Co-funded by the
Erasmus+ Programme
of the European Union

Development of Regional Joint Master Program in Maritime Environmental Protection and Management
- MEP&M -

Blue Bioeconomy: Aquaculture and blue biotechnology

WP3. Capacity Building through staff training and equipment purchase
DEV 3.4.4 KNOW-HOW TRANSFER TO TEACHING STAFF RELATED TO THE MEP&M

Manuel Alejandro Merlo Torres, Department of Biomedicine, Biotechnology and Public Health (University of Cádiz)

July 11th 2022

This project has been funded with support from the European Commission. This presentation reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Project no. 619239-EPP-1-2020-1-ME-EPPKA2-CBHE-JP

Co-funded by the
Erasmus+ Programme
of the European Union

GENERAL INDEX

1) Aquaculture
   a) Why aquaculture?
   b) History, systems and current status
   c) Negative aquaculture impacts
   d) Sustainable aquaculture
   e) Aquaculture in 2030 Agenda and the Sustainable Development Goals (SDGs)
   f) Suggested teaching methods

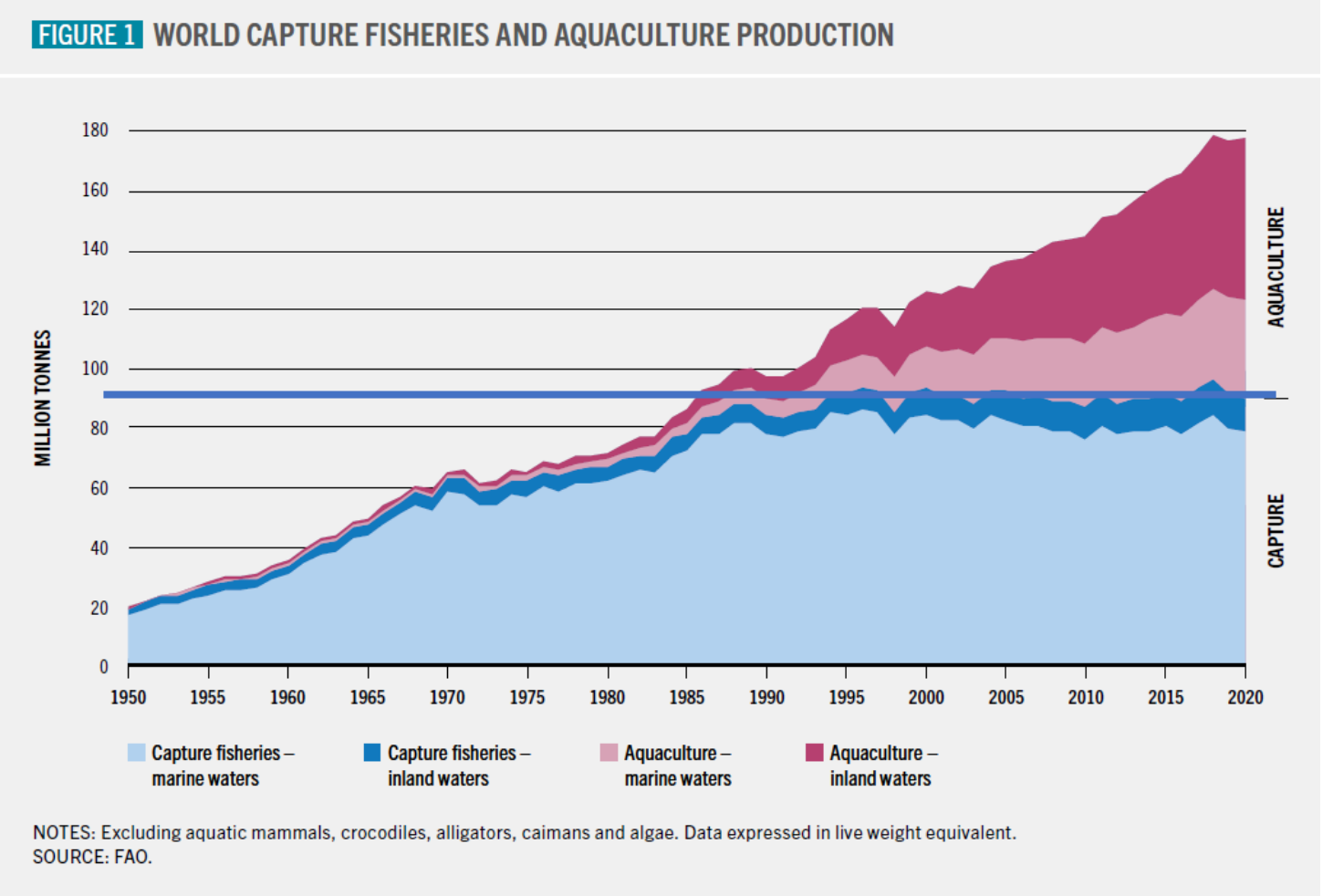
2) Blue biotechnology
   a) Biotechnology colors
   b) Why blue biotechnology?
   c) Some examples
   d) Blue biotechnology and sustainable aquaculture
   e) Blue biotechnology in 2030 Agenda and the Sustainable Development Goals (SDGs)
   f) Suggested teaching methods

Co-funded by the
Erasmus+ Programme
of the European Union

AQUACULTURE

Why aquaculture?

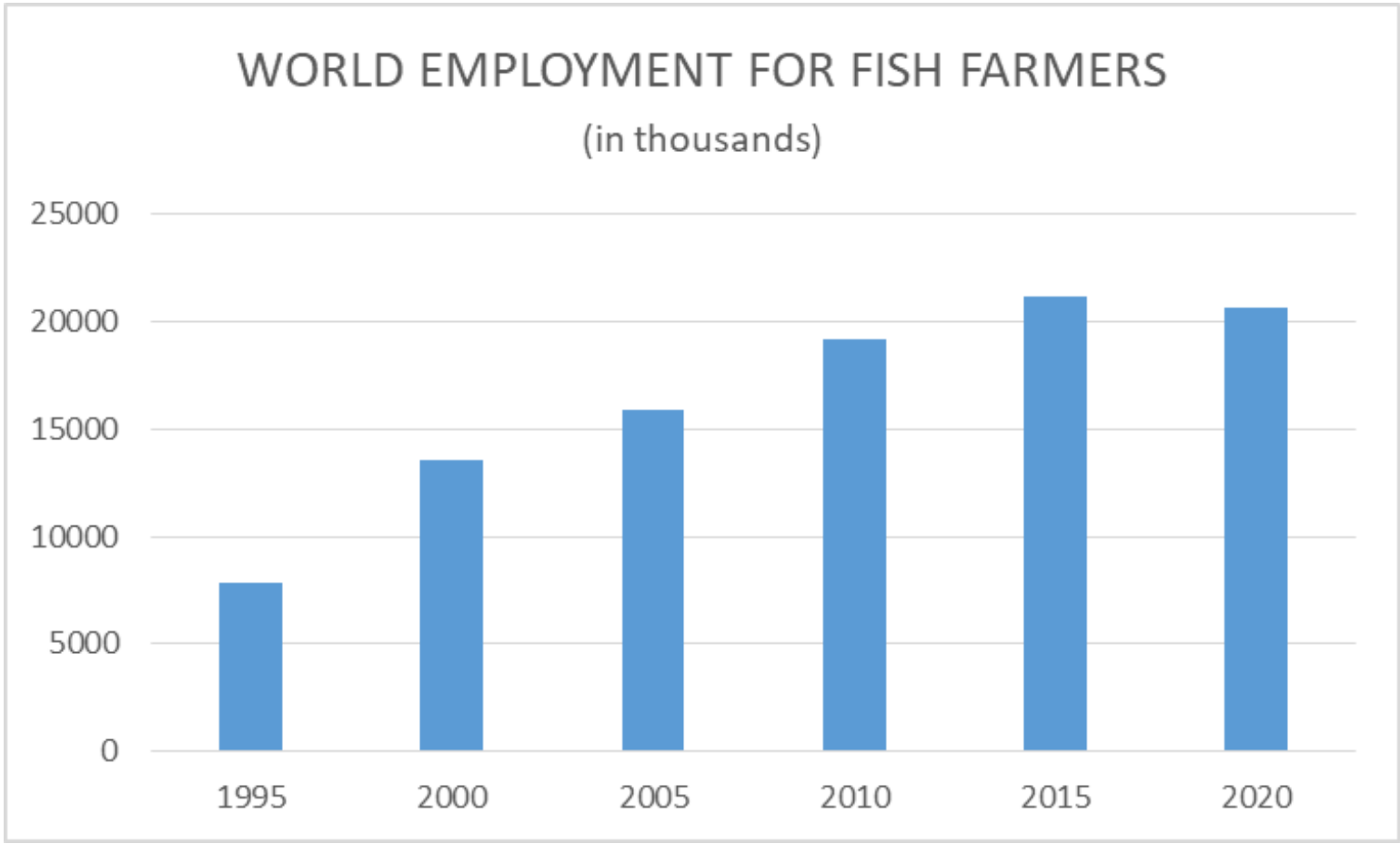
- Increasing sector in terms of:
  - ✓ Production
  - ✓ Employment
  - ✓ Diversification
  - ✓ Economic impact



AQUACULTURE

Why aquaculture?

- Increasing sector in terms of:
  - ✓ Production
  - ✓ Employment
  - ✓ Diversification
  - ✓ Economic impact

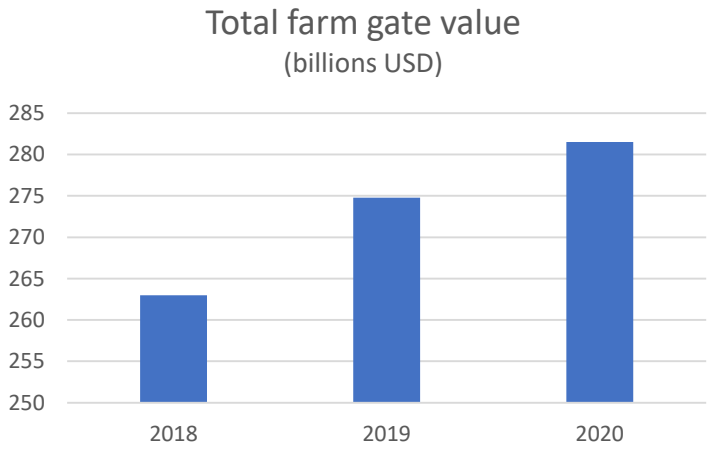


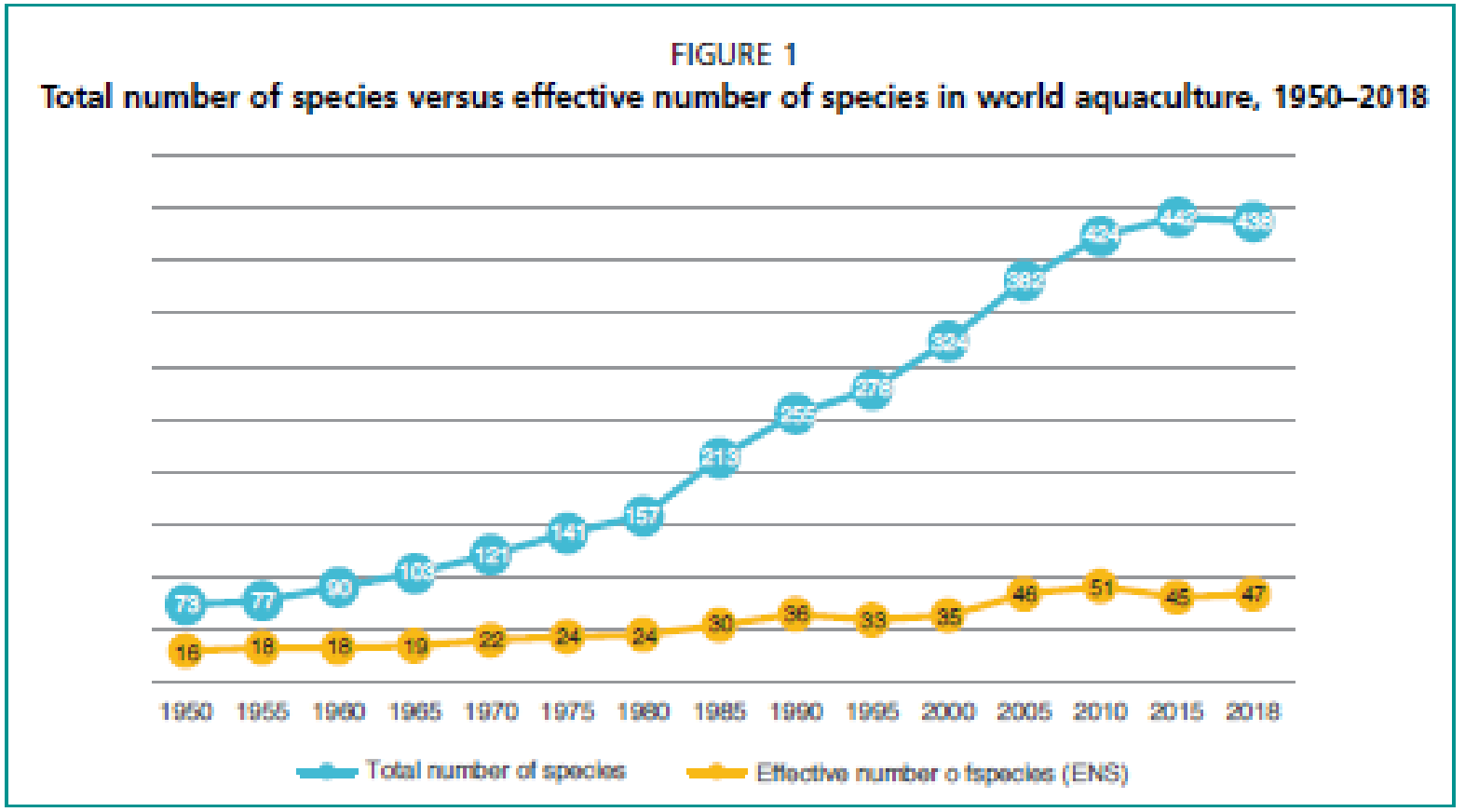
Source: FAO

AQUACULTURE

Why aquaculture?

- Increasing sector in terms of:
  - ✓ Production
  - ✓ Employment
  - ✓ Diversification
  - ✓ Economic impact





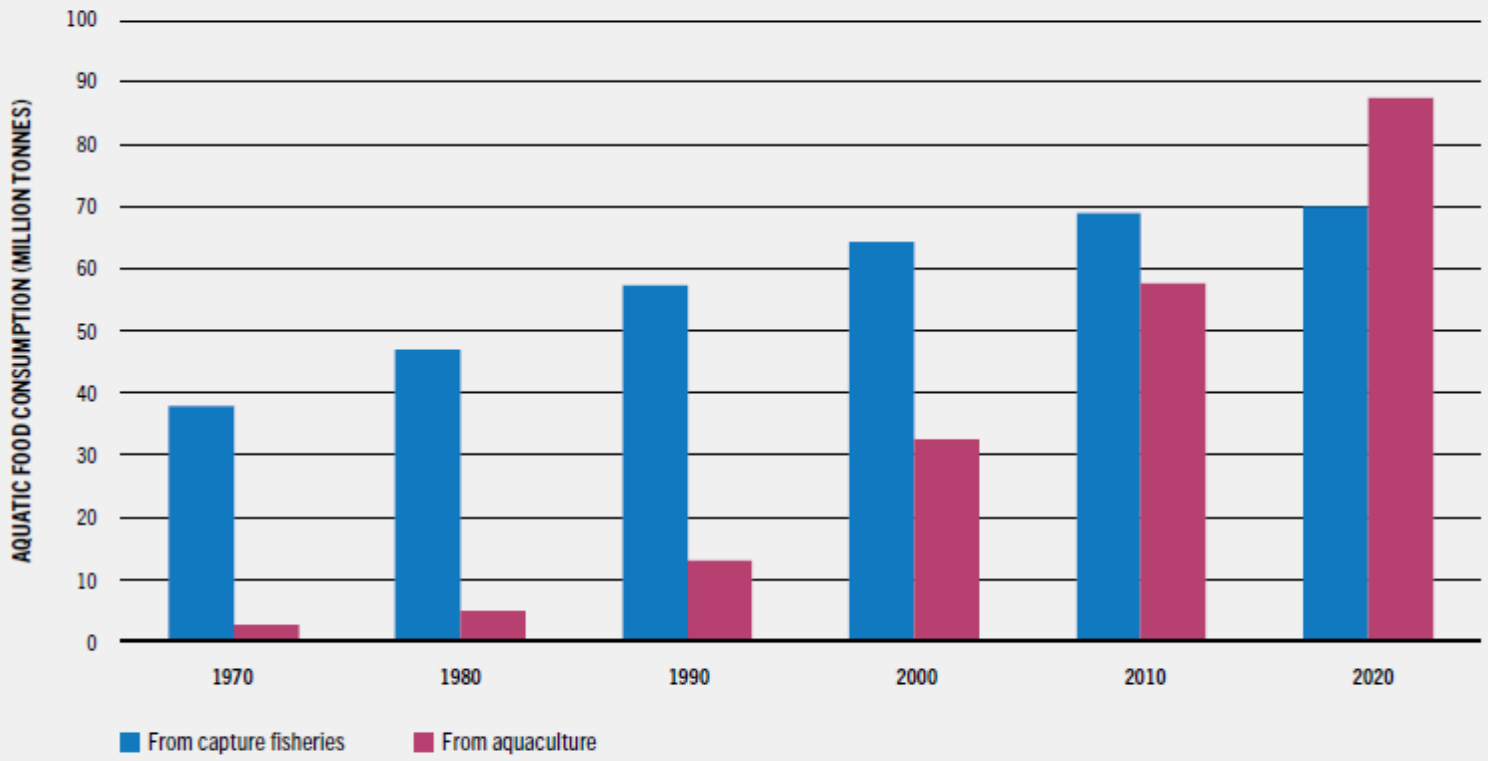
Source: FAO

AQUACULTURE

Why aquaculture?

- Increasing sector in terms of:
  - ✓ Production
  - ✓ Employment
  - ✓ Diversification
  - ✓ Economic impact
- Fisheries pressure relief

FIGURE 44 RELATIVE CONTRIBUTIONS OF AQUACULTURE AND CAPTURE FISHERIES TO AQUATIC FOODS AVAILABLE FOR HUMAN CONSUMPTION



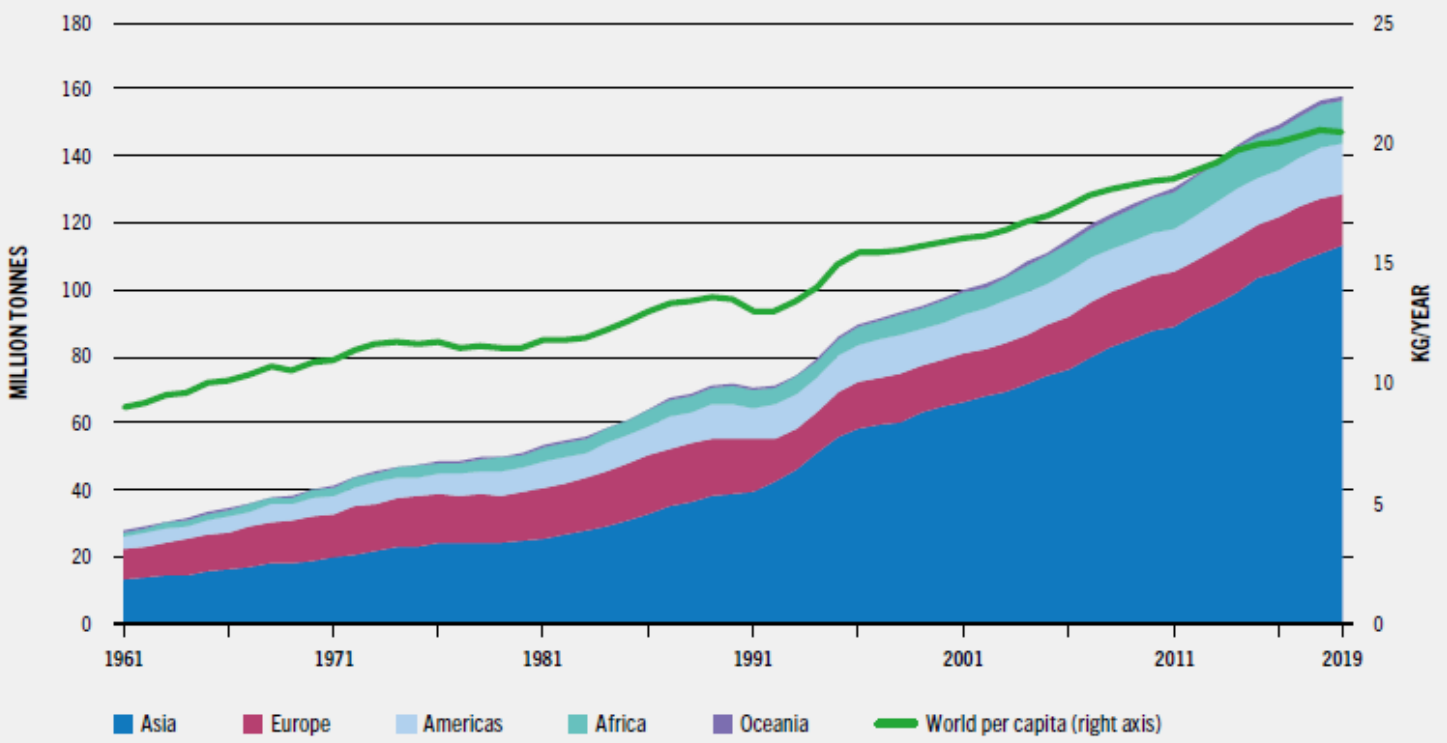
NOTE: Data expressed in live weight equivalent.
SOURCE: FAO.

AQUACULTURE

Why aquaculture?

- Increasing sector in terms of:
  - ✓ Production
  - ✓ Employment
  - ✓ Diversification
  - ✓ Economic impact
- Fisheries pressure relief
- Response to the increasing demand of aquatic products

FIGURE 39 AQUATIC FOOD CONSUMPTION BY CONTINENT, 1961–2019



NOTE: Data in million tonnes expressed in live weight equivalent.
SOURCE: FAO.

Co-funded by the
Erasmus+ Programme
of the European Union

AQUACULTURE

Why aquaculture?

- Increasing sector in terms of:
  - ✓ Production
  - ✓ Employment
  - ✓ Diversification
  - ✓ Economic impact
- Fisheries pressure relief
- Response to the increasing demand of aquatic products

Source: Hanson Lu

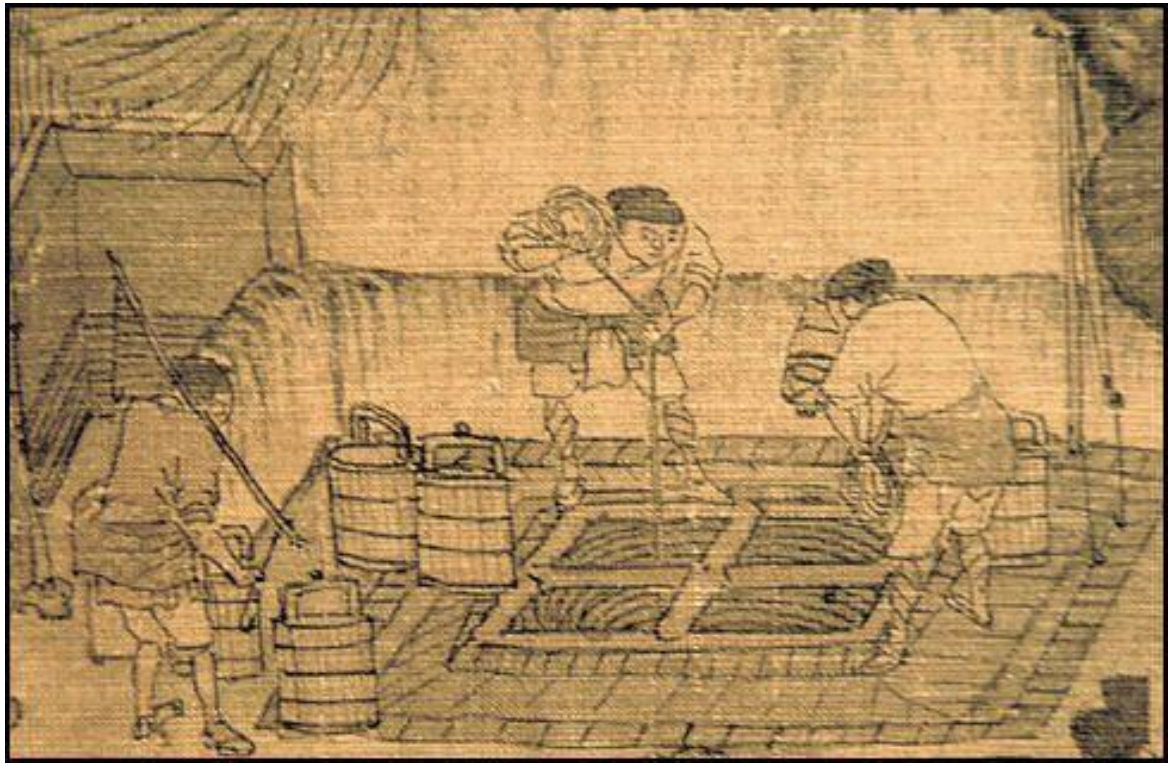
Need for an integrated management!!!

Co-funded by the
Erasmus+ Programme
of the European Union

AQUACULTURE

History, current status and aquaculture systems

- When did the aquaculture practice appear?



Co-funded by the
Erasmus+ Programme
of the European Union

AQUACULTURE

History, current status and aquaculture systems

- When did the aquaculture practice appear?
- What do we know as modern aquaculture?

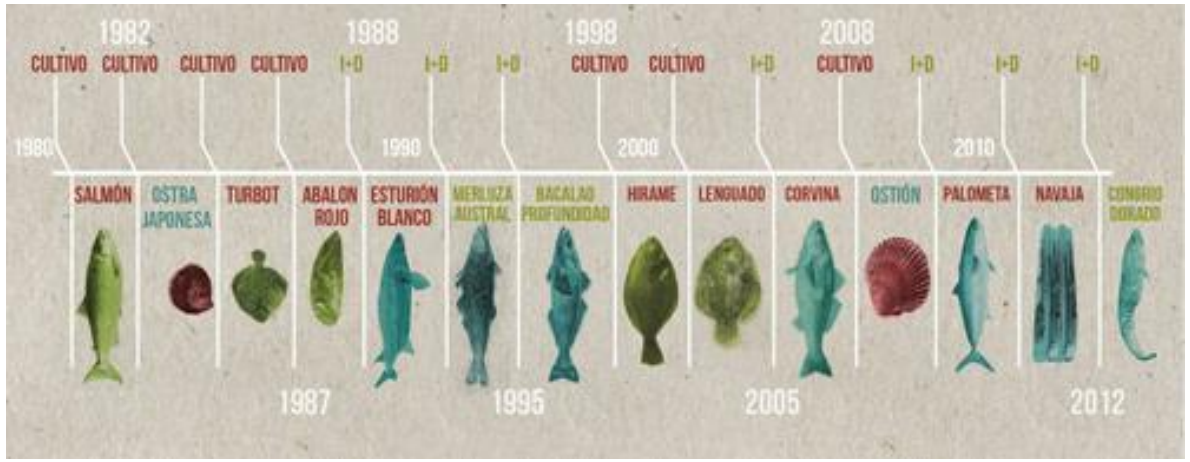
Source: alamy.es

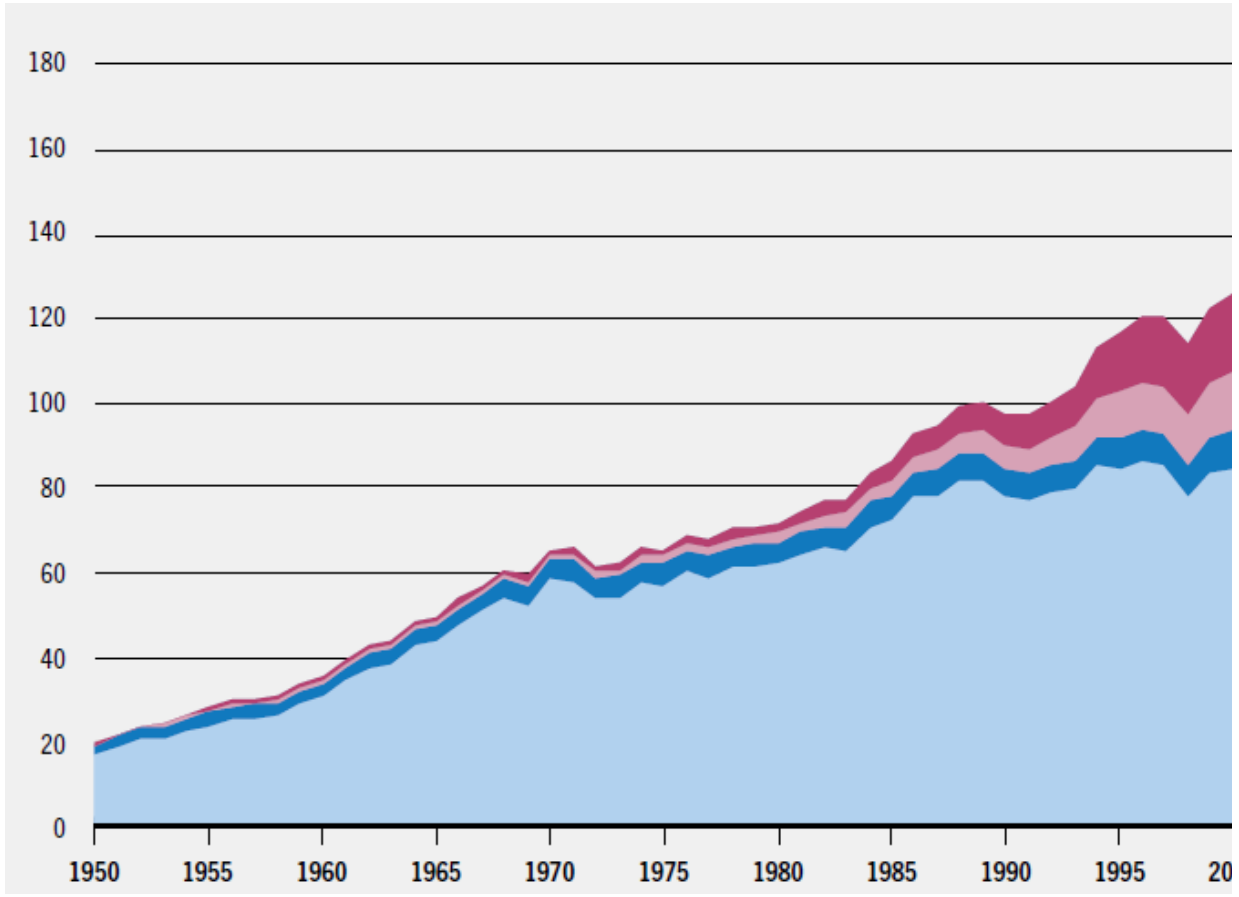
Co-funded by the
Erasmus+ Programme
of the European Union

AQUACULTURE

History, current status and aquaculture systems

- When did the aquaculture practice appear?
- What do we know as modern aquaculture?
- Aquaculture expansion



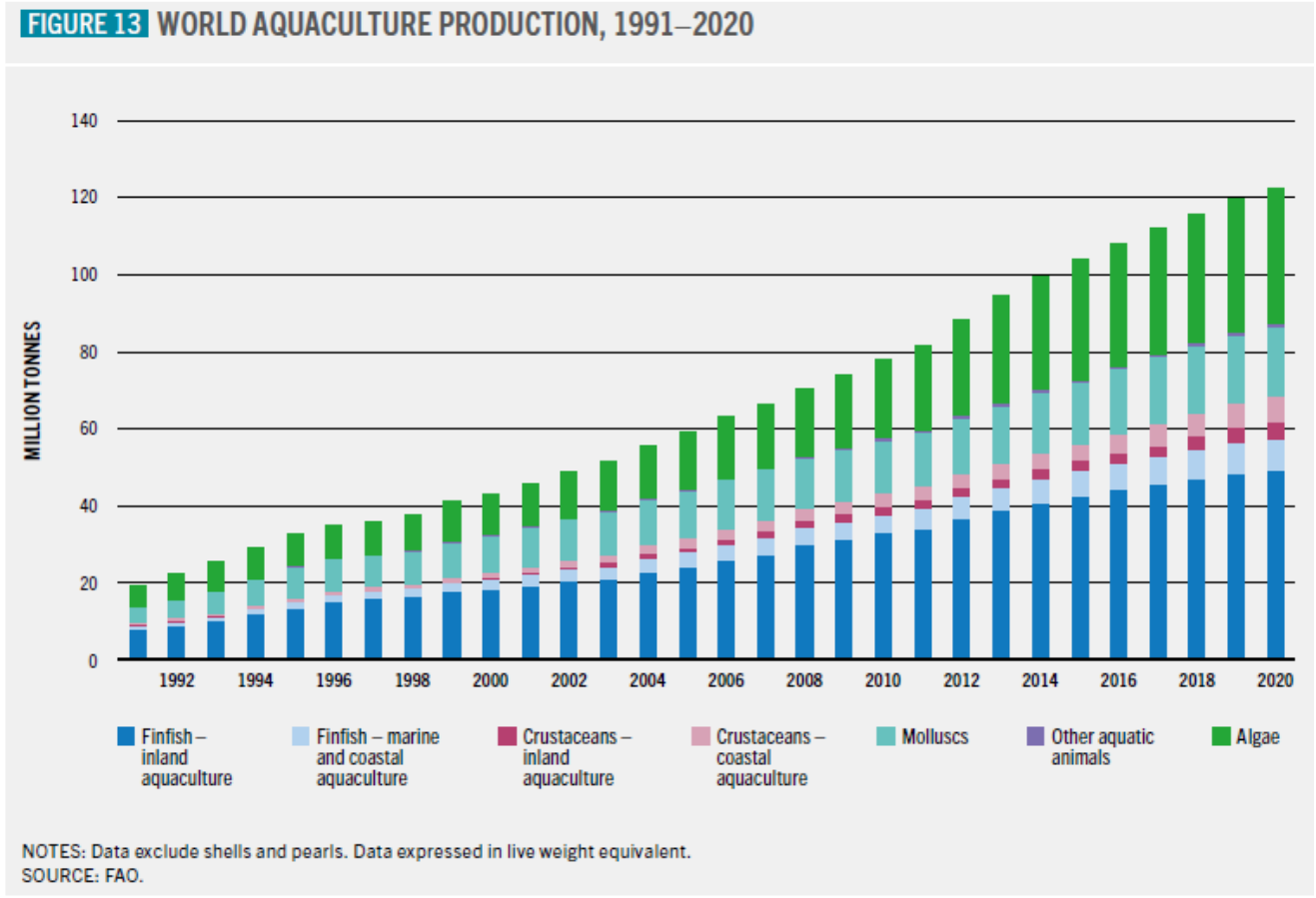


Co-funded by the
Erasmus+ Programme
of the European Union

AQUACULTURE

History, current status and aquaculture systems

- When the aquaculture practice appears?
- What do we know as modern aquaculture?
- Aquaculture expansion
- Current status:
  - ✓ Global vs. regional
  - ✓ Main species



Co-funded by the
Erasmus+ Programme
of the European Union

AQUACULTURE

History, current status and aquaculture systems

- When the aquaculture practice appears?
- What do we know as modern aquaculture?
- Aquaculture expansion
- Current status:
  - ✓ Global vs. regional
  - ✓ Main species

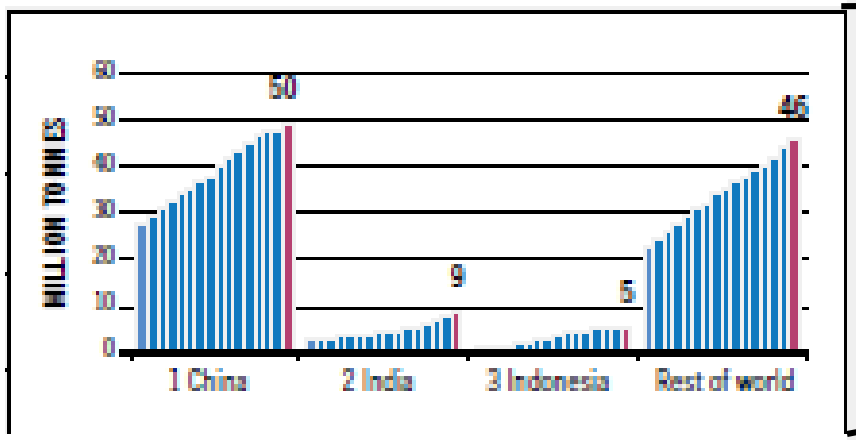
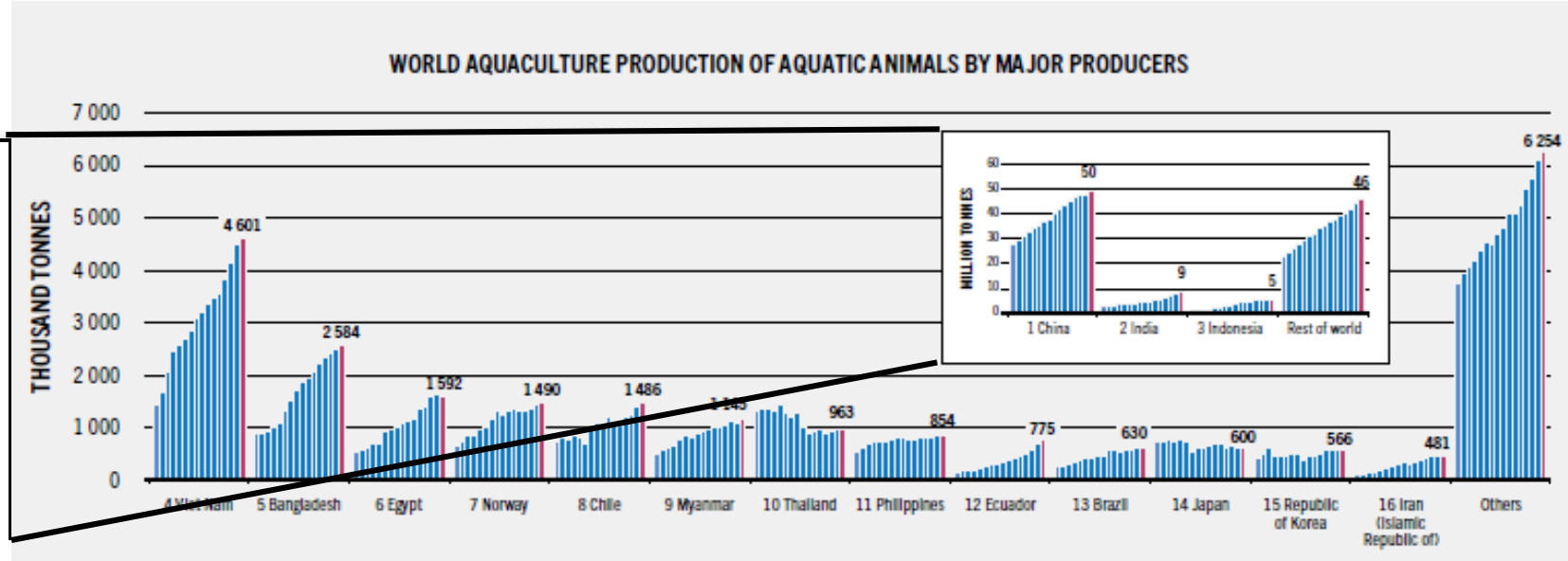


FIGURE 15 PRODUCTION DISTRIBUTION OF SELECTED MAIN SPECIES GROUPS AND TYPE OF AQUACULTURE, 2005–2020



Co-funded by the Erasmus+ Programme of the European Union

AQUACULTURE

<u>History, current status and aquaculture systems</u>

- When the aquaculture practice appears?
- What do we know as modern aquaculture?
- Aquaculture expansion
- Current status:
  - ✓ Global vs. regional
  - ✓ Main species

Position	Species	Production
1	Japanese kelp	12469.8
2	Eucheuma seaweeds	8129.4
3	Whiteleg shrimp	5812.2
4	Grass carp	5791.5
5	Cupped oysters	5450.3
6	Gracilaria seaweeds	5180.4
7	Silver carp	4896.6
8	Nile tilapia	4407.2
9	Japanese carpet shell	4266.2
10	Common carp	4236.3

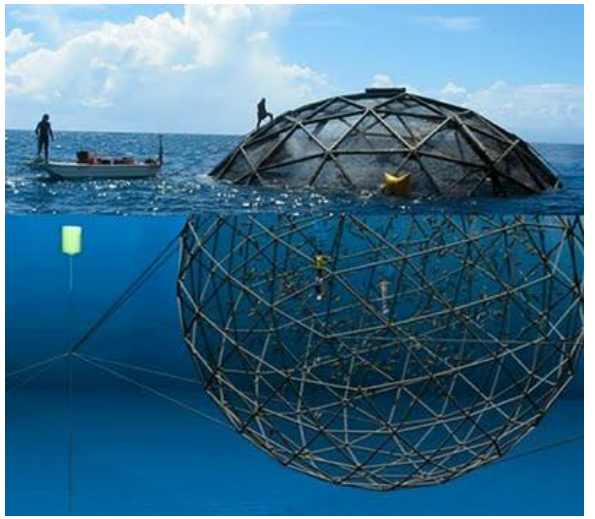
>50% global production

Co-funded by the
Erasmus+ Programme
of the European Union

AQUACULTURE

<u>History, current status and aquaculture systems</u>

- When the aquaculture practice appears?
- What do we know as modern aquaculture?
- Aquaculture expansion
- Current status:
  - ✓ Global vs. regional
  - ✓ Main species
- Aquaculture systems:
  - ✓ Facility types
  - ✓ Culture density
  - ✓ Water exchange
  - ✓ Growing phase



Co-funded by the
Erasmus+ Programme
of the European Union

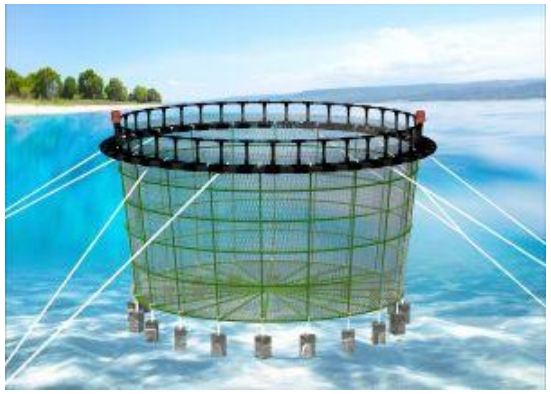
AQUACULTURE

<u>History, current status and aquaculture systems</u>

- When the aquaculture practice appears?
- What do we know as modern aquaculture?
- Aquaculture expansion
- Current status:
  - ✓ Global vs. regional
  - ✓ Main species
- Aquaculture systems:
  - ✓ Facility types
  - ✓ Culture density
  - ✓ Water exchange
  - ✓ Growing phase

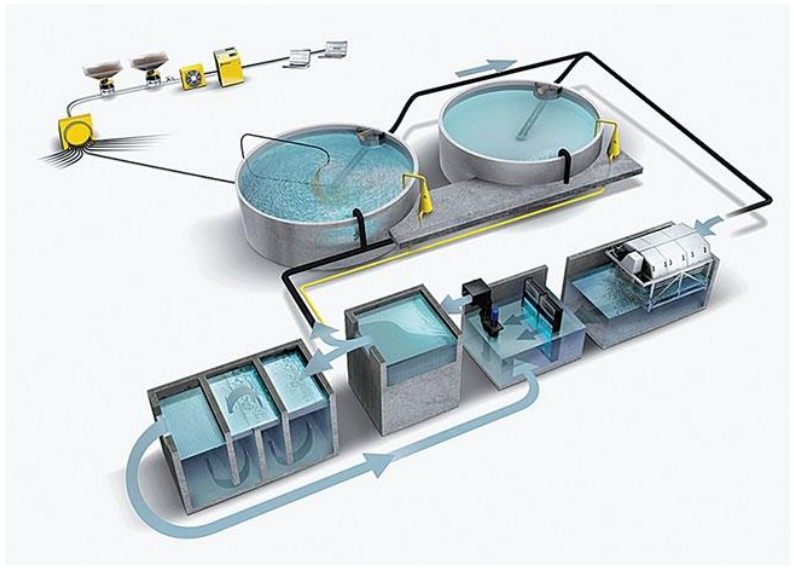
Co-funded by the
Erasmus+ Programme
of the European Union

AQUACULTURE



History, current status and aquaculture systems

- When the aquaculture practice appears?
- What do we know as modern aquaculture?
- Aquaculture expansion
- Current status:
  - ✓ Global vs. regional
  - ✓ Main species
- Aquaculture systems:
  - ✓ Facility types
  - ✓ Culture density
  - ✓ Water exchange
  - ✓ Growing phase

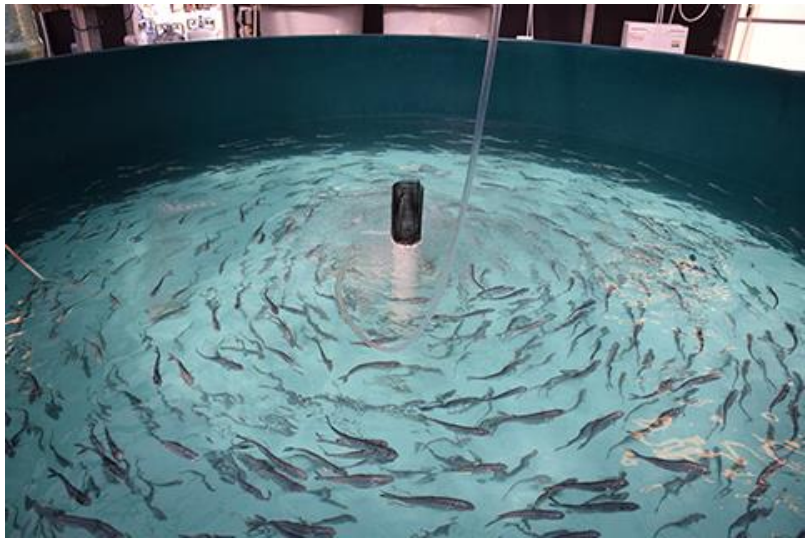


Co-funded by the
Erasmus+ Programme
of the European Union

AQUACULTURE

History, current status and aquaculture systems

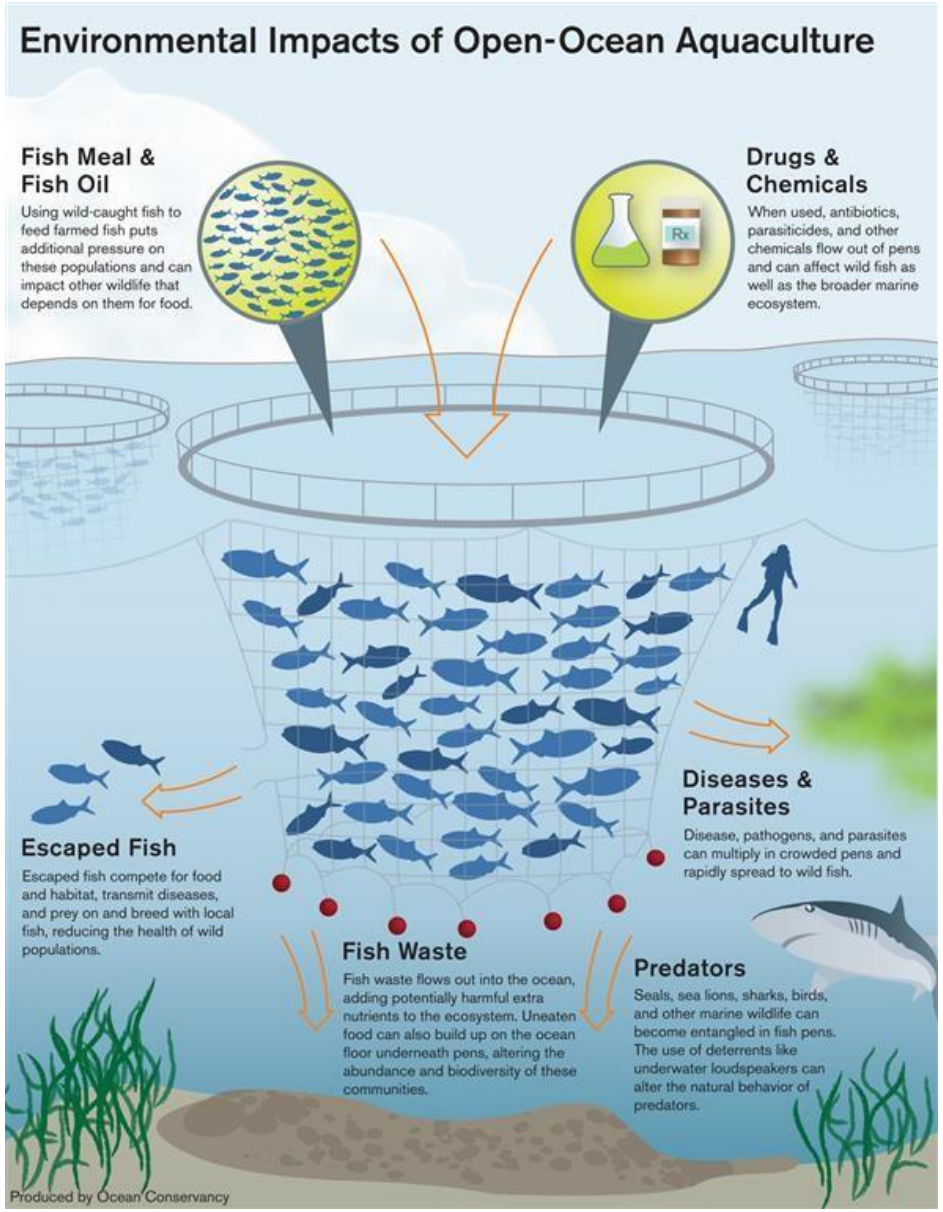
- When the aquaculture practice appears?
- What do we know as modern aquaculture?
- Aquaculture expansion
- Current status:
  - ✓ Global vs. regional
  - ✓ Main species
- Aquaculture systems:
  - ✓ Facility types
  - ✓ Culture density
  - ✓ Water exchange
  - ✓ Growing phase



AQUACULTURE

Negative aquaculture impacts

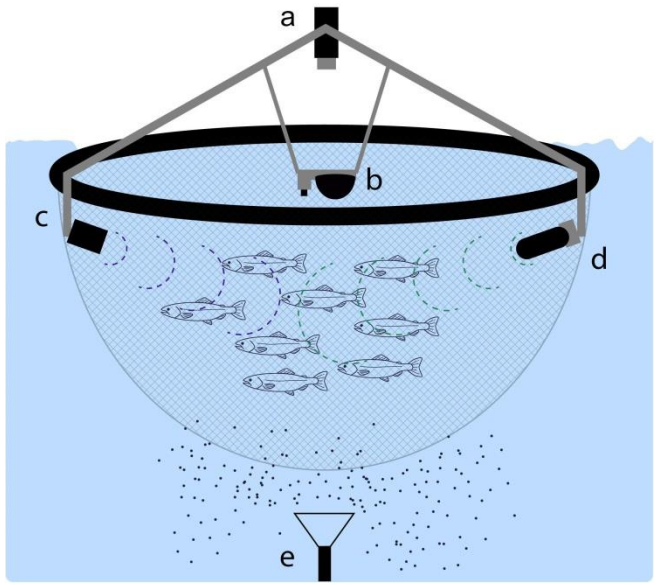
- Nutrient build-up and water pollution
- Invasive species introduction
- Diseases transmission
- Antibiotic usage
- Feed production
- Habitat destruction
- Soil acidification

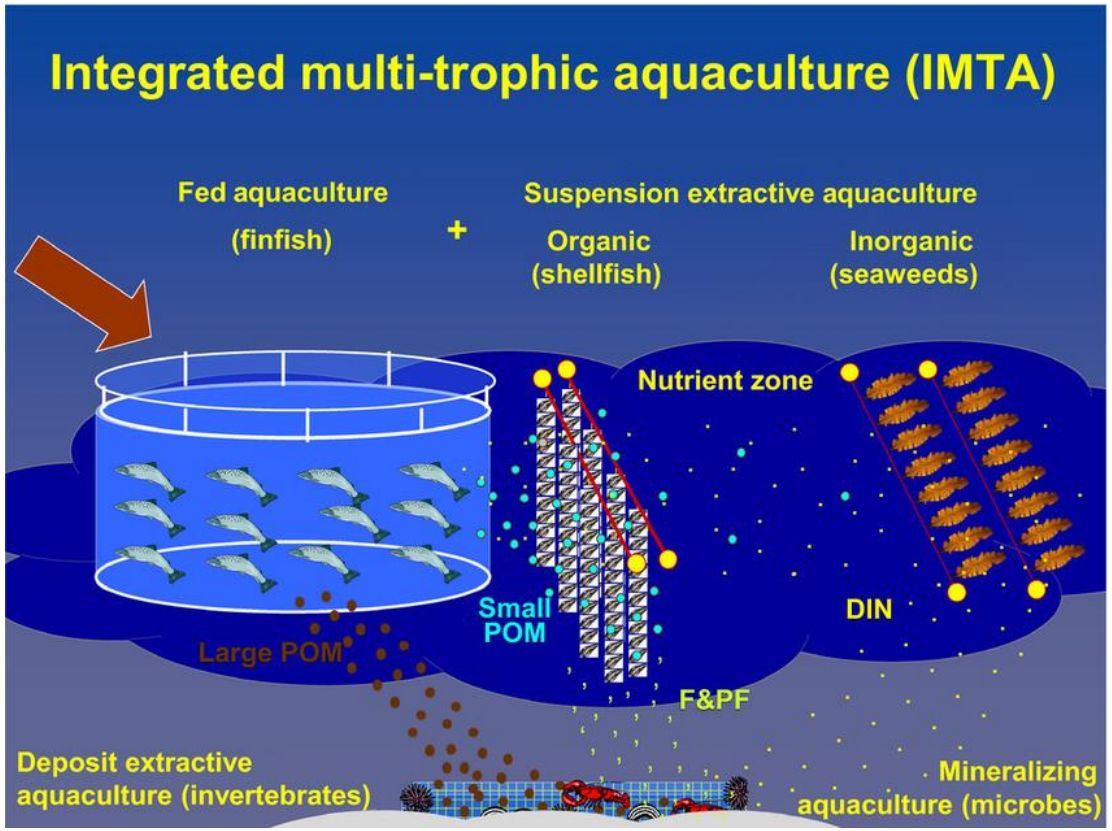


AQUACULTURE

Sustainable aquaculture

- Bioremediation with Integrated Multi-Trophic Aquaculture (IMTA)
- Precision Fish Farming (PFF)
- Probiotic feeding and effective vaccinations
- Sustainable feed
- Management of facility location



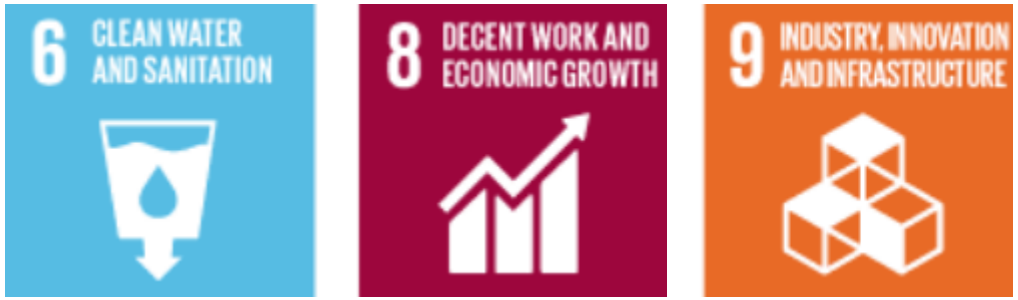


Co-funded by the
Erasmus+ Programme
of the European Union

AQUACULTURE

Aquaculture in 2030 Agenda and the Sustainable Development Goals (SDGs)

- SDGs directly implicated:
  - ✓ SDG #1: No poverty
  - ✓ SDG #2: Zero hunger
  - ✓ SDG #3: Good health and well-being
  - ✓ SDG #12: Responsible consumption and production
  - ✓ SDG #13: Climate action
  - ✓ SDG #14: Life bellow water
- SDGs indirectly implicated:
  - ✓ SDG #6: Clean water and sanitation
  - ✓ SDG #8: Decent work and economic growth
  - ✓ SDG #9: Industry, innovation and infrastructure



AQUACULTURE

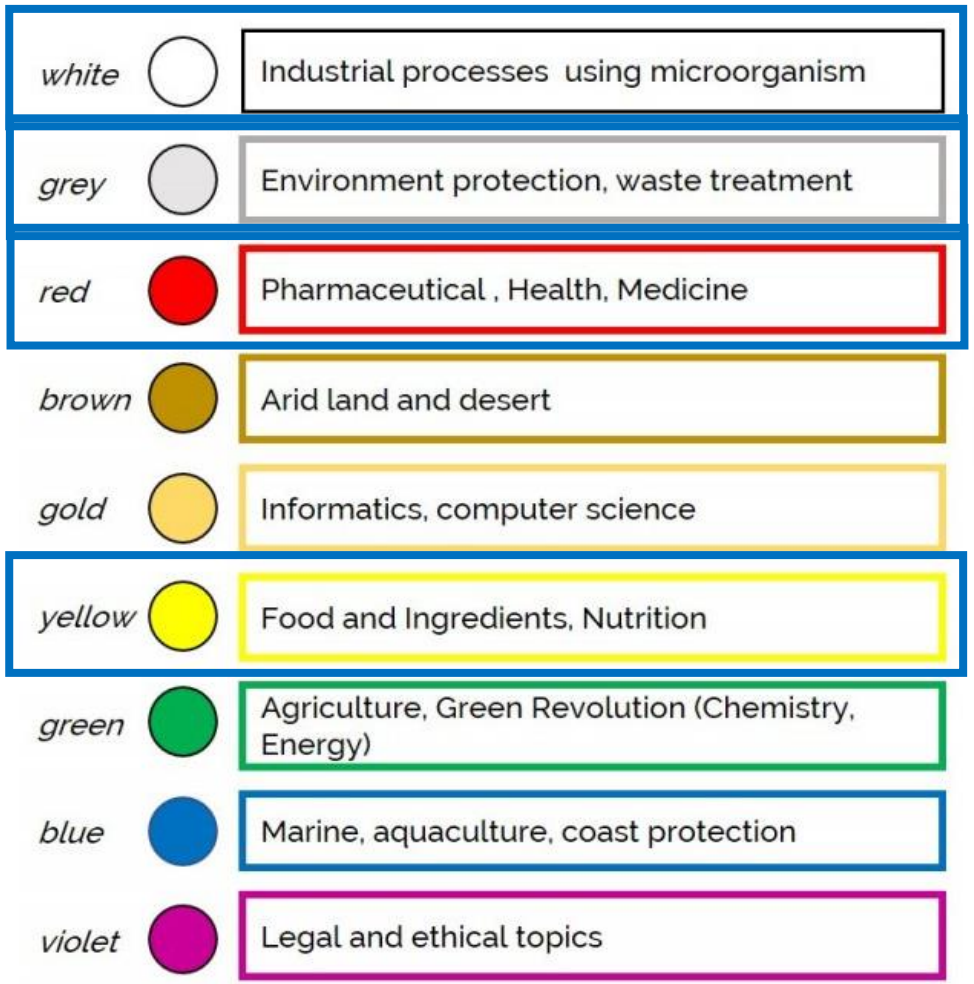
Suggested teaching methods

- High theoretical charge → Lectures
- Specialized sector → Seminars carried out by aquaculture specialists
- Wide variety of facilities → Visit to facilities

Co-funded by the
Erasmus+ Programme
of the European Union

BLUE BIOTECHNOLOGY

Biotechnology colors



What is biotechnology?

Any technological application that utilizes biologic systems and living organisms or their derivatives for the creation or modification of products or processes for specific uses

Co-funded by the
Erasmus+ Programme
of the European Union

BLUE BIOTECHNOLOGY

Why blue biotechnology?

- Market opportunities
- Economically important
- Medicine source
- Pollutants bioremediation
- Source of alternative renewable energy
- Sustainable aquaculture development:
  - ✓ Reproduction
  - ✓ Nutrition
  - ✓ Waste assimilation or treatment
  - ✓ Larval rearing
  - ✓ Health management
  - ✓ Genetic improvement

BLUE BIOTECHNOLOGY

Some examples

- Medicine Source

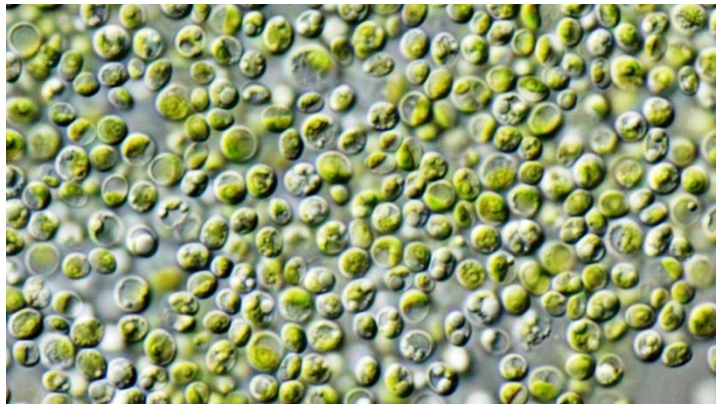
Drugs derived from marine organisms

Product	**Source**	**Application**
Cephalosporin	Fungi (*Cephalosporium*)	Antibiotic
Squalamine	Spiny dogfish (*Squalus acanthus*)	Antibiotic
Vidrabine/Ara-A	Caribbean sponge (*Tethya crypta*)	Antiviral
Cytarabine/Ara-C	Caribbean sponge (*Tethya crypta*)	Anticancer
Ziconotide	Cone snail (*Conus magus*)	Analgesic
Trabectedin	Caribbean tunicate *(Ecteinascidia turbinata)*	Anticancer
Eribulin mesylate	Marine sponge (*Halichondria okadai*)	Anticancer
Holothurin	Bahamian sea cucumber (*Actynopyga agassizi*)	Anticancer

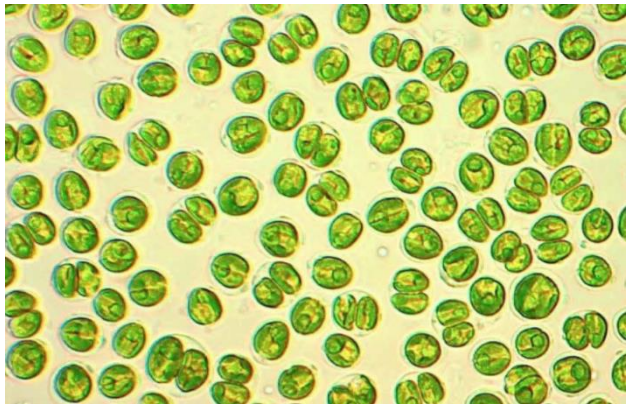
BLUE BIOTECHNOLOGY

Some examples

- Medicine Source
- Source of alternative energy

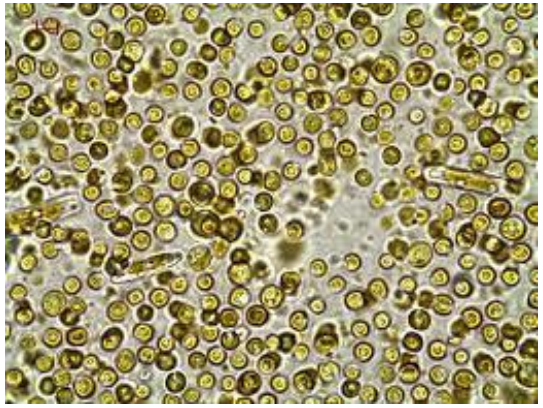


Chlorella

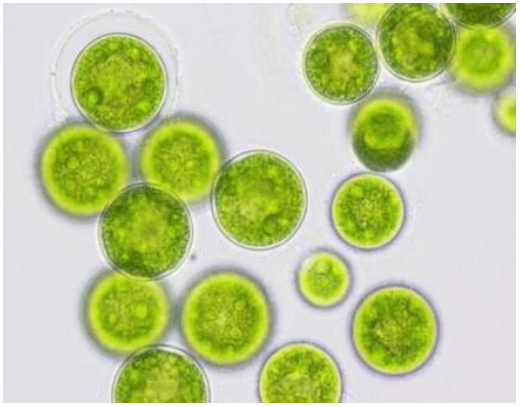


Tetraselmis

Chaetoceros



Isochrysis



Nannochloropsis

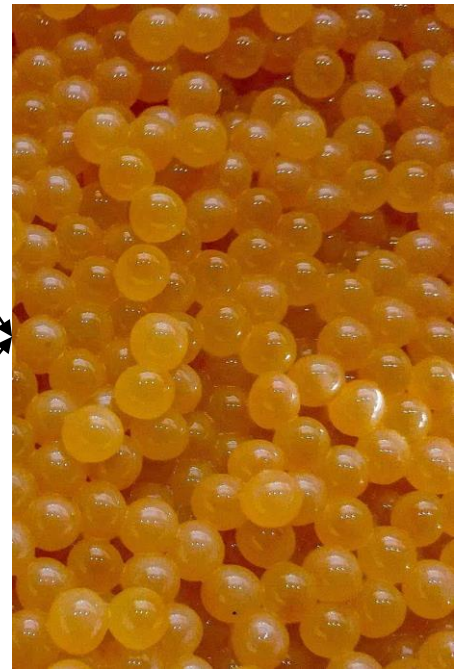
BLUE BIOTECHNOLOGY

Blue biotechnology and sustainable aquaculture

- Reproduction

Extraction and preparation of the pituitary glands

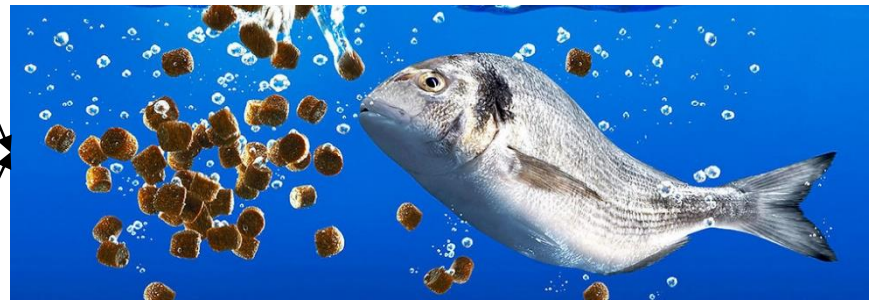
Hormone purification by recombinant DNA technology



BLUE BIOTECHNOLOGY

Blue biotechnology and sustainable aquaculture

- Reproduction
- Nutrition

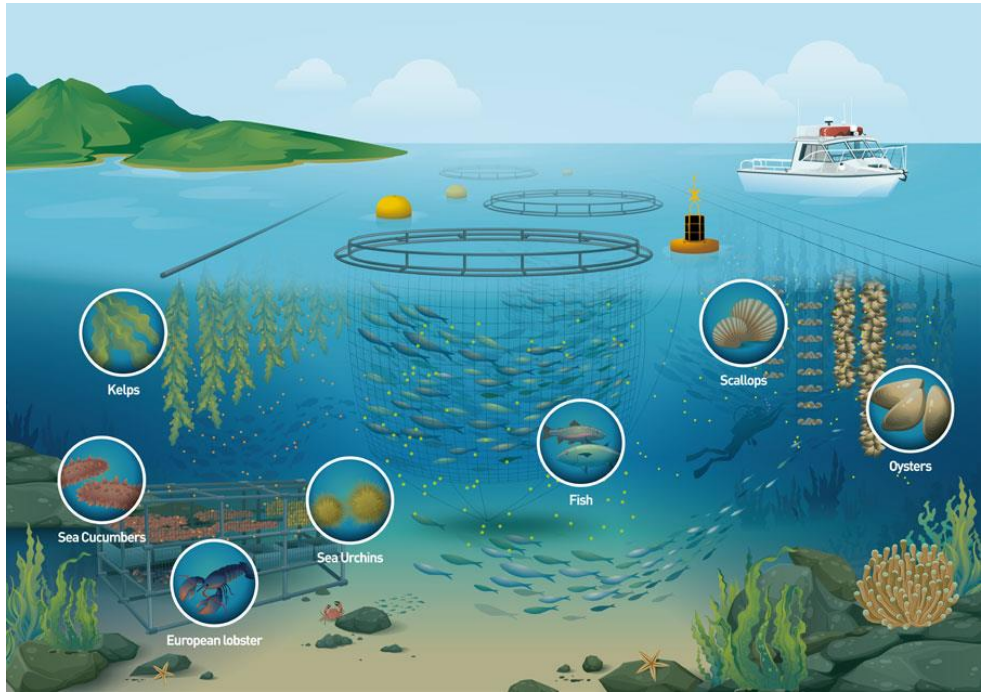


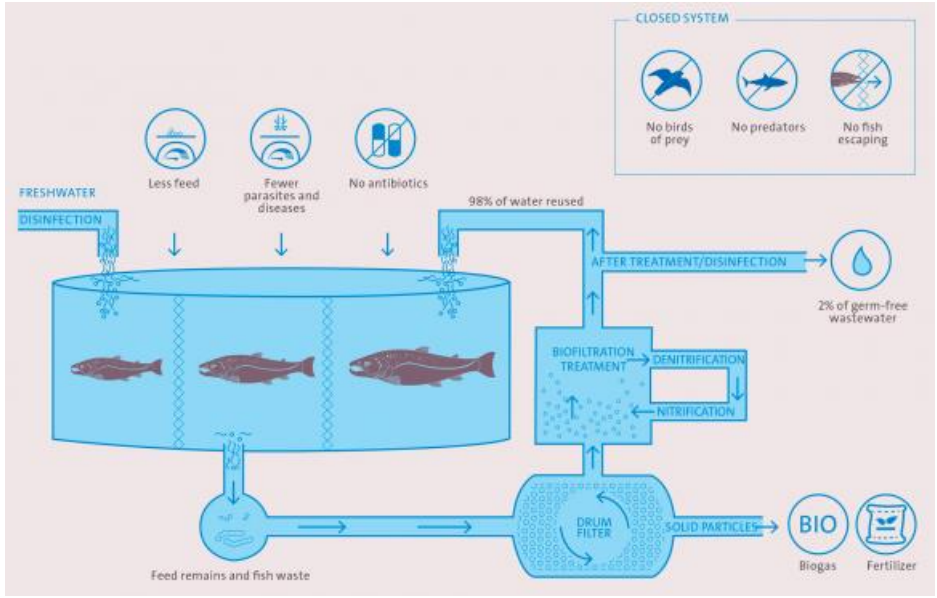
GM Camelina sativa

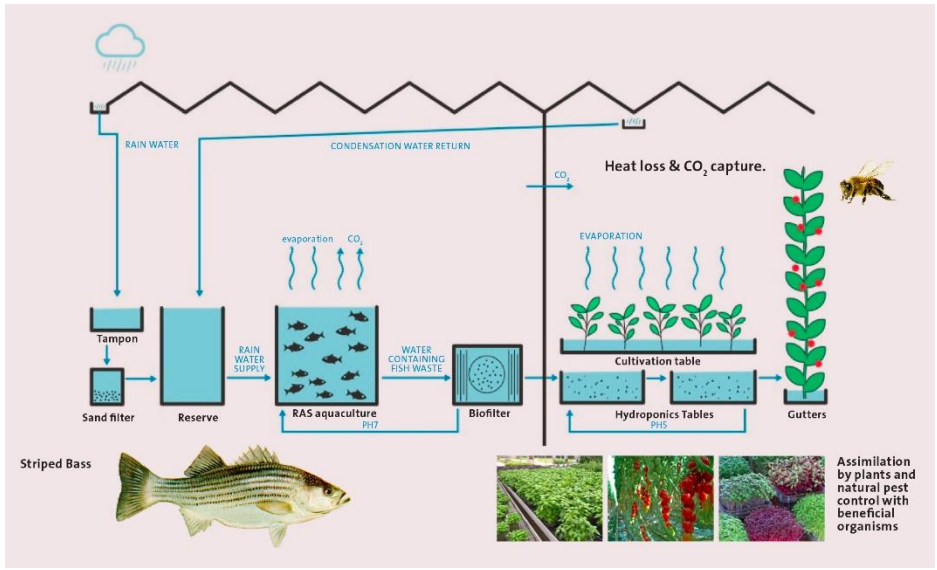
BLUE BIOTECHNOLOGY

Blue biotechnology and sustainable aquaculture

- Reproduction
- Nutrition
- Waste assimilation or treatment



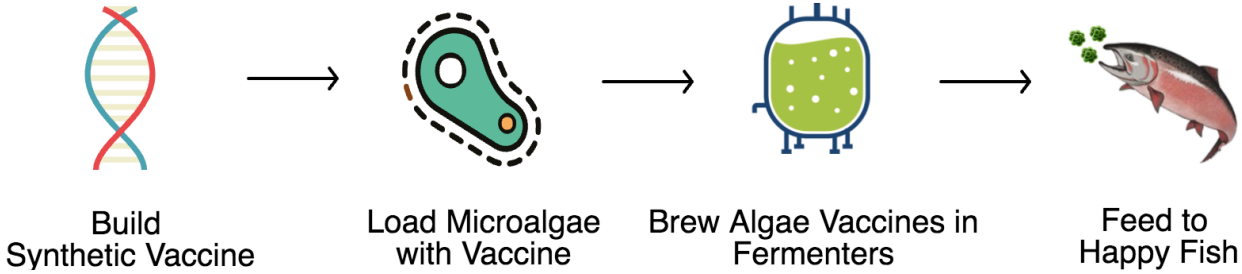


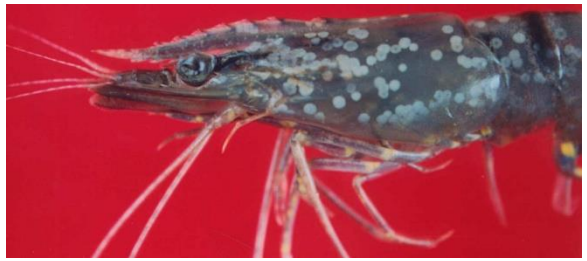


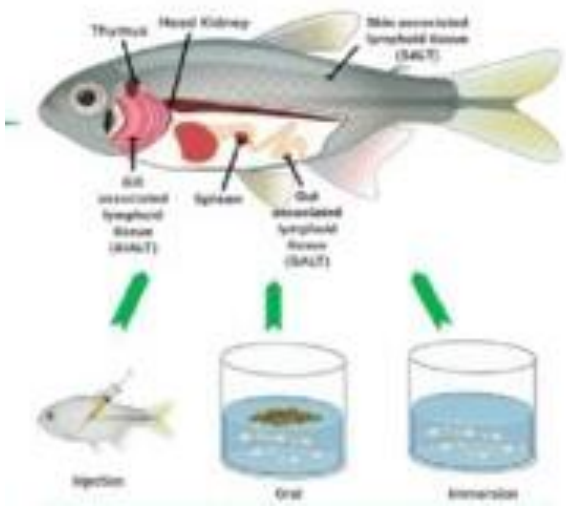
BLUE BIOTECHNOLOGY

Blue biotechnology and sustainable aquaculture

- Reproduction
- Nutrition
- Waste assimilation or treatment
- Larval rearing
- Health management



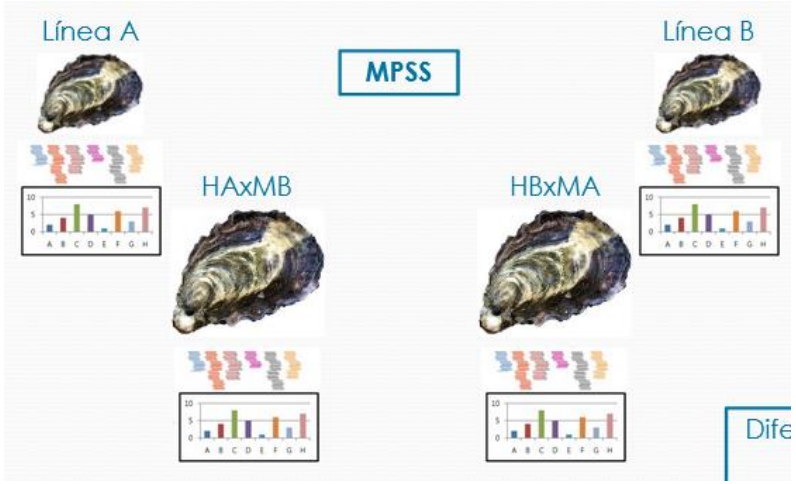


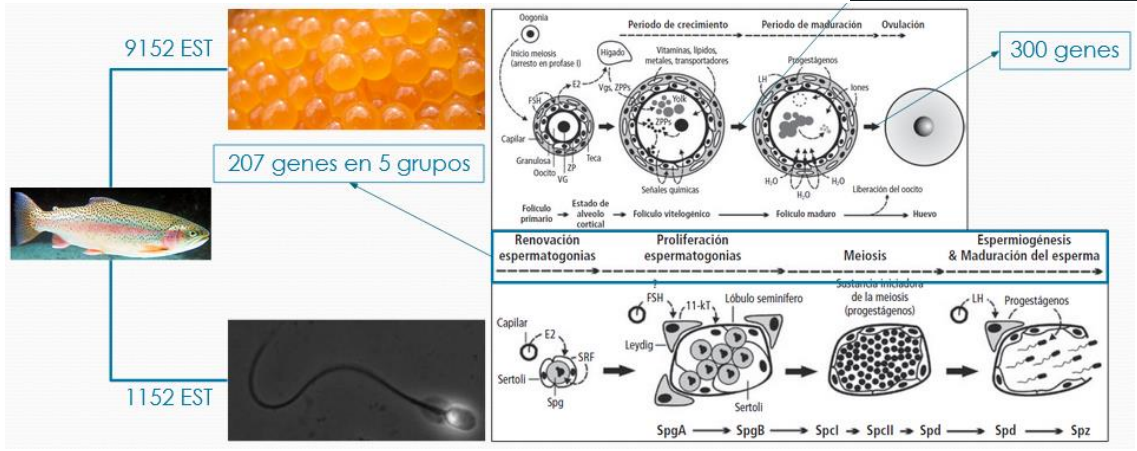


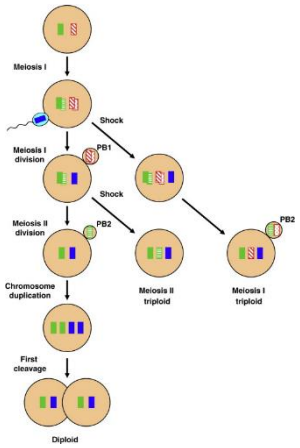
BLUE BIOTECHNOLOGY

Blue biotechnology and sustainable aquaculture

- Reproduction
- Nutrition
- Waste assimilation or treatment
- Larval rearing
- Health management
- Genetic improvement







BLUE BIOTECHNOLOGY

Blue biotechnology in 2030 Agenda and the Sustainable Development Goals (SDGs)

BLUE BIOTECHNOLOGY

Suggested teaching methods

- High theoretical charge → Lectures
- Laboratory works → Lab practices or visit to research centers
- Specialized topics → Seminars

¡GRACIAS! Thank you Faleminderit Hvala.

Manuel Alejandro Merlo Torres
alejandro.merlo@uca.es

OTHER INFORMATION:
Master Degree in Aquaculture and Fishery: https://ccmaryambientales.uca.es/master-en-acuipesca/
master.acuipesca@uca.es

UCA Universidad de Cádiz

MEP&M
Development of Regional Joint Master Program in Maritime Environmental Protection and Management

UCG Univerzitet Crne Gore
UNIVERSITÉ CÔTE D'AZUR
UCA Universidad de Cádiz
AGENCIJA ZA ZAŠTITU PRIRODE I ŽIVOTNE SREDINE CRNE GORE
EKO CENTAR DELFIN