The greater amberjack (*Seriola dumerili*): objectives and progress

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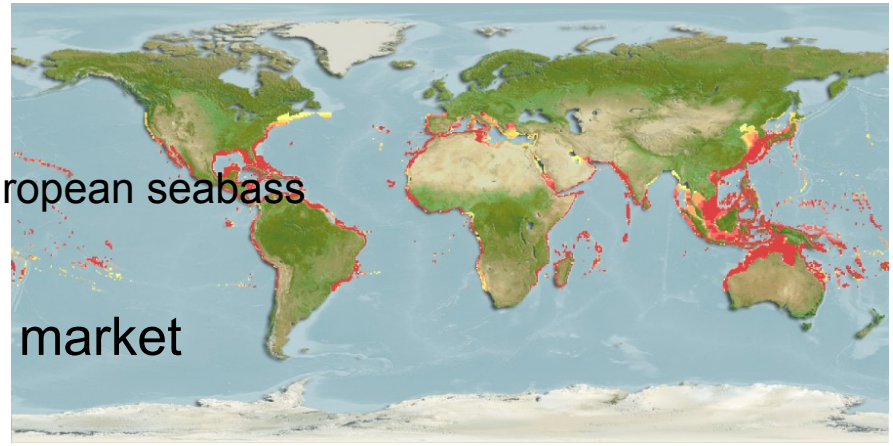
DIVERSIFY
Final Coordination and Dissemination Meeting 2018
Brussels, 22-23 November

A good candidate for diversification!

- Interesting characteristics
  - Fast growth
    - Growth rates **10x** higher than the European seabass
  - Excellent flesh quality and global market
  - Significant potential for exports
    - congener species are produced commercially elsewhere



- An innovative product
  - Large size attained
    - suitable for development of value added products

G. Amberjack rearing in the Mediterranean

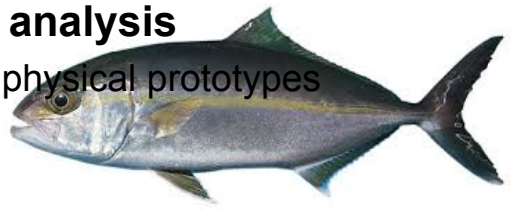
- Started in the 80s with capture-based activities using wild juveniles
  - fish of ~90 g reached ~1 kg in a year, 4 and 6 kg in a period of 2 and 3 years
  - standard culture conditions in cages
  - feeding on fresh fish passing quickly to artificial feeds

- The Mediterranean production in 2016 was 500 t (FAO, 2016)
  - in Malta, Spain **hatchery-produced individuals**
  - interest exists and efforts have been made by various aquaculture companies in Spain, Greece, Italy, Turkey, etc.

- Market price >14 € kg^{-1} (capture fisheries catches)

Major bottlenecks for the G. amberjack aquaculture … and what DIVERSIFY "promised"

- **Reliable reproduction**
  - In captivity problematic reproduction
    - captive-reared breeders have reproduced after hormonal treatments, and in some cases spontaneously
- **Production of adequate numbers of juveniles**.
  - Larval rearing of greater amberjack using semi-intensive methods with limited survival
- **Fish health**
  - Several pathogens as potential threats
    - *Photobacterium damsella*
    - Epitheliocystis
    - *Cryptocaryon*
    - monogenean parasites
    - *Neobenedenia* spp …
- **Reproduction**
  - spawning induction methods
- **Larval husbandry**
  - rearing protocols
- **Nutrition**
  - live food enrichments, weaning, grow-out diets and broodstock diets
- **Growout husbandry**
  - feeding strategies, husbandry for cage rearing
- **Health**
  - detection - diagnosis tools, veterinary solutions and preventive protocols
- **Consumer market analysis**
  - new products with physical prototypes



Broodstock management and spawning induction

Mylonas, C.C., Fakriadis, I., Raftopoulos, A, Iakovopoulos, G, Papandroulakis, N., Lisi, F., Sigelaki, I., Papadaki, M.
Hipolito Fernandez-Palacios, Aldo Corriero, Salvador Jerez

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Reproductive cycle studies

mid May – late July
19-26°C

Purse seine,
Lampedousa Island, Italy

Sea cages,
Salamina Island, Greece

ARGOSARONIKOS FISHFARMS S.A.

Available broodstocks

Stocks	Rearing method	Number of individuals	Size (kg)	Feeding (pellets >2 yr)
ARGO	sea-cages	49	7.1-16.0	raw fish
GMF	sea-cages	28	6.3-15-6	live fish
SOUDA	sea-cages	12	7.4-14.8	moist pellet
AQUALABS	land-based	27	6.5-23.8	raw fish
ARGO	land-based	9	8.1-11.1	live, raw fish
FORKYS	land-based	22	7.7-10.3	raw fish, squid

Spawning induction period:

- mid May – late July
- 20-26°C

Initial approach

- Fish in tanks/ cages during the year
- Spawning induced at the expected spawning season
- Egg collection in tanks/ cages

New approach

- Fish in sea cages during the year
- Spawning induced at the expected spawning season
- Transfer immediately to land-based tanks
- Egg collection in tanks

Recommended protocol

- Fish in sea cages during the year with no handling after March-April
- Spawning induced at any time between late May - early July (20-25°C)
- Use a GnRHa implant at 50 µg kg^{-1} every 2 weeks
- Transfer immediately to land-based tanks
- Return to cages after spawning




Nutrition

Daniel Montero, C.M. Hernández Cruz, S. Sarih, H. Fernández-Palacios, M. Izquierdo (FCPCT-ULPGC)
S. Jerez, M. Virginia Martín (IEO), J. Perez, C. Rodríguez (ULL)
Kotzamanis, Y., (HCMR)
Fontanillas, R., Rosenlund, G. (SARC)

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SKRETTING

ULL
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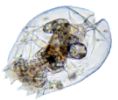
Hatchery nutrition for greater amberjack

- Determine the nutritional requirements and optimum levels of ***DHA, EPA, and combined PUFA-carotenoids*** in greater amberjack enrichment products during ***rotifer and Artemia*** feeding

Results

- DHA in enrichment products for rotifers 14% TFA
- EPA in enrichment products for rotifers 6% TFA
- DHA/EPA in enrichment products for rotifers 2.3
- DHA in enrichment products for *Artemia* 10-17% TFA
- EPA in enrichment products for *Artemia* 14-20% TFA
- DHA/EPA in enrichment products for *Artemia* 1-5
- Carotenoids levels in enrichment products 10 ppm



Feeding for broodstocks to optimize reproduction

- Effect of increased **protein, histidine and taurine** dietary levels on egg quality,
- Optimum **DHA and EPA** levels as essential fatty acids for reproductive success,
- effects of an experimental diet with a potentially improved formula of lipids, on reproductive development of hatchery produced greater amberjack

Results

- Raising histidine contents in broodstock diets from 1 to 1.5% optimize the reproductive performance
- Taurine levels in broodstock diets (1%) increase fecundity
- Increasing protein contents over 51% lead to the lowest number of egg and larvae produced
- Best spawn quality and production parameters were obtained from broodstock fed diet 1.57% EPA+DHA in contrast to 2.8% EPA+DHA

Hatchery production

N. Papandroulakis, Tsalafouta, P. Anastasiadis, I. E. Papadakis, N. Mitrizakis (HCMR)
C.M. Hernández Cruz, A. La Barbera, H. Fernández-Palacios Barber, M. Izquierdo (FCPCT)
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Marine Farm S.A.

- **Objectives**: to obtain new information on the larval rearing parameters
  - Acquire basic biological information
    - ontogeny of digestion and vision system
    - ontogeny of Somatotropic axis
    - skeletal Ontogeny
  - Feeding regime - Prey enriching diet
  - Husbandry parameters
    - tank type-shape
    - stocking density
    - light conditions

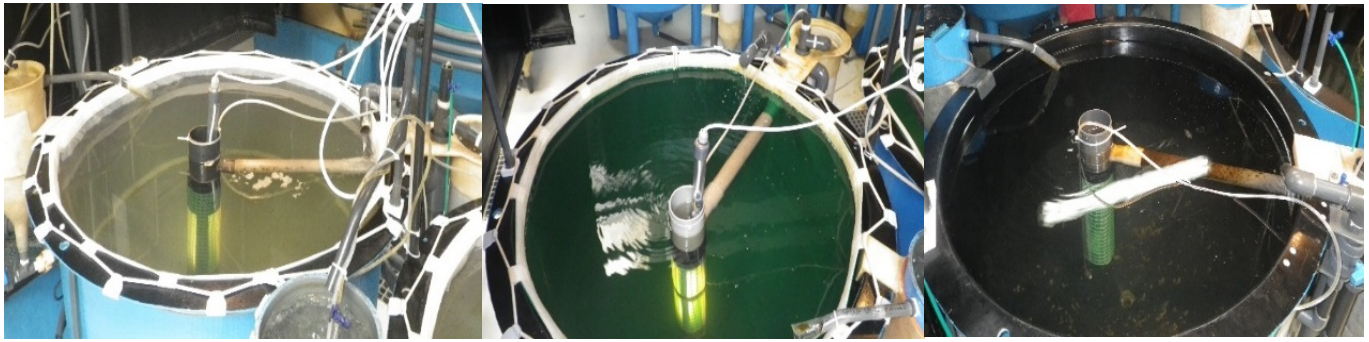
Ontogeny of digestive and vision systems

- Transitions to juveniles after 5.5 mm
- Protein main energy source since first feeding
- Night vision after 5.0 mm
- Rotifer appropriate as diet
- Difficult adaptation to Artemia

The effect of light

- Background color (black, green, white)

SURVIVAL: WHITE: 22,2%
BLACK: 8,2%
GREEN: 16,5%



- The study showed a catalytic effect of the light conditions on larval survival
- Indicate a substantial technological step in the larval rearing of the greater amberjack

Towards an industrial protocol

Validation in Commercial hatcheries

- Hatchery 1
  - 15.000 juveniles classified in 4 size-classes between 0.3 and 2.5 g to nursery
  - In 2018 similar method
    - until 20 dph survival ~10%
    - between 20-30 dph: no sorting ➡ mortality >65% due to cannibalism
    - 30 dph 15.000 individuals were transferred to nursery

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- Hatchery 2
  - Tanks with high light intensity performed better
  - Sorting in size from 20 dph, improves significantly survival
    - 48.300 juveniles of 25-50 g transferred in cages

NIREUS

Recommendations

- Rearing parameters
  - large tank improves growth performance and survival
  - egg stocking densities ~ 25 eggs l^{-1}
  - pH: 7.8-8.5, T: 22 to 27ºC, preferably between 23.5 and 25.0ºC
  - photophase 18L:06D from 1 to 25 dph
  - light intensity: Defused light of 800-1200 lux
- Feeding
  - coordinate rearing conditions and larval development
  - immune modulators (*Echium* and black cumin oil) together with optimized enriching emulsion and astaxanthin as carotenoid improve larval performance
- Husbandry
  - high size variability (at 20-30 dph) in all rearing systems tested until today (unknown reasons)
    - early sorting to appropriate size classes
  - transportation of individuals
    - larvae with 15 > TL > 20 mm do not tolerate netting, transfer performed with care

Grow out

- Temperature tolerance ranges
- Husbandry in sea cages

HCMR: N. Papandroulakis, P. Pereira, A. Tsalafouta, M. Henry, P. Anastasiadis
FCPCT: A. Fernandez-Montero, M. J. Caballero, S. Torrecillas, L. Robaina, D. Montero
IEO: S. Jerez, M. Virginia Martín
ULL: J . Perez, C. Rodríguez
FORKYS SA: A. Ploumis,
Argosaronikos SA: T. Raftopoulos

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Temperature tolerance ranges

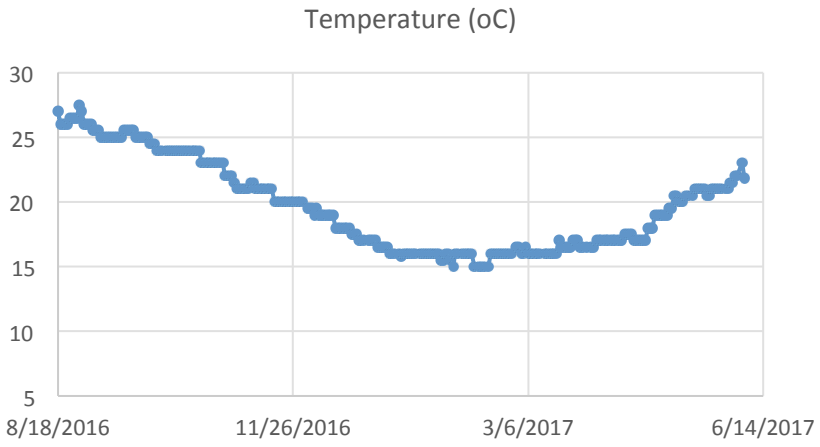
- Juveniles of 20-300 g
  - perform better at 26°C
  - higher caudal propulsion efficiency index (CPE) in fish at 26°C
    - improved movement efficiency during swimming
- Individuals of 350-600 g
  - perform better at 21ºC
  - individuals at 26ºC seemed to display compensatory growth throughout the last month

Development of rearing method in cages

- Two trials in commercial cages for 12 months

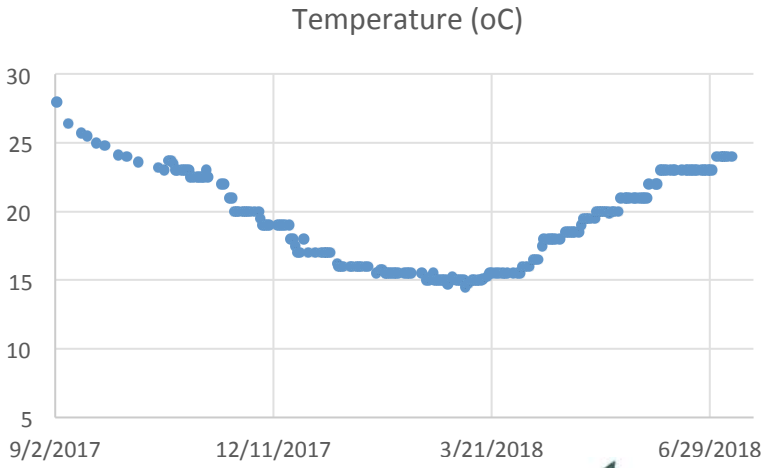
FORKYS (2016)

- 12,000 ind at 10g
- Two cages 2,800 and 1,600 m^3

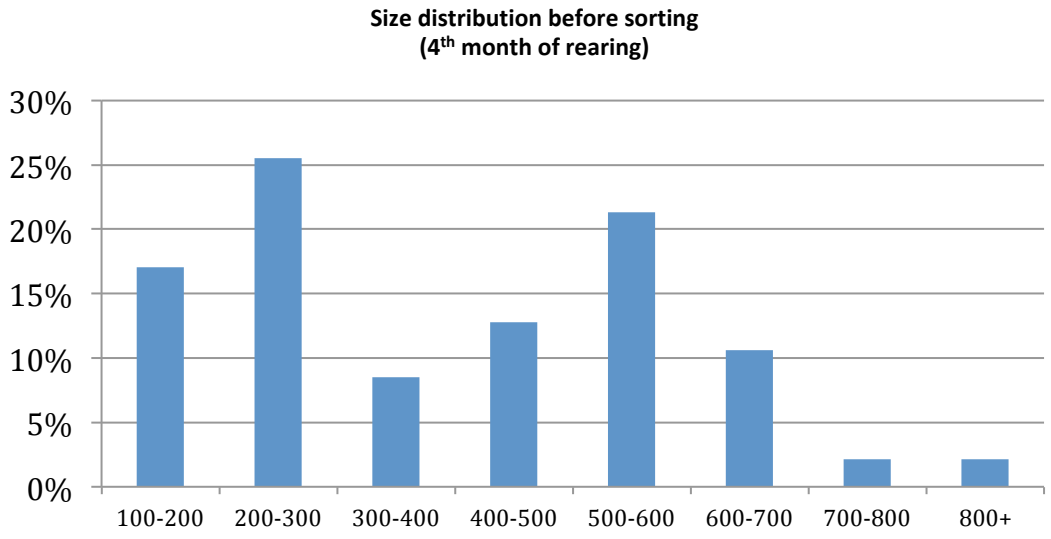


ARGOSARONIKOS (2017)

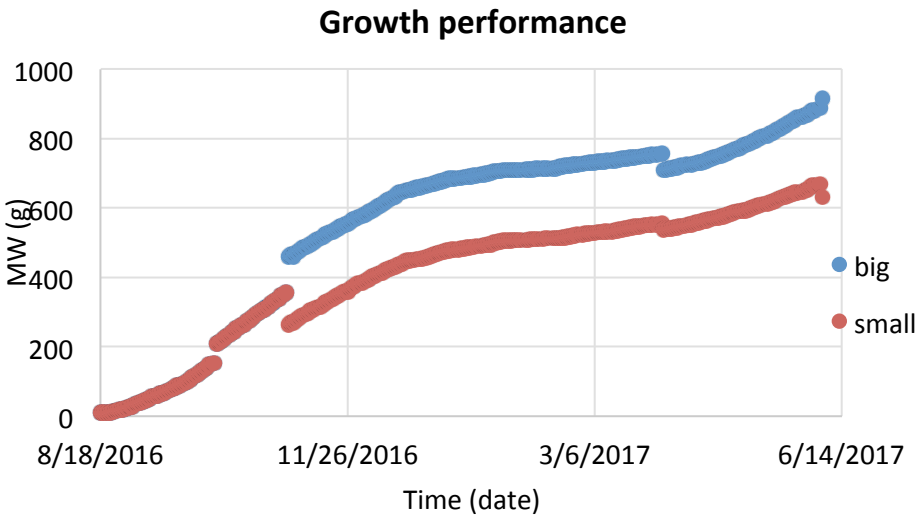
- 12,000+14,500 ind at 23g and 15g
- Two cages 1,300 and 900 m^3



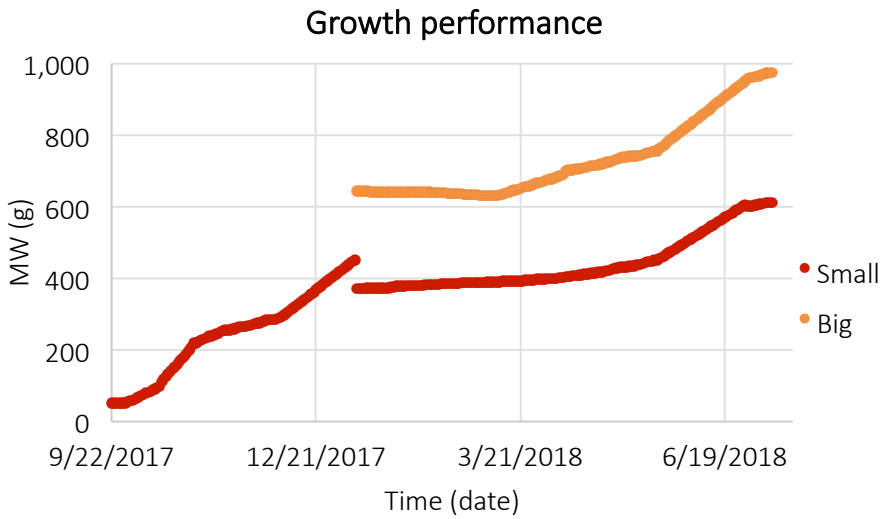
- In some cases parasites outbreak resulted in loss of more than 50% of the group
  - Later successfully treated with hydrogen peroxide
- All groups developed high size variability



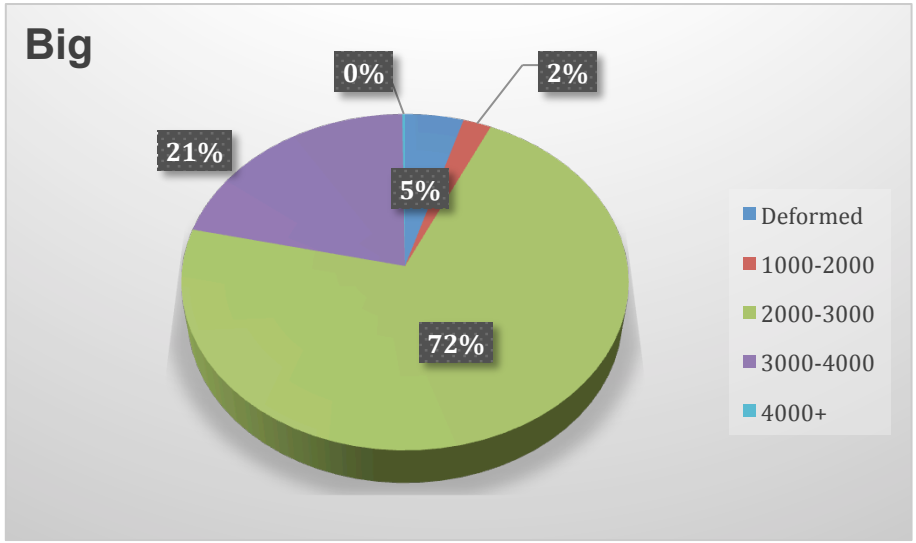
2016

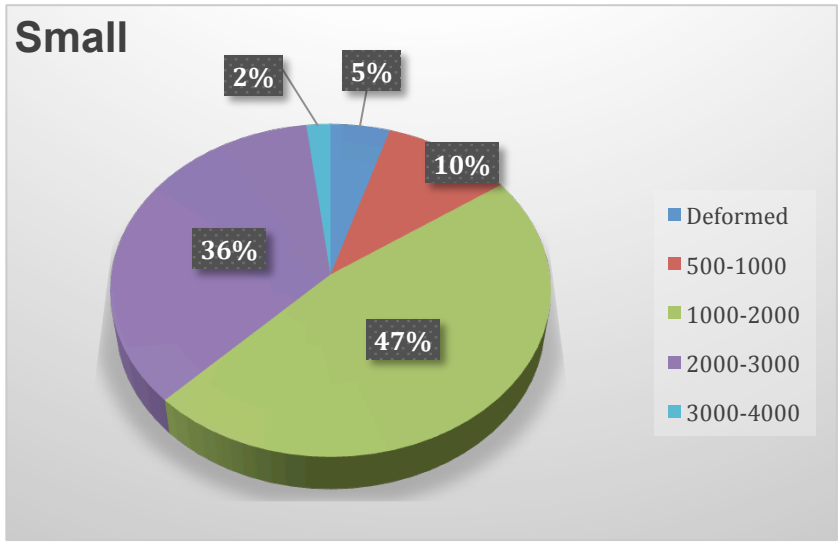


2017



Size distribution at harvesting 18 months post hatching





The rearing of greater amberjack in commercial cages although thought to be easy remains still a challenge

- The fish accept commercial feeding of appropriate composition
  - high protein (of fish origin) prepared at commercial scale
- No problem with standard husbandry practices
  - net cleaning/changing and
  - stocking density of max apx 5 kg m^{-3} is acceptable for a pelagic fish

- The species specific parasites
  - treatment with peroxide is well established and confirmed
  - application is not easy and methodologies for big cages should be developed
- The bacterial infections
  - *V. harvey* causing significant mortalities (HCMR)

- It exists a clear commercial potential for the species

Health

Dr. Pantelis Katharios et al, HCMR
Prof. Chris Secombes et al, Aberdeen University
Prof. Daniel Montero et al, FCPCT
Prof. Covadogna Rodriguez et al, ULL
Dr. Salvador Jerez et al, IEO

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- Immune system and Immunomodulation
  - Identification and mapping of the immune-related genes
- Epitheliocystis
  - Toolbox for proper diagnosis
- Vibriosis - *Vibrio harvey*
  - Difficult to treat
- Parasites - *Zeuxapta seriolae*
  - Hydrogen peroxide extremely effective

Market, Consumer perception, new products and business model

G. Tacken, M. Reinders, M. Banovic, R. Robles, L. Guerrero, A. Krystallis, H. Saltavarea, K. Larentzakis

LEI WAGENINGEN UR

AARHUS UNIVERSITY
MAPP Centre for research on customer relations in the food sector

HELLENIC RESEARCH HOUSE

IRTA

ctaqua
CENTRO TECNOLÓGICO DE LA ACUICULTURA

- 3 product ideas for G. amberjack
  - Fresh greater amberjack fillet received the highest score

- A **consumer acceptance** test
  - greater amberjack needs extra clarification to consumers before introducing the products in the market

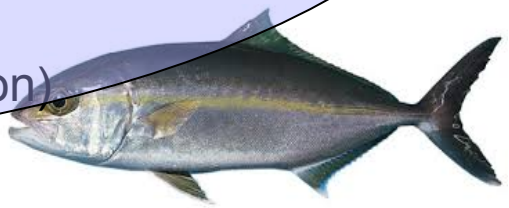
What next
for G. amberjack?

- **Biological barriers**
  - Nutrition
    - Studies in all stages of production: breeders, larvae, on-growing
  - Reproduction
    - off season egg production, reproduction in land based facilities, natural spawning
  - Larval rearing
    - size variability, husbandry practices
  - On growing
    - size variability, husbandry practices
  - Pathology
    - prevention schemes
    - oral antiparasitic treatment

Coordination between producers

- for site selection
- pathology management
- promoting the product

- **Marketing/ trade-mark/ product development**
  - Develop a trademark
  - G. amberjack should not be “one-more-fish”
    - base for more fish-products (the example of salmon)



Thank you!

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Forkys