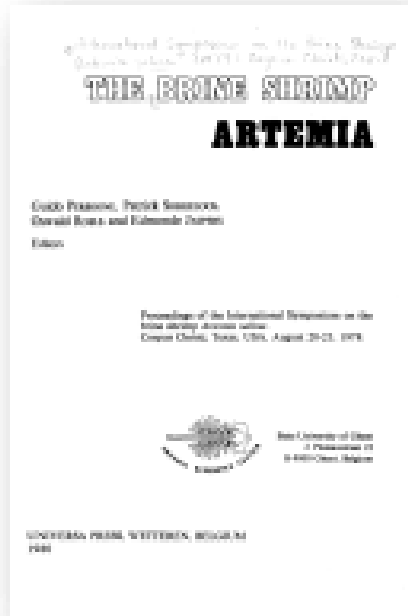
INTERNATIONAL STUDY ON ARTEMIA - ISA

International Interdisciplinary Study of *Artemia* Strains



Symposia, proceedings and books...

1980



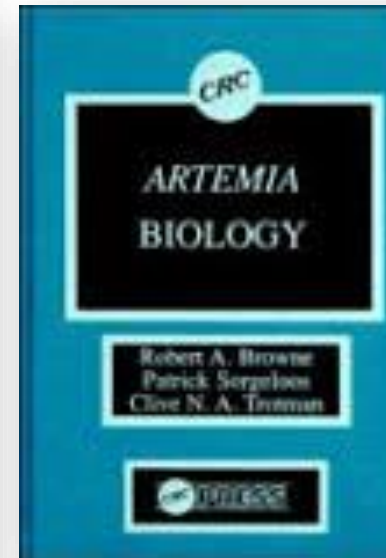
The Brine Shrimp Artemia:
Proceedings of the
International Symposium on
the Brine Shrimp Artemia
Salina, Corpus Christi, Texas,
USA, August 20-23, 1979
(3 volumes)

1987

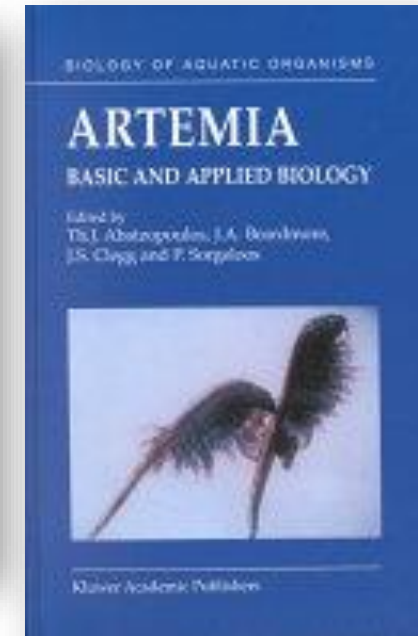


Artemia Research and
its Applications:
Proceedings of the
Second International
Symposium on the
Brine Shrimp Artemia,
Antwerp, Belgium
(3 volumes)

1990

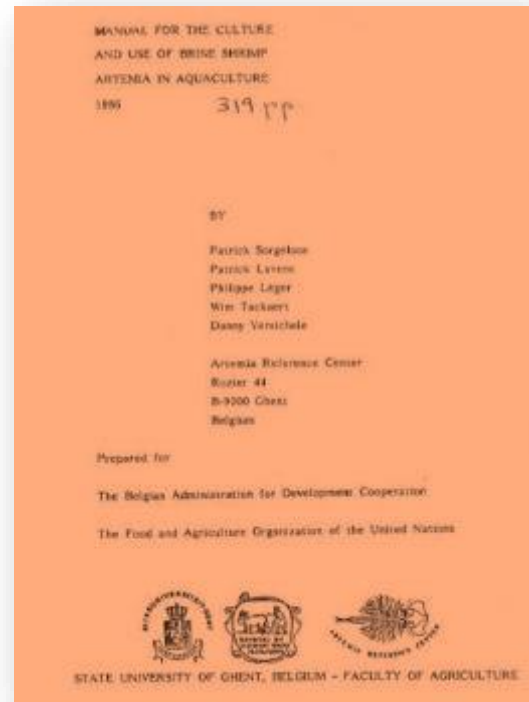


2002

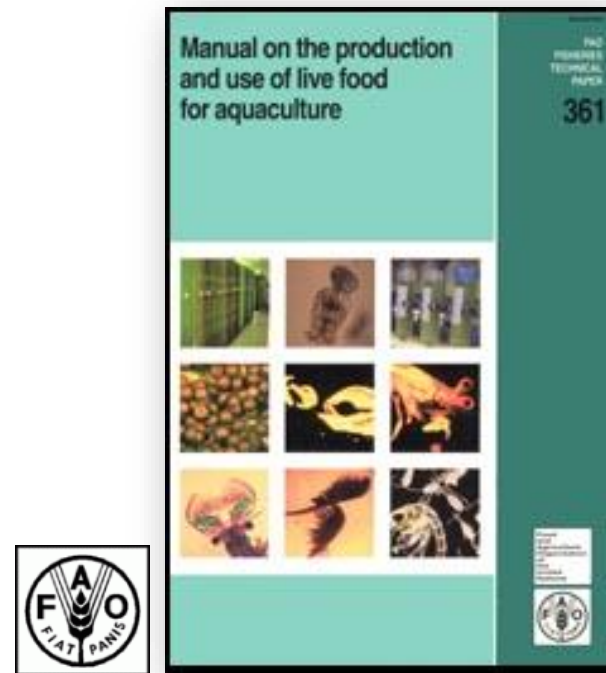


Manuals...

Manual for the Culture and Use of Brine Shrimp Artemia in Aquaculture (1986)



Manual on the Production and Use of Live Food for Aquaculture (1996)



FAO FISHERIES TECHNICAL PAPER 361

Critical role of Artemia in the *predictable & cost-effective* hatchery production of *high-quality* fry, postlarvae, crablets, ...



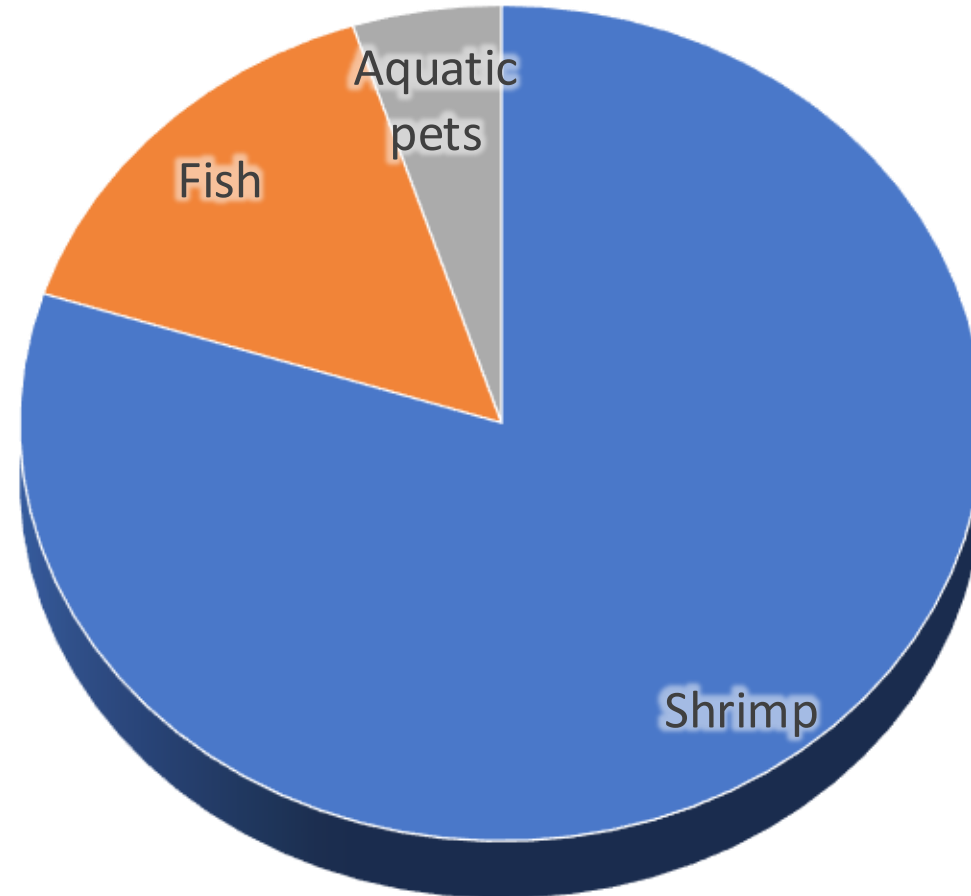
THE key to successfull aquaculture !



Improved commercial availability of *Artemia* cysts as of the early 1980's

Artemia cyst consumption

- 1970 < 1 ton
- 1980 < 100 tons
- 1990 > 1500 tons
- 2000 > 2000 tons
- 2010 > 3000 tons



Annual consumption of approx 3500 tons of Artemia cysts, value of 200m US \$

Commercial Artemia sources (fisheries)

- **Great Salt Lake** (Utah, USA)
- different **salt lakes in Central Asia** (Siberia, Kazakhstan and Uzbekistan)
- coastal saltworks and inland salt lakes in **China**



Critical needs:

- sustainable harvesting – intergovernmental agreements?
- protection of Artemia habitats – climate change impacts?
- preservation of the Artemia species genepool

Seasonal solar salt farms in different tropical/subtropical regions



daily cyst harvest

inoculation of Artemia 1 month into the dry season



CANTHO UNIVERSITY

SOCIO-ECONOMICS OF ARTEMIA FARMERS



income 3-fold to 5-fold compared to salt production

total income in Artemia production
(in 6 months):

- traditional model: **3,500-4,000 US\$/ha**
- intensive model: **7,000-10,000 US\$/ha**



On-farm cost prices (in wet weight):

cysts: app. 30 US\$/kg biomass: app. 0.7 US\$/kg

recently almost 1000 families are involved in Artemia production in Soc trang, Bac lieu, Tra vinh and Ben tre provinces

ARTEMIA POND PRODUCTION OF ARTEMIA BIOMASS





Artemia
biomass



brine water



Artemia
cysts



DRY SEASON
salt



shrimp / prawn



**RAINY
SEASON**

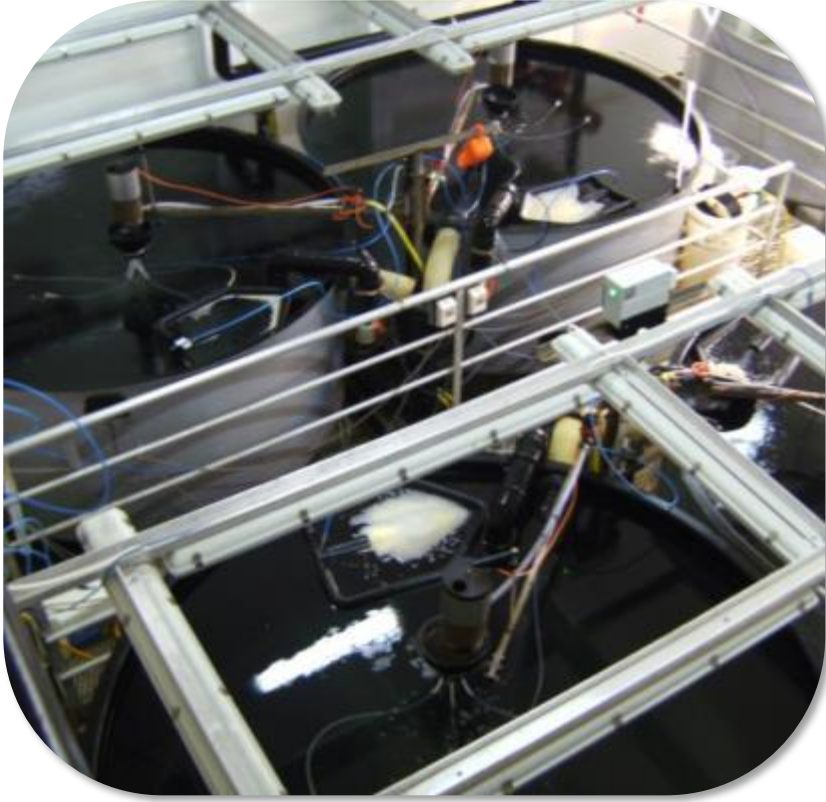


mud skipper



mud crab

Marine fish & crustacean hatcheries: a multi-billion US \$ industry



- final production of over 10 million tons of high-value aquatic species

past, present and future scenarios for SDG-aligned brine shrimp *Artemia* aquaculture

The 0.5 mm *Artemia* nauplii that can be easily hatched from so-called "dried cysts" (i.e. inactive embryos in low protein stage) are used as a suitable substitute for natural live plankton in the feeding of a wide variety of marine and freshwater crustaceans and fishes. In the 1960s, two companies in the United States of America started marketing *Artemia* cysts collected from the salt ponds in San Francisco Bay, California and the Great Salt Lake. Early initial use of these cysts was by aquarium hobbyists to prepare live food for their ornamental pets.

As of the 1970s, different research institutes developed the first hatchery protocols with *Artemia* nauplii as a crucial live food source, initially to Japan with Japanese freshwater and brackish shrimp and soon thereafter in other parts of the world with other fish, shrimp and prawn species. The two companies mentioned above started receiving increasing demands for their products, and market prices quickly increased to more than USD 70 per kg despite inconsistencies in hatching qualities. The possible domestic impact of a cyst shortage on the expansion of aquaculture was repeatedly underlined at international conferences in 1969 and 1972, culminating in the 1976 FAO Technical Conference on Aquaculture in Jordan, where the conference chairman, the late Dr Ramon Pallas, stated that it was not advisable to develop an aquaculture to feed the poor if one had to rely on hard currency to purchase *Artemia* cysts.

However, an alternative idea was postulated that the critical *Artemia* shortage was solvable and that there were several challenges to be addressed, e.g. exploitation of more natural resources; transplantation and inoculation of suitable habitats; improved techniques for cyst harvesting, processing, storage and hatching; as well as the use of pondwater to hatch *Artemia* nauplii. Within the following ten years and with the support of FAO and the Southeast Asian Fisheries Development Center (SEAFDEC), the possibilities to produce *Artemia* in natural salt ponds in the Philippines and to apply new techniques for *Artemia* use in the hatchery were demonstrated. In 1977, a small quantity of *Artemia* franciscana nauplii from San Francisco Bay was introduced in the large salt pond complex at Mucos (Rio Grande do Norte, Brazil), and less than six months later the first tonne of top-quality cysts was harvested. Confidence increased regarding a future for *Artemia* in



Clockwise from top:
Artemia hatchery in the Delta of the Yellow River, China; a hatchery in the Delta of the Yellow River, China; a hatchery in the Delta of the Yellow River, China; a hatchery in the Delta of the Yellow River, China.

hatchery operations and, upon recommendation of FAO, the *Artemia* Reference Center was founded in 1978 at Ghent University in Belgium.

An international interdisciplinary approach was adopted by *Artemia* experts from Europe and the Americas to address various issues in characterizing species and strains, develop techniques for processing cysts, large-scale hatching and use of *Artemia* under different new product forms, such as desiccated cysts, cold-stored nauplii and enriched metanauplii. More than 65 scientific articles were published under the common heading "International Study on *Artemia*", international conferences were organized, and further extension was ensured through the publication of the FAO Manual and the organization of many local training courses. This also resulted in the identification and exploitation of new natural resources in Australia, Brazil, China, Ecuador, Iran (Islamic Republic of), the Russian Federation and Venezuela (Bolivarian Republic of), and the setting up of seasonal *Artemia* production in coastal ornamental salt works in Kenya, Mozambique, Peru, the Philippines, Sri Lanka, Thailand and Viet Nam. As of the 1980s, and especially in the 1990s, the commercial hatchery industry experienced growth in Latin America and Asia, and with marine fish in Asia and Europe. Annual *Artemia* cyst consumption increased from less than 100 tonnes in the 1980s to over 2 000 tonnes by the turn of the century.

New resources, mainly in Central Asia (large salt lakes and lagoons in China, Kazakhstan, Siberia (Russian Federation), Turkmenistan and Uzbekistan) were tapped and several new companies entered into business. Meanwhile,

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FAO Fisheries Division, Rome, Italy

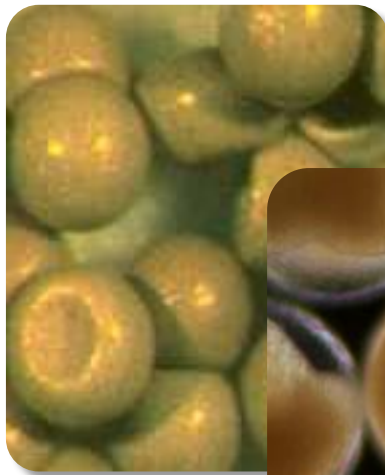
FAO AQUACULTURE NEWS - N° 63 - MAY 2021

Thematic Articles

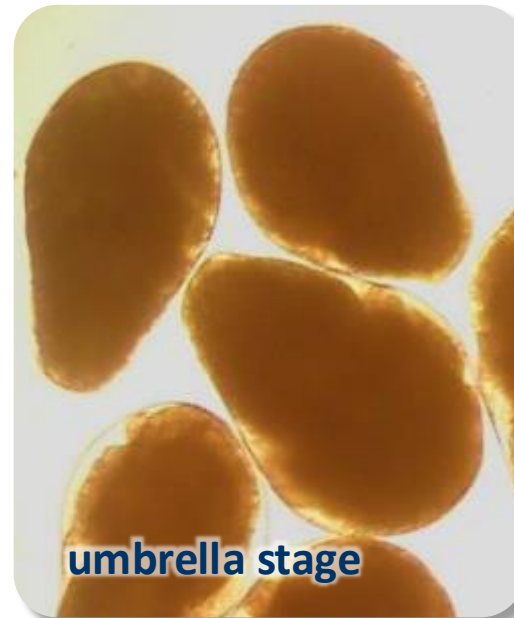
International *Artemia* Aquaculture Consortium

to consolidate and expand sustainable use of *Artemia* in aquaculture





decapsulated cysts

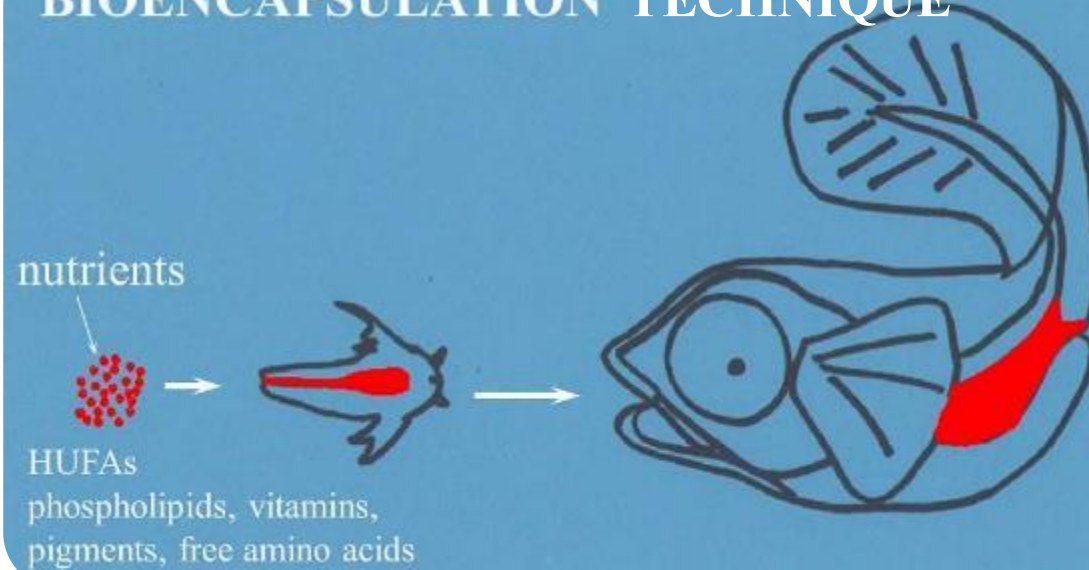


umbrella stage



instar I nauplius

BIOENCAPSULATION TECHNIQUE



enriched metanauplii

2m³ /5m³ tanks



500L tanks

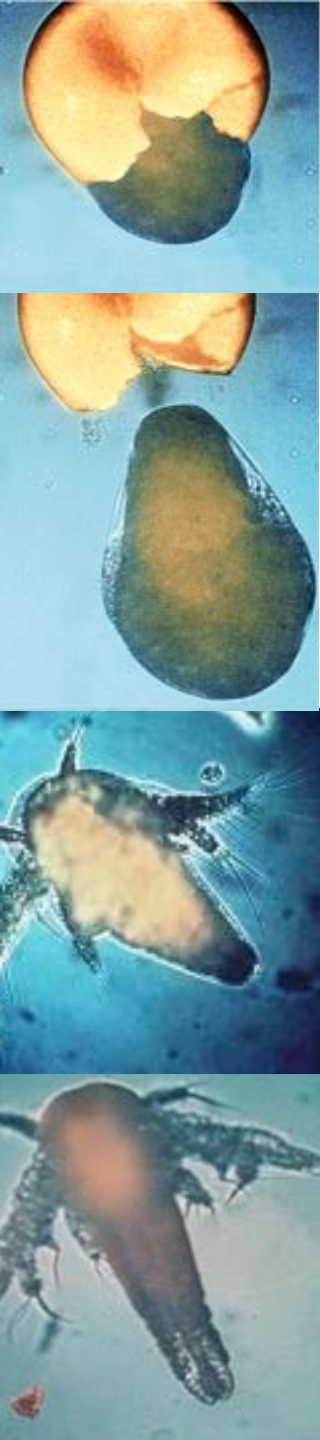


Concrete tanks





Remarks / Recommendations



- Improve and standardize GAPs for Artemia hatching – separation – cleaning - cold storage
→ *Vibrio free instar I*
- Update FAO Artemia Manual – organize training courses
- More use of umbrella Artemia as earlier live food (crab, shrimp, fish)
- Selected strains/species for specific applications
- Better documentation of value of nutrient-enriched Artemia

Brine shrimp *Artemia* as human food

Artemia omelet - partial replacement in shrimp/fish/crab cakes





SDG-aligned *Artemia* Aquaculture Workshop



Food and Agriculture
Organization of the
United Nations



Network of
Aquaculture
Centres in
Asia-Pacific



亚洲区域卤虫参考中心
Asian Regional
Artemia Reference
Center





联合国
粮食及
农业组织

Food and Agriculture
Organization of the
United Nations

Organisation des Nations
Unies pour l'alimentation
et l'agriculture

Продовольственная и
сельскохозяйственная организация
Объединённых Наций

Organización de las
Naciones Unidas para la
Alimentación y la Agricultura

منظمة
الغذية والزراعة
للأمم المتحدة

COMMITTEE ON FISHERIES

SUB-COMMITTEE ON AQUACULTURE

Eleventh Session

24–27 May 2022

**REPORT OF THE SDG-ALIGNED ARTEMIA AQUACULTURE
WORKSHOP**



International Artemia Aquaculture Consortium

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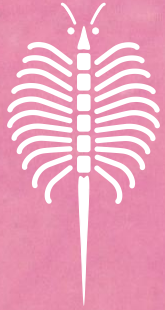
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Eduardo Leano, NACA and IAAC host



International Artemia Aquaculture Consortium

Conservation, management and sustainable utilization of Artemia biodiversity



Role and formation

- *Artemia* remains a critical feed source for larval fish and crustaceans, underpinning around **10 million tonnes** of aquaculture production.
- Around **90 percent** of *Artemia* cysts are harvested from salt lakes. The dependence of much of the aquaculture industry on these natural *Artemia* supplies is a significant risk to global production.
- An international and interdisciplinary approach is needed to assure the sustainable supply of *Artemia* cysts to support hatchery production.
- The **International *Artemia* Aquaculture Consortium** serves this purpose. The consortium is a network of scientists and institutions collaborating in research and development of *Artemia* and its role in aquaculture.



44 consortium partners from 29 countries

- Algeria
- Bangladesh
- Belgium
- Brazil
- Cambodia
- Chile
- China
- Cuba
- Ecuador
- France
- Greece
- France
- Greece
- India
- Iran
- Kenya
- Myanmar
- Malaysia
- Portugal
- Russia
- South Africa
- Spain
- Sri Lanka
- Sweden
- Thailand
- Tunisia
- Turkey
- Ukraine
- USA
- Uzbekistan
- Vietnam

Steering Committee

- **Yeong Yik Sung**, University Malaysia Terengganu (Chair)
- **Sui Liying**, Asia Regional Artemia Reference Center, China
- **Simon Wilkinson**, Network of Aquaculture Centres in Asia-Pacific
- **Nguyen Van Hoa**, Can Tho University, Vietnam
- **Meezanur Rahman**, Artemia4Bangladesh Project, WorldFish
- **Betty Nyonje**, Kenya Marine Fisheries Research Institute
- **Gonzalo Gajardo**, Los Lagos University, Chile
- **Annelies Declercq**, Artemia Reference Center, Ghent University, Belgium
- **Parisa Norouzitallab**, Swedish University of Agricultural Sciences
- **Naser Agh**, Urmia University, Iran

Advisory Committee

Chair

- Patrick Sorgeloos

Representing FAO

- Matthias Halwart

Representing the academic sector

- John Beardmore
- Jim S. Clegg
- Theodore Abatzopoulos

Representing the Private Sector

- Philippe Léger
- David Christopher Garriquez



Recent activities

The consortium is engaged in research, conservation and capacity building world-wide.



SDG-aligned *Artemia* Aquaculture

Workshop at the Global Conference on Aquaculture Millennium +20.



Status of *Artemia* Cyst Use

Webinar on cyst use practices in hatcheries around the world.



Great Salt Lake Management, Utah

Webinar on multi-stakeholder management of the lake & its *Artemia* resources.



Artemia Activities in Africa

Webinar on the history of *Artemia* usage and developments.



Artemia Pond & Tank Production

Webinar on culture practices and experiences around the world.



Meeting with Saxon Bosworth

Webinar to assist research for a National Geographic article on *Artemia*.

R&D opportunities

Some of the issues we anticipate the consortium will explore include:

- Conservation of *Artemia* biodiversity.
- Science-based protocols for sustainable harvesting of wild resources.
- Integration of *Artemia* into artisanal salt farms in Asia and Africa.
- New applications through selective breeding strain selection.



R&D opportunities

- Integration of *Artemia* farming with fish/crustacean aquaculture.
- Use of *Artemia* biomass as a high-value protein source for people.
- Study of climate change impacts on *Artemia* production.
- Further research on *Artemia* biology.





Website resources

<https://artemia.info>

Webinar on management of Artemia resources of the Great Salt Lake, Utah USA

2 August 2022 2333 views | [Resource management](#), [Country status](#)

The International Artemia Aquaculture Consortium (IAAC) hosted a webinar on Management of the Artemia Resources of the Great Salt Lake, 5 May 2022, at 14:00 UTC. The purpose of the webinar was to familiarise participants with recent international developments in Artemia research cooperation, and to examine the Great Salt Lake as a case study in successful management of Artemia resources in a multi-stakeholder environment. Video recordings of the presentations and the report of the webinar are available below.



Programme

- **Welcome and aims of the webinar**
Patrick Sorgeloos, Artemia Reference Center, Belgium
- **History of sustainable harvest management on Great Salt Lake**
Thomas Bosteels, Great Salt Lake Brine Shrimp Cooperative Inc., Utah USA
- **Initial policy efforts to protect Great Salt Lake**
Timothy Hawkes, Utah State Representative
- **Managing salinity and nutrients on Great Salt Lake: A cooperative approach involving multiple stakeholders**
Thomas Bosteels, Great Salt Lake Brine Shrimp Cooperative Inc., Utah USA

In this collection

Welcome and aims of the webinar



Introduction by Simon Wilkinson, Network of Aquaculture Centres in Asia-Pacific, and Patrick Sorgeloos, Artemia Reference Center, Belgium, at the Webinar on Management of Artemia Resources of the Great Salt Lake, Utah USA.

History of sustainable harvest management on Great Salt Lake



Presentation by Thomas Bosteels, Great Salt Lake Brine Shrimp Cooperative Inc., at the Webinar on Management of Artemia Resources of the Great Salt Lake, Utah USA.

Initial policy efforts to protect Great Salt Lake



Presentation by Timothy Hawkes, Utah State Representative, at the Webinar on Management of Artemia Resources of the Great Salt Lake, Utah USA.

Managing salinity and nutrients on Great Salt Lake, a cooperative approach involving multiple stakeholders



Presentation by Thomas Bosteels, Great Salt Lake Brine Shrimp Cooperative Inc., at the Webinar on Management of Artemia Resources of the Great Salt Lake, Utah USA.

More mature law and policy efforts to protect water supply and enhanced stakeholder engagement



Presentation by Timothy Hawkes, Utah State Representative, at the Webinar on Management of Artemia Resources of the Great Salt Lake, Utah USA.

Q&A and panel discussion



Q&A and panel discussion at the Webinar on Management of Artemia Resources of the Great Salt Lake, Utah USA.

Closing remarks by Mike Rust, NOAA



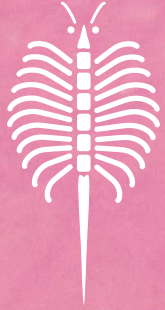
Closing remarks by Mike Rust, National Oceanic and Atmospheric Administration, USA, at the Webinar on Management of Artemia Resources of the Great Salt Lake, Utah USA.

Now:

- Video recordings of webinar presentations.
- Member directory.
- Committee structure.
- Reference list of recent *Artemia* literature.

Future:

- Artemia production reference manuals.
- Good practice guidelines.
- Natural resource management protocols.
- Outcomes of consortium research projects.
- Video-based training & educational materials.



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Please visit <https://artemia.info> for more information





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Recommendations as formulated by the IAAC membership

Yeong Yik Sung, Huang Jie & Patrick Sorgeloos



Network of
Aquaculture
Centres in
Asia-Pacific



8 recommendations

1. Develop science-based protocols to assure **sustainable harvesting of wild Artemia sources** to meet the needs for aquaculture transformation.
2. **Quality certification of Artemia cyst products** following guidelines proposed by FAO and approved by a future COFI-SCA: QR code referring to specific product characteristics in terms of source (sustainably harvested from wild resource), biological characteristics, instructions for use, ...
3. Develop improved guidelines for **bio-secure production and use of Artemia in hatcheries**: promotion of new FAO Artemia manual, convene regional Artemia training courses for local hatcheries, to disseminate good practices and facilitate adoption of standardized protocols. In view of the large variety of species and strains of Artemia that are now available in the market their specific characteristics should be studied to identify their most suitable application for specific species of fish and crustaceans. Investigate new applications with Artemia in aquaculture such as the use of umbrella Artemia as a new source of live food in earlier larval stages, reconsider a wider use of Artemia enrichment techniques in hatcheries.
4. Assess the **contribution and demand of Artemia resources** to the development of aquaculture transformation, and estimate the irreplaceable limit of Artemia in the developing aquaculture industry.
5. Investigate the **impact of climate change on Artemia production** in inland lakes and coastal saltworks and the potential contribution of Artemia to aquatic ecosystem sustainability and climate change mitigation.
6. Consider **sustainable integration of Artemia production** in artisanal salt farming in Asia, Africa and Latin America, in desert/arid and salt-affected areas, and examine its potential contribution to improving the livelihoods of local communities.
7. Promote and further investigate the **production and use of Artemia biomass** as a low-in-the-food-chain, high nutritional food in nursery and brood stock feeding, as fishmeal alternative, and even as a direct source of food in human nutrition .
8. **Conserve Artemia biodiversity** through means such as cyst banks, species identification, “wild” vs “farmed” species, genotyping and strain characterization. Initiate strain selection and selective breeding to develop improved Artemia strains for aquaculture applications, noting the availability of the Artemia genome



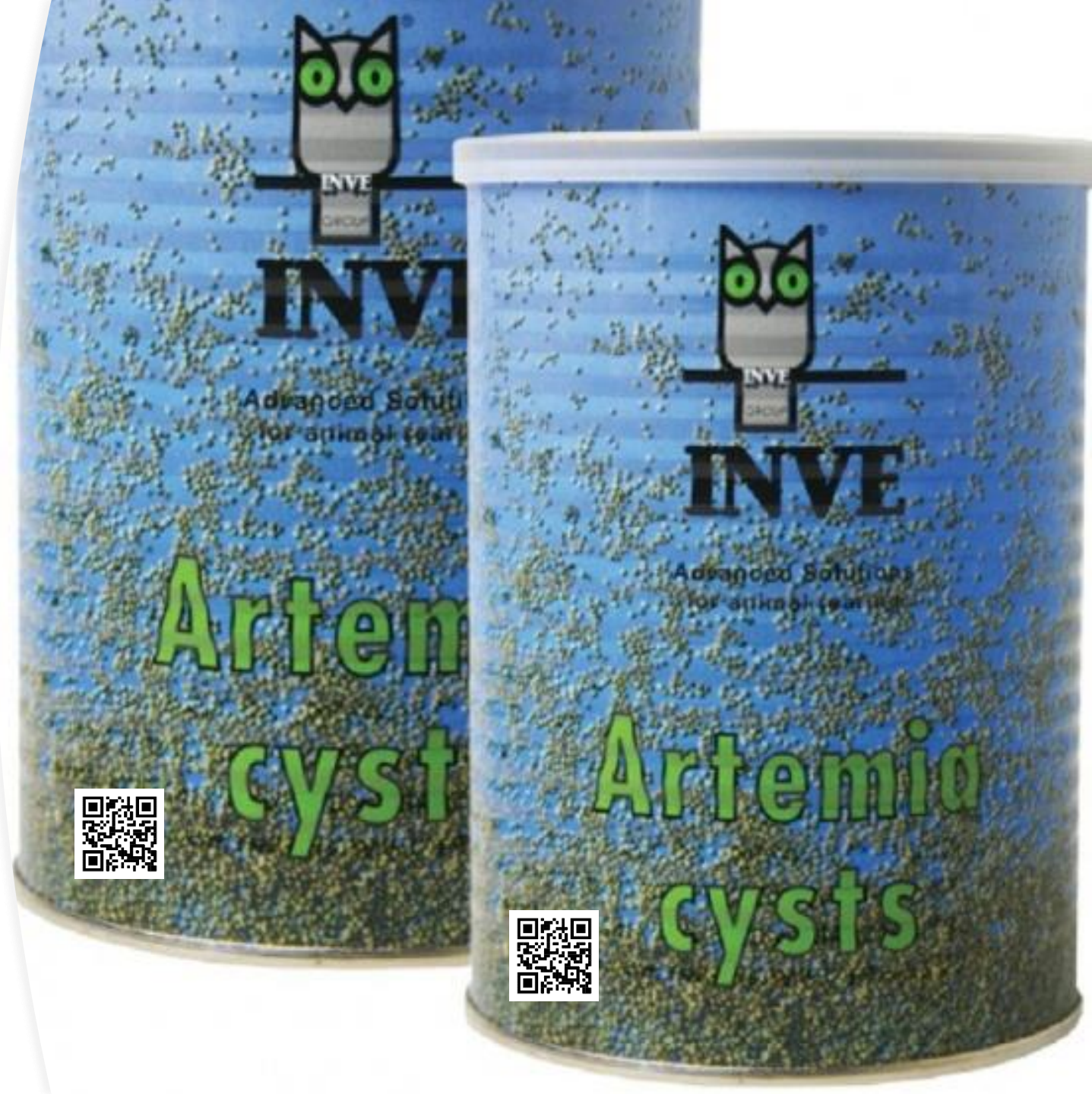
Recommendation No. 1

Develop science-based protocols to assure **sustainable harvesting of wild Artemia sources** to meet the needs for aquaculture transformation.



Recommendation No. 2

Quality certification of Artemia cyst products following guidelines proposed by FAO and approved by a future COFI-SCA: QR code referring to specific product characteristics in terms of source (sustainably harvested from wild resource), biological characteristics, instructions for use...



Recommendation No. 3

Develop improved guidelines for **bio-secure production and use of Artemia in hatcheries**: promotion of new FAO Artemia manual, convene regional Artemia training courses for local hatcheries, to disseminate good practices and facilitate adoption of standardized protocols. In view of the large variety of species and strains of Artemia that are now available in the market their specific characteristics should be studied to identify their most suitable application for specific species of fish and crustaceans. Investigate new applications with Artemia in aquaculture such as the use of umbrella Artemia as a new source of live food in earlier larval stages, reconsider a wider use of Artemia enrichment techniques in hatcheries.





Recommendation No. 4

Assess the **contribution and demand of Artemia resources** to the development of aquaculture transformation and estimate the irreplaceable limit of Artemia in the developing aquaculture industry.



Recommendation No. 5

Investigate the **impact of climate change on Artemia production** in inland lakes and coastal saltworks and the potential contribution of Artemia to aquatic ecosystem sustainability and climate change mitigation.

Recommendation No. 6

Consider **sustainable integration of Artemia production** in artisanal salt farming in Asia, Africa and Latin America, in desert/arid and salt-affected areas, and examine its potential contribution to improving the livelihoods of local communities.



Recommendation No. 7

Promote and further investigate the **production and use of Artemia biomass** as a low-in-the-food-chain, high nutritional food in nursery and brood stock feeding, as fishmeal alternative, and even as a direct source of food in human nutrition .

Brine shrimp *Artemia* as human food

Artemia omelet - partial replacement in shrimp/fish/crab cakes



WorldF

ARTEMIA BIOMASS FOR HUMAN CONSUMPTION



Recommendation No. 8

Conserve Artemia biodiversity through means such as cyst banks, species identification, “wild” vs “farmed” species, genotyping and strain characterization. Initiate strain selection and selective breeding to develop improved Artemia strains for aquaculture applications, noting the availability of the Artemia genome





International Artemia Aquaculture Consortium

Conservation, management and sustainable utilisation of *Artemia* biodiversity



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IN ASIA-PACIFIC

Artemia Side Event

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Hermosillo (Mexico) May 16, 2023

- **Opening remarks:** Octavio Alberto Almada Palafox, Commissioner of Fisheries and Aquaculture and Matthias Halwart, COFI SCA Technical Secretary.
- **History of Artemia use in aquaculture since the Kyoto FAO Conference in 1976 – need and opportunities for new action:** Patrick Sorgeloos, IAAC facilitator and advisor
- **Presentation of the International Artemia Aquaculture Consortium** IAAC: Eduardo Leano, IAAC host
- **Recommendations as formulated by the IAAC membership:** Yeong Yik Sung, IAAC chair
- **Short video to showcase the recommendations by IAAC members:**
 - Pond production of Artemia (Nguyen Van Hoa, Vietnam and Meezanur Rahman, Bangladesh)
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- **Production interests for Africa:** Betty Nyonje, Kenya

History of Artemia Activities in Africa

IAAC webinar organized by



History of Artemia Activities in Africa

IAAC webinar organized by



Time	Topic	Speaker
14:00	Welcome by moderator	Betty Nyonje , KMFRI Assistant Director Blue Economy
14:01	Opening remarks	Erick Okuku , KMFRI Director Mombasa Centre
14:05	Aim of the workshop	Patrick Sorgeloos , Artemia Reference Center, Belgium
14:10	Introduction of Artemia in Kenya	Joseph Rasowo , Technical University of Mombasa Eddy Naessens , INVE Aquaculture, Belgium
14:20	History of Artemia activities in Kenya	Morine Mukami , KMFRI
14:30	History of Artemia activities in Morocco	Noura Hanif , Laboratory Nutrition and Marine Products, Chouaib Doukkali University
14:40	History of Artemia activities in Tunisia	Mohamed Salah Romdhane , National Institute of Agricultural Sciences of Tunisia
14:50	History of Artemia activities in Libya	Gilbert Van Stappen , Artemia Reference Center, Ghent University, Belgium
15:00	History of Artemia activities in Egypt	Nagy El-bermawi , Alexandria University
15:10	History of Artemia activities in Uganda	Martin Serrwandat , Mountains of the Moon University, Uganda
15:20	History of Artemia activities in Tanzania	Imani Kapinga , Tanzania Fisheries Research Institute (TAFIRI)
15:30	History of Artemia activities in Mozambique	Rafael Rafael , Aquaculture Research Center (CEPAQ)
15:40	History of Artemia activities in South Africa	Horst Kaiser , Rhodes University, Grahamstown
15:50	History of Artemia activities in Algeria, Eritrea, Namibia, Madagascar and Botswana	Patrick Sorgeloos , Artemia Reference Center, Ghent University, Belgium
16:00	Q&A, discussion	moderated by Erick Ogello , Maseno University, Kenya
16:25	Closing remarks	Simon Wilkinson , Network of Aquaculture Centres for Asia and Pacific (NACA)



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- **Discussion with member states participants**



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- Discussion with member states participants
- **Concluding remarks**



thank you for your attention