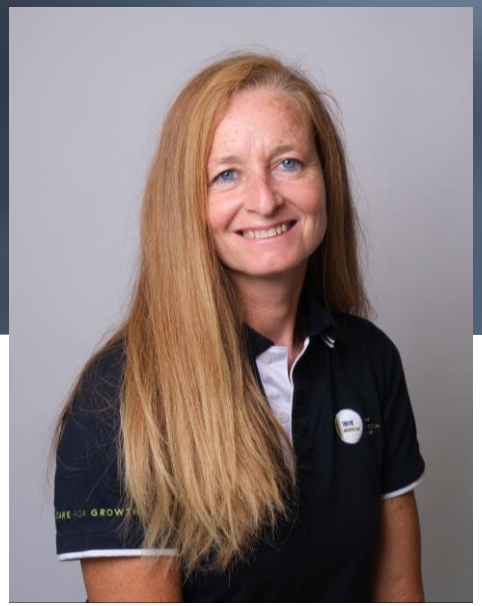
INNOVATION IN MARINE FISH LARVICULTURE

ACCOMPLISHMENTS AND THEIR IMPACT IN THE PRODUCTION CHAIN



Tania De Wolf
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Larvi 2022

CARE FOR GROWTH

SHAPING AQUACULTURE TOGETHER

CONTENT

- **Global aquaculture production**
  - Numbers
  - Trends
- **Innovation in Live Feed**
  - Algae
  - Rotifers
  - Artemia and SEP-Art Tools
- **Broodstock**
  - Programming egg supply
  - Broodstock diets
- **Co-feeding & early weaning diets**
  - Diet optimizations
  - Changes in feeding protocols
- **Sustainability and The Future**
  - Sustainability
  - Certification
  - Outlook

CARE FOR GROWTH

SHAPING AQUACULTURE TOGETHER

Global Aquaculture production and trends

GLOBAL AQUACULTURE PRODUCTION

Global aquaculture production
IN BRIEF
(2018)

114.5 million tons

50% of human fish consumption is from aquaculture

622 species, 387 finfishes

20.53 million people (>50% ♀)

263 billion USD

Bartley, D.M. 2022. World Aquaculture 2020 – A brief overview. FAO Fisheries and Aquaculture Circular No. 1233. Rome, FAO. https://doi.org/10.4060/cb7669en

GLOBAL AQUACULTURE PRODUCTION TRENDS

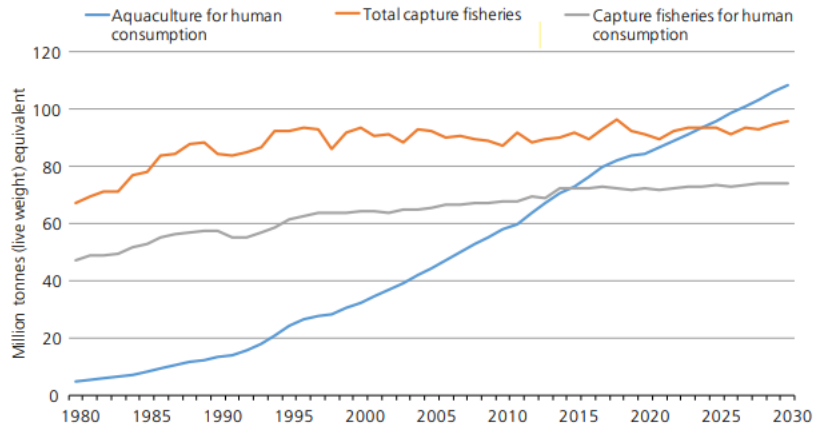
Annual growth rate between 2000-2018:

- Freshwater: 5.7%
- Brackish water: 7.7%
- Marine water: 5.2%

Predictions until 2030:

- Steady increase in aquaculture production
- No increase in global capture fisheries

Global capture fisheries and aquaculture historic and projected production (excl. Aquatic plants)



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Innovation in Live Feed

- Algae
- Rotifers
- Artemia

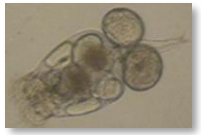
IMPORTANCE OF LIVE FOOD

Live food remains a fundamental aspect to ensure **optimal survival** and **quality** marine fish juveniles

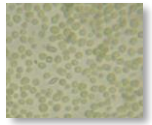
Dry Feeds

Artemia

Rotifers



Algae



Eggs Hatched larvae	Onset exogenous feeding	Larval stages	Metamorphosed fry

LIVE FOOD ACHIEVEMENTS - ALGAE

Shift in algal production techniques
…shift in mentality

Outdoor extensive systems

↓

Indoor

↓

PBR

↓

Fresh and frozen algal pastes

↓

Dried algae or algal substitutes

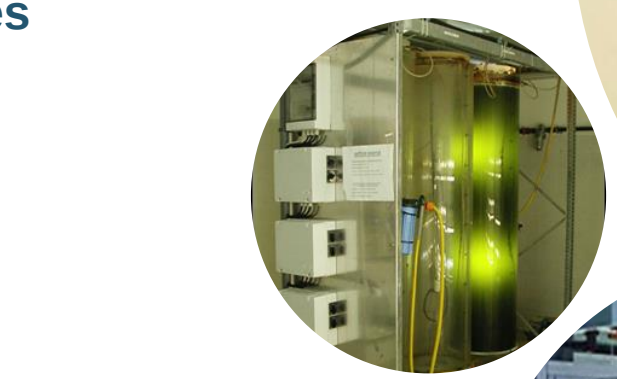
↓

INCREASED BIOSECURITY

Increased consistency in fry performance

Easier use

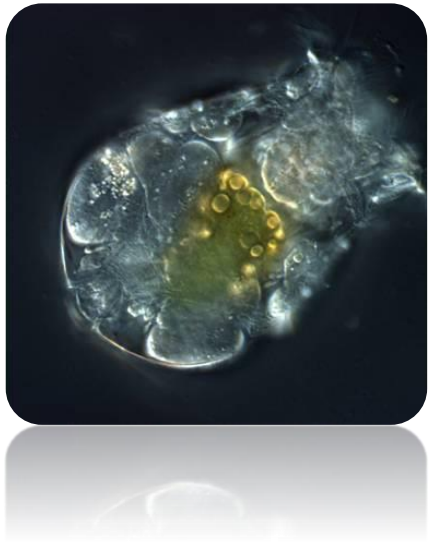
To achieve high survival rates and high-quality fry, high-quality algae remain fundamental



LIVE FOOD ACHIEVEMENTS – ROTIFER CULTURE

Rotifer **culture consistency** has evolved thanks to:

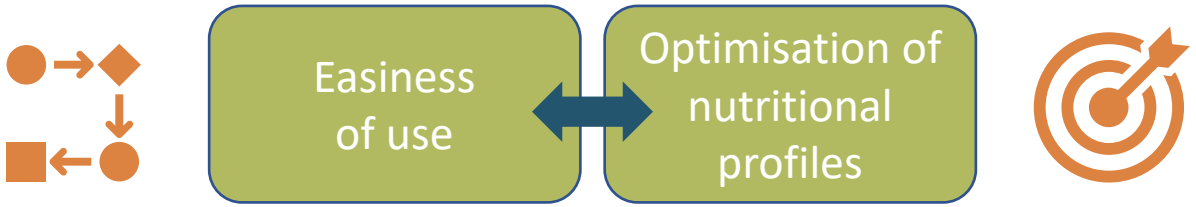
- More controlled and intensified culture systems
- Recirculation/semi-continuous/continuous systems for HD rotifer culture => shorter feed particle retention time => lower bacterial load



Success is highly dependent on:

- Knowledge and personal **skills**
- Adaptation in the use of culture and enrichment products ifo **local conditions**

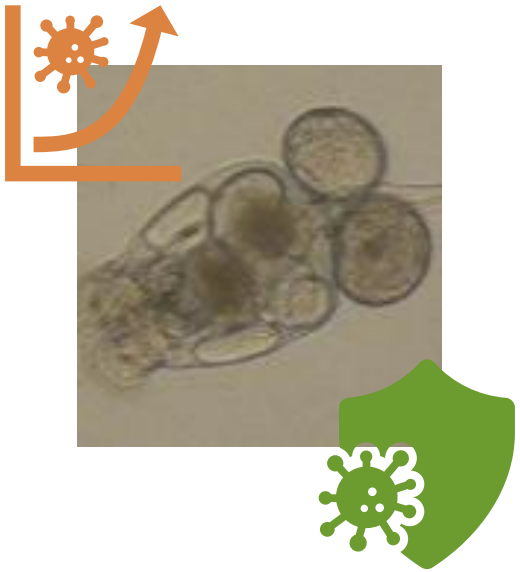
Evolution in rotifer culture and enrichment products

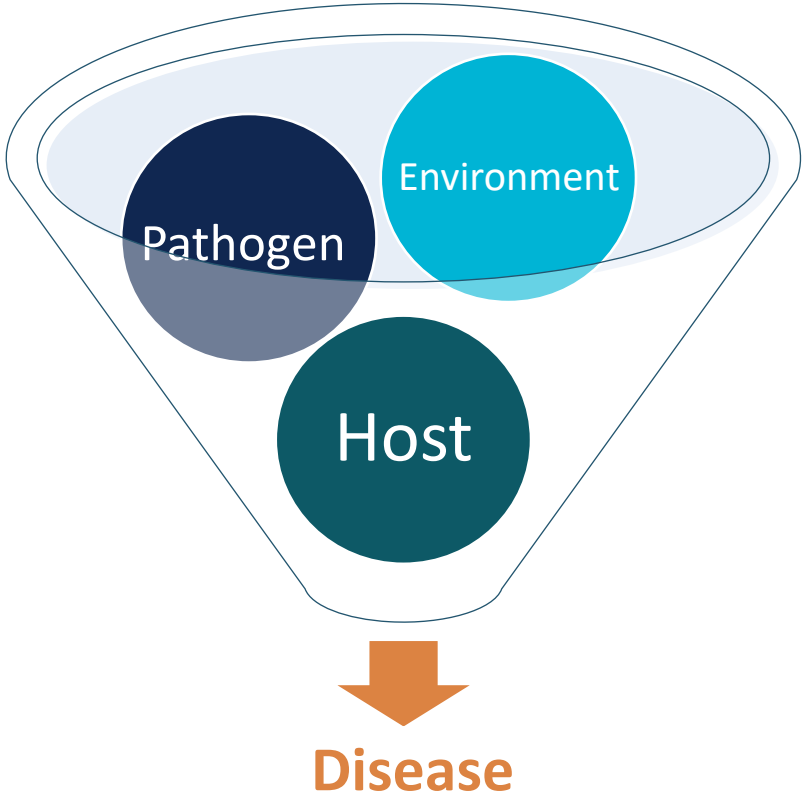


LIVE FOOD ACHIEVEMENTS – ROTIFERS

Attention towards **microbial management**:

- **Disinfection** to reduce the transfer of potential pathogens and lower the *Vibrio* loads
- Use of **probiotics** to steer and control the microflora



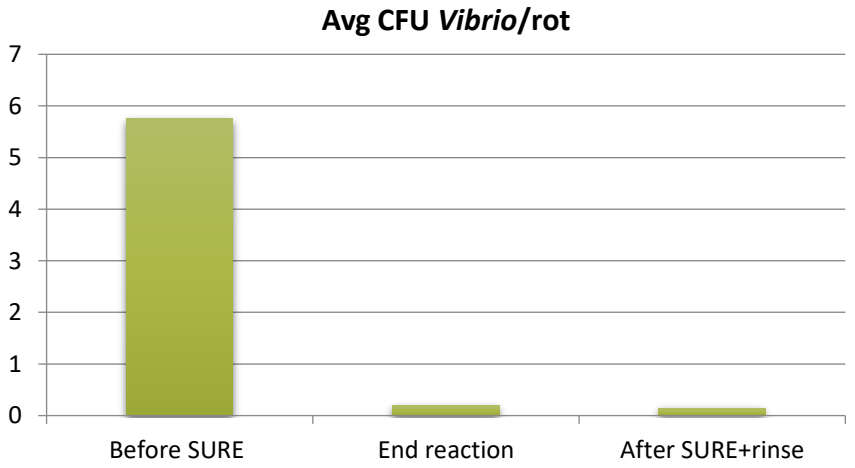


ROTIFER DISINFECTION

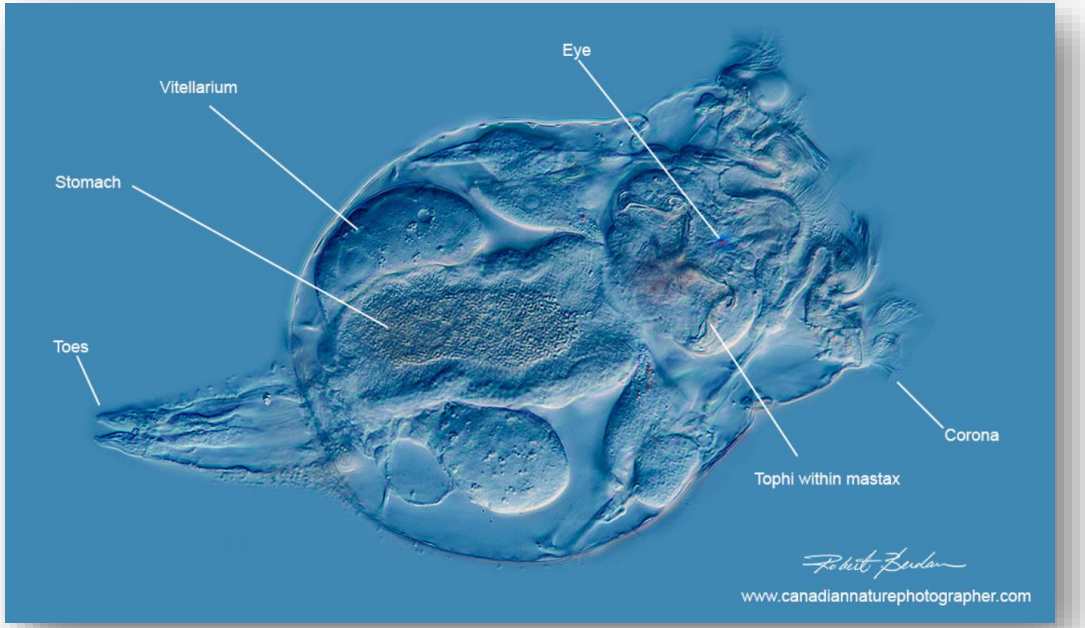
Example: ***Disinfectant application for Vibrio reduction in rotifers***

Application of a water conditioner containing herbal ingredients

- can be used at the end of a standard rotifer culture or enrichment
- directly in the rotifer tank or in the concentrator/rinser



USE OF PROBIOTICS

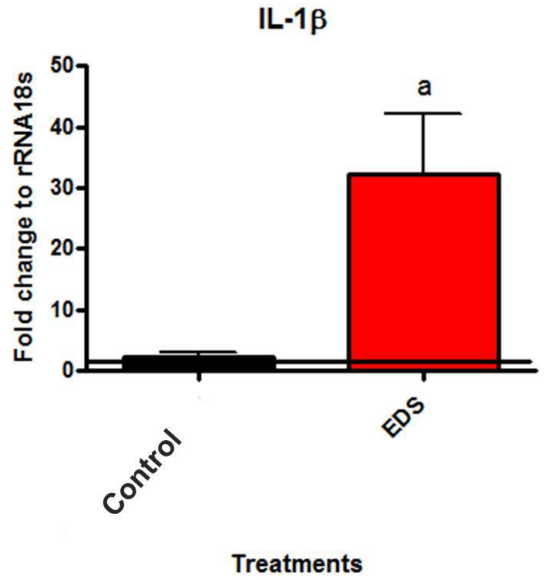


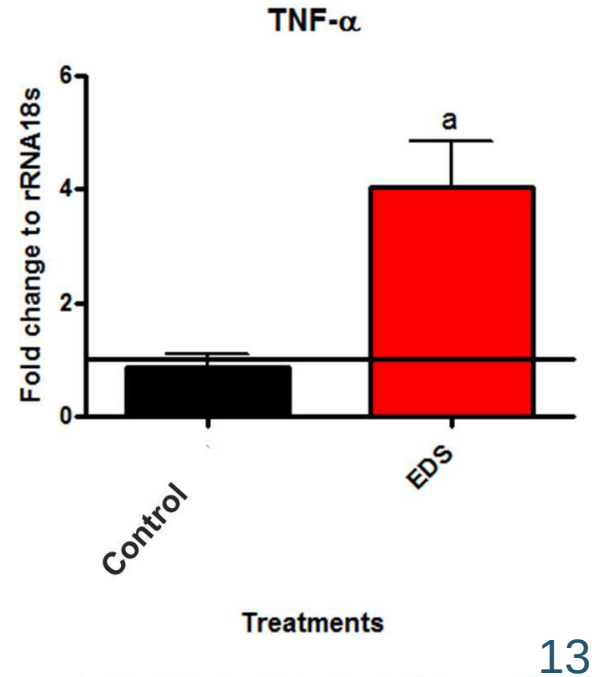
After reducing the *Vibrio* load in the live food, and especially in rotifers, it is advised to use **probiotics** to avoid the development of fast-growing opportunistic bacteria.

Rotifers can be used as a **vector** for the probiotics, as opposed to the direct use of probiotics in the larval rearing water.

ENRICHMENTS WITH NUTRACEUTICALS

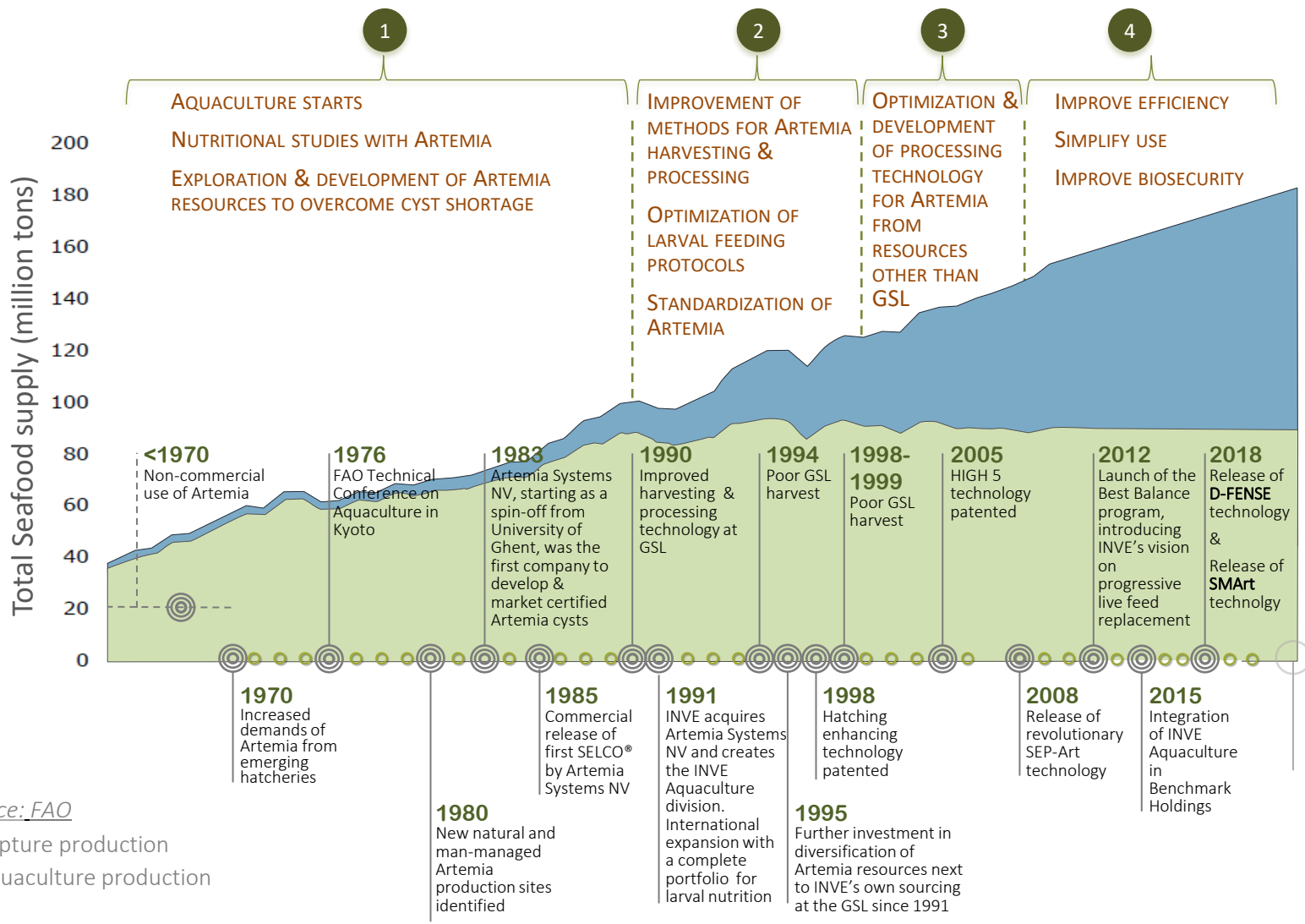
The enrichment product “Easy DRY SELCO” has proven to **stimulate the immune system** of Seabream larvae in very early stages.
(De Wolf et al, EAS 2016)





LIVE FOOD ACHIEVEMENTS - ARTEMIA

35 YEARS OF INNOVATIONS



LIVE FOOD ACHIEVEMENTS – HARVESTING TOOLS

How to separate empty cyst shells from the hatched nauplii?

Double sieve separation

Chemical decapsulation

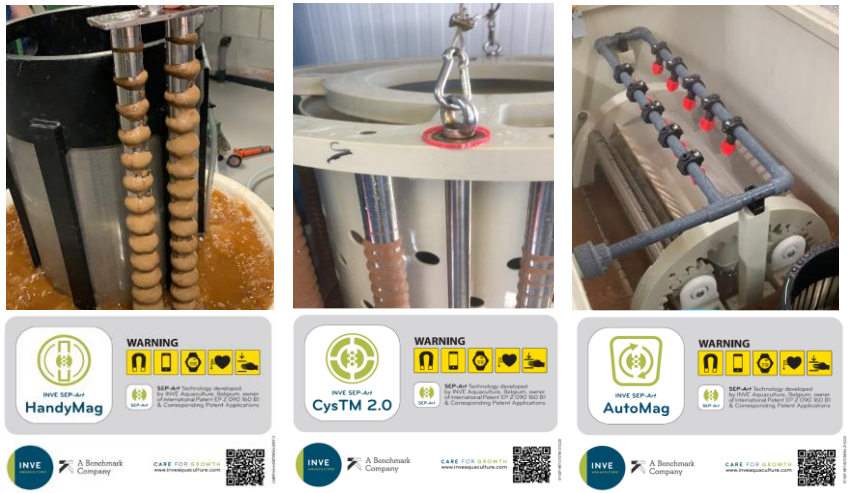
SEP-*Art* technology

Instar I

Instar II

LIVE FOOD ACHIEVEMENTS – HARVESTING TOOLS

A **new generation** of separation tools facilitates the harvesting of Artemia nauplii from SEP-*Art* cysts – 3 types:



- The **SEP-*Art* HandyMag** is a manual tool
- The **SEP-*Art* CysTM, SEP-*Art* CysTM 2.0 & Drum** are semi-automated
- The **SEP-*Art* AutoMag** is a fully automated tool.

LIVE FOOD ACHIEVEMENTS – HARVESTING TOOLS

- SEP-*Art* technology **simplifies and standardizes** the use of Artemia, separating the cyst & cyst shells from the nauplii easily and efficiently

- The SEP-*Art* technology is an **environmentally friendly** technology, offering an alternative for the decapsulation process

LIVE FOOD ACHIEVEMENTS - ARTEMIA

Changes in the philosophy of Artemia enrichment:

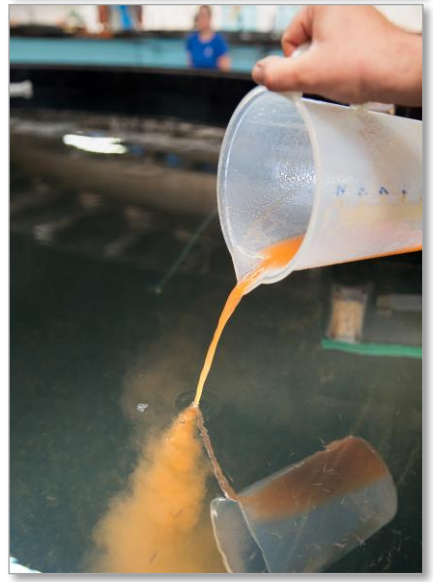
Evolution from a “simple” HUFA enriched live prey into a biosecure, nutritionally complete, biochemically optimized live prey that still holds a secret for the success of larval rearing

EASY DHA

S.PRESSO

A1 DHA

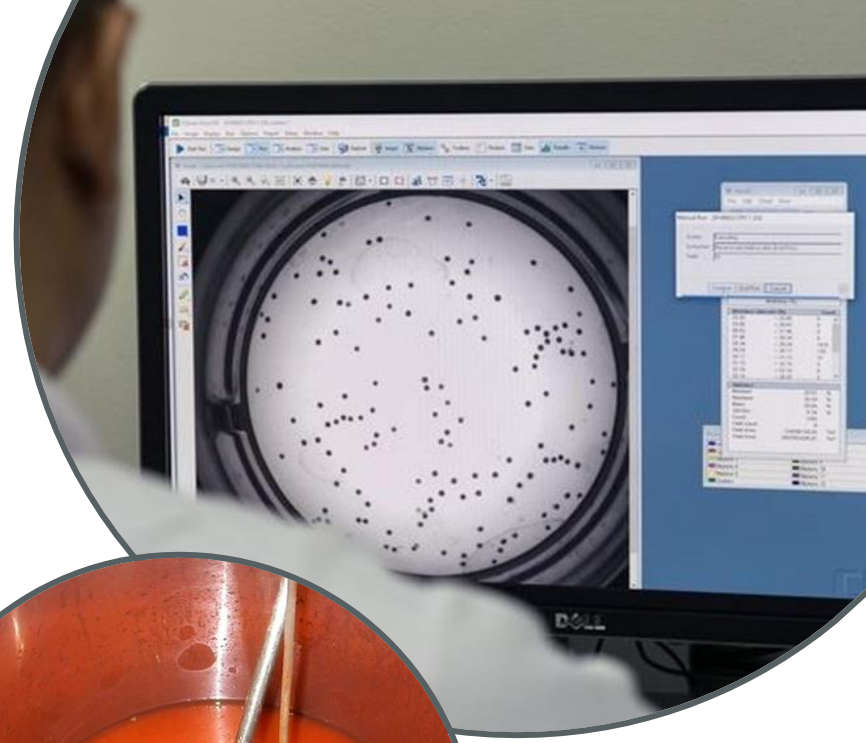
Easy DRY SELCO®

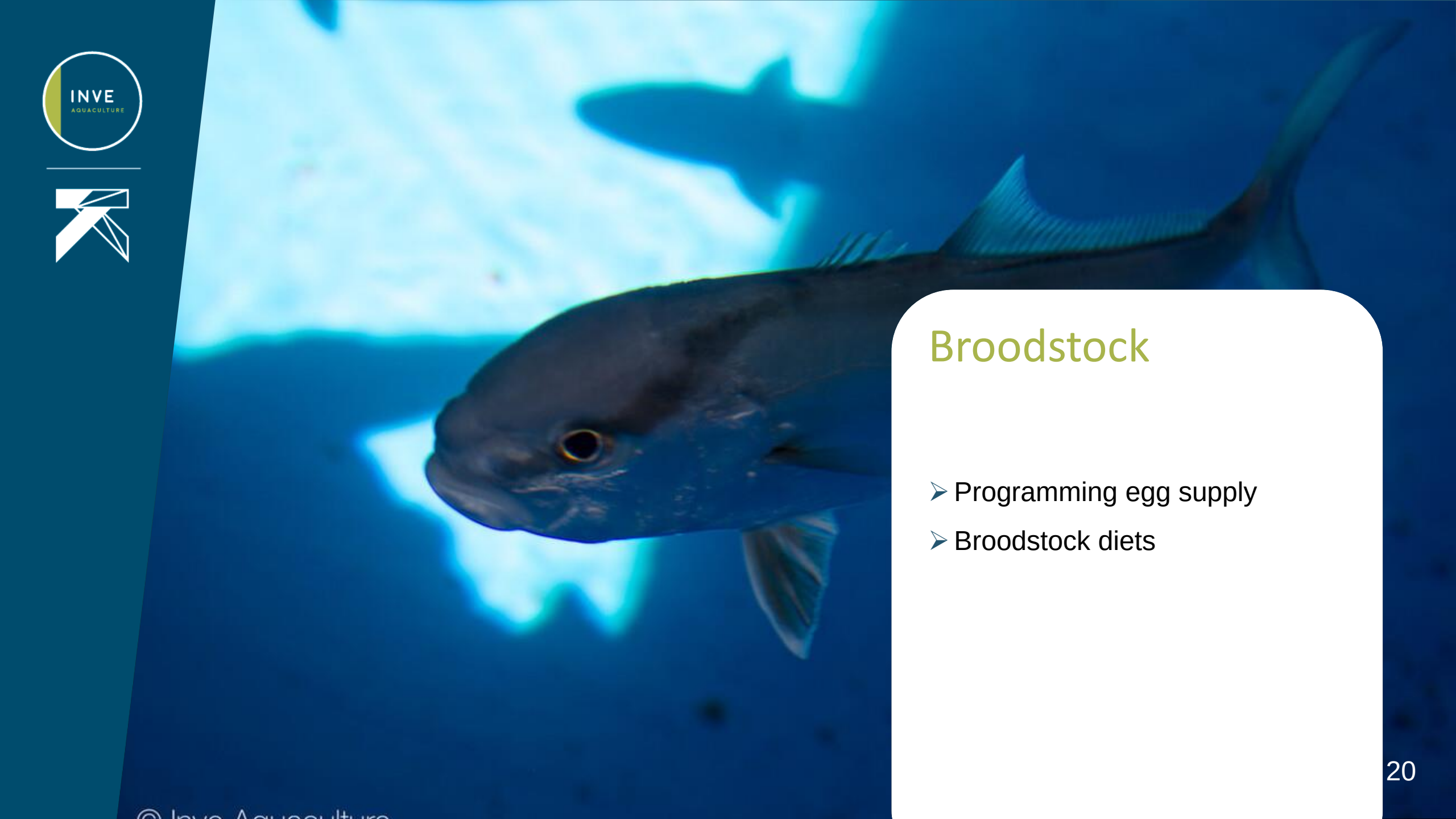


LIVE FOOD ACHIEVEMENTS – ARTEMIA

Further trends

- Automation of feeding / dosing devices
- Automatic counting devices
- Simplified and more controlled enrichment systems
- Longer conservation techniques for the ready-to-feed Artemia





Broodstock

- Programming egg supply
- Broodstock diets

BROODSTOCK ACHIEVEMENTS

- **Controlled thermo-photoperiod**
  - Consistent egg supply
- **Biosecurity**
  - Pathogen screening
  - Preventive programs for bacterial infections and parasites
- **Nutrition**
  - Most species are fed successfully on 100% dry broodstock diets
  - Diets optimized for spawning season – recovery phase/rest phase

BROODSTOCK ACHIEVEMENTS

Genetics

- The backbone of fry performance and there is no doubt that we need to continue to work on broodstock genetics in the future
- Improvements towards growth, disease resistance, deformities

Trait	Average genetic gain per generation	No. of estimates
Body weight	**12.7 %**	61
Filet and meat yield	0.7 % units	3
Survival	6.4 % units	3
Disease resistance	**12.5 % units**	7

Gjedrem, T. and Robinson, N. (2014) Advances by Selective Breeding for Aquatic Species: A Review. Agricultural Sciences, 5, 1152-1158.

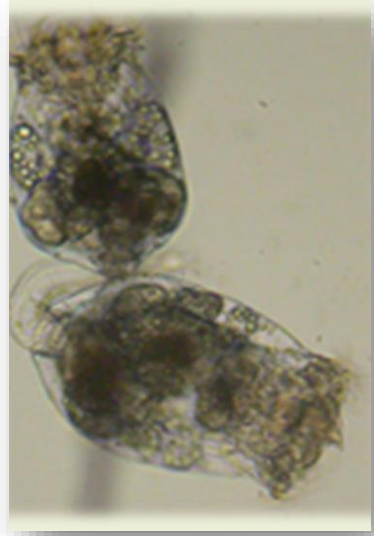
Co-feeding & early weaning diets

- Diet optimizations
- Changes in feeding protocols

CO-FEEDING AND WEANING DIETS

- In the past, larval rearing performance mainly depended on the availability of **high-quality** live food
- Live food remains an indispensable factor for the success of larval rearing
- **Trends** in the use of dry diets:
  - Optimized formulas and physical behavior
  - Early introduction in the feeding protocol
- Last generation dry diets are giving the opportunity to further **standardize** the larval rearing production, reducing the risk of human errors
- **Simplifying** the larval rearing process and more importantly increasing the **predictability** of quality fry production unleashing the production potential of marine fish hatcheries

CO-FEEDING AND WEANING DIETS



Examples of adaptations of feeding protocols using last generation larval diets:

Natura pRo

Gilthead seabream: Reduction of the rotifer consumptions by 50-80% without decreasing the larval performance

Sea bass larval rearing:

- Algae and Rotifer are not used
- Specialty Artemia is started by day 9 post-hatch

Now improved by using Greenwater and use of dry diets from 5dph resulting in **better survival rates and more resistant larvae**

ADAPTATIONS OF FEEDING PROTOCOLS FOR OTHER SPECIES

Introduction of early larval diets to complement live food are studied for different species among which:

- Asian Sea Bass
- Hybrid Grouper

Challenges:

- Adaptation to local conditions
- No pure oxygen supply
- Basic water and air filtration systems
- Basic biosecurity levels
- Need for mindset change for technology transfer

Sustainability and the future

- Sustainability
- Certification
- Outlook

SUSTAINABILITY AND THE FUTURE

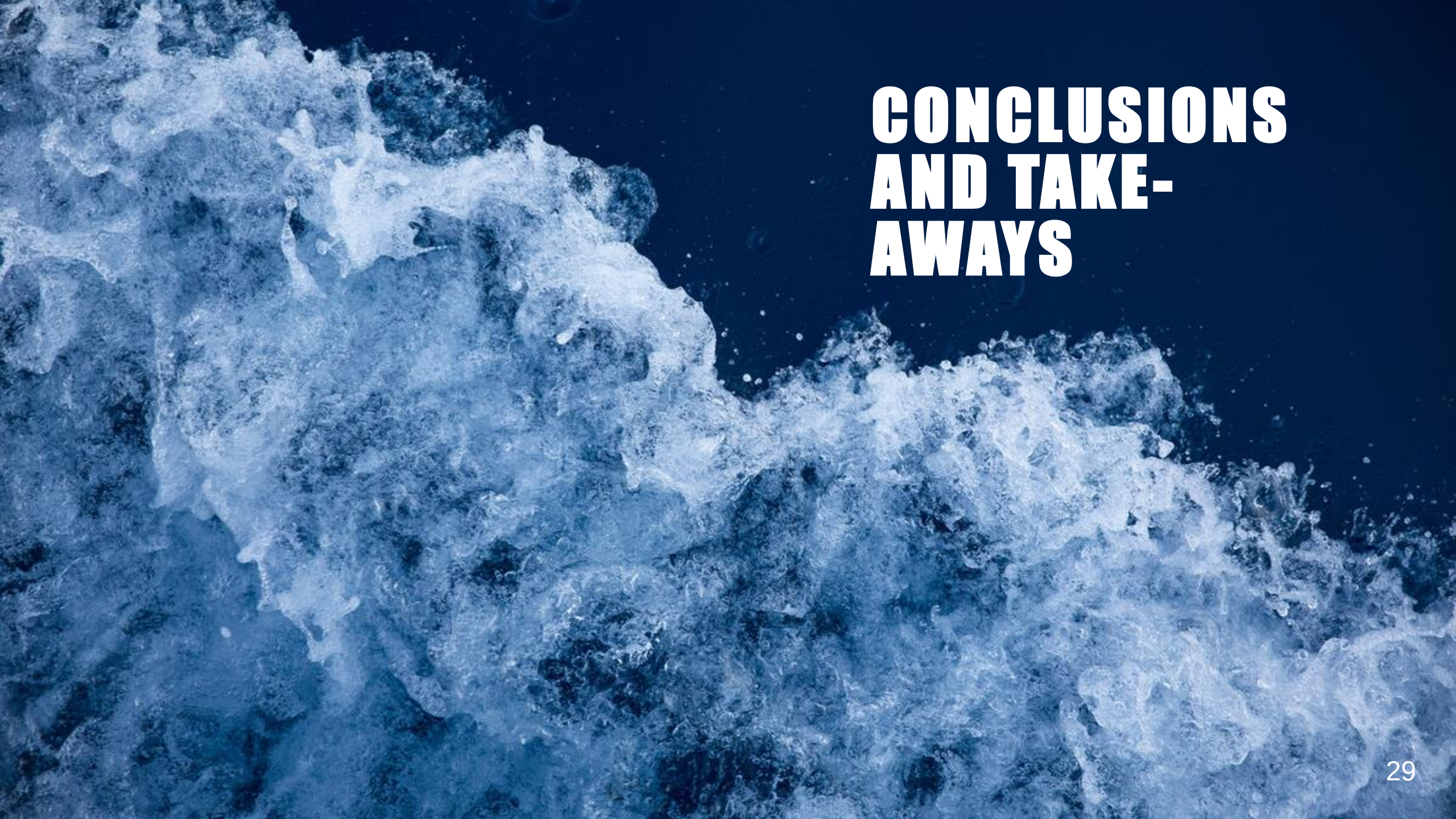
More attention toward **sustainability**, **ethics** and **environmental** awareness

- Quality labels - Certified Artemia
- Welfare
- Sustainable raw materials and packaging
- Optimized use of the feed ingredients, improved FCRs and in general, work under more intensive and controlled environments
- Circular economy and re-use of byproducts
- Blue economy: reduced carbon footprint, LCA,… Increase sustainability through technological innovation

Automation for monitoring of water and performance parameters, improved data collection, **artificial intelligence**, **predictive** feeding programs

→ **Precision Aquaculture**

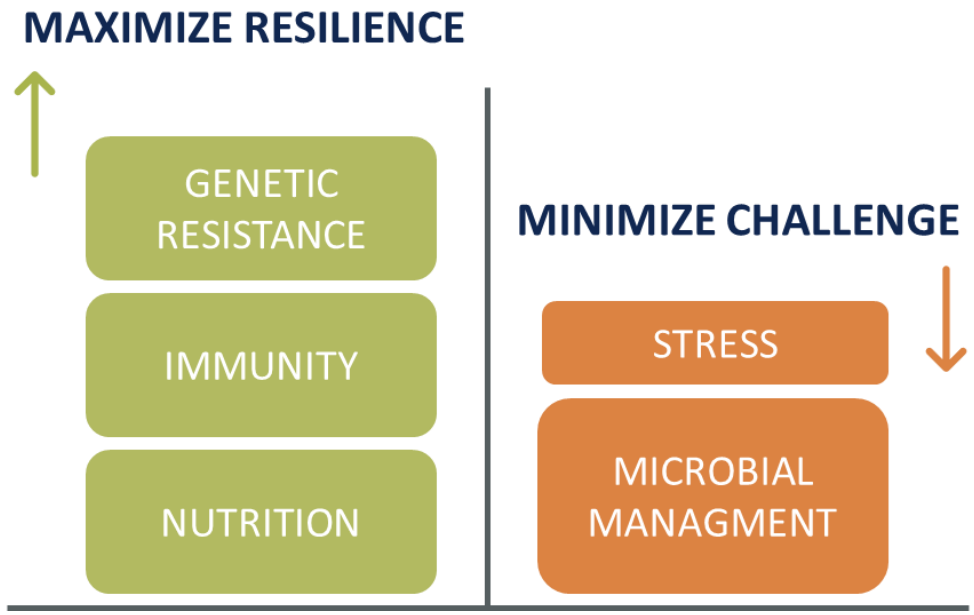
Legislation – common efforts needed: Regulations and legislation should follow and support the development of new aquaculture methods and technologies to make aquaculture more efficient and resilient.



CONCLUSIONS AND TAKE-AWAYS

CONCLUSIONS AND TAKE-AWAYS

- The Aquaculture sector has shown **a positive growth trend** with optimizations in the production of live food, formulations of dry feeds, microbial control and optimizations of the rearing protocols
- Disease prevention in all rearing stages is fundamental and can be influenced through **genetics**, **biosecurity**, **microbial control** and activation of the **immune system**
- **Sustainable** sources and resources need to be used under an ethical correct contest
- **Technological improvements** are being done but more must follow to drive the sector to an industrial level



A sustainable and efficient production benefits the entire value chain

THANK YOU

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