ParaFishControl

Impact of parasite infections in sea bream and sea bass farms: the ParaFishControl approach

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CSIC
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 634429. This output reflects the views only of the author(s), and the European Union cannot be held responsible for any use which may be made of the information contained therein.

Economic impact of parasites

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- **Pathogens can produce financial losses estimated to be about 20% of the total production value**
- **World grow-out loss due to parasites in finfish farming can reach 10% of annual harvest and up to $9.58 billion. Due to:**
- **Direct mortalities**
- **Morbidity: not economically measured in most cases:**
  - **Growth retardation: lower feed intake and feed conversion efficiency**
  - **Parasitic castration**
  - **Reduced marketability, quality and durability**
  - **Higher susceptibility to other pathogens**
  - **Higher susceptibility to stress and handling**

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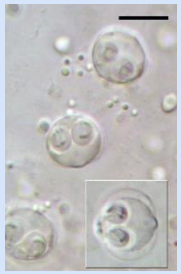
3 M€
UK

PKD

102 M€

ICH

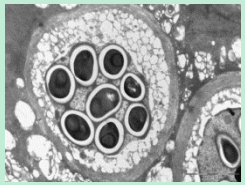


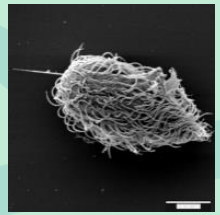
300 M€

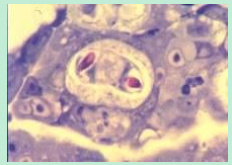
36M€
Scotland

AGD

SEA LICE







WHY PARASITIC DISEASES ARE EMERGING?

Multifactorial reasons

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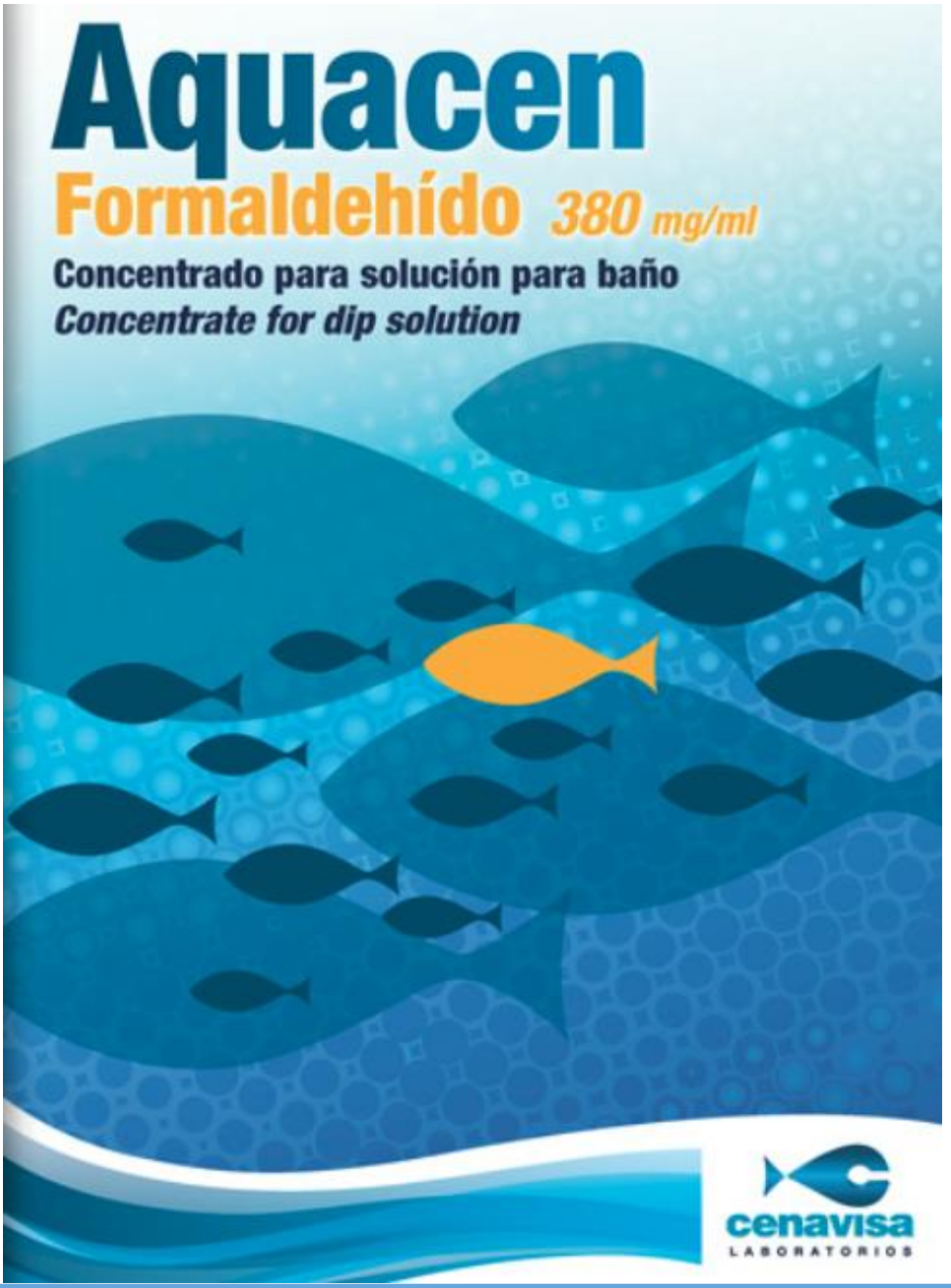
- Historically neglected
- Not properly diagnosed
- Few commercial treatments
- No vaccines available
- Legislation does not help:
  - Fish diseases are controlled under directive 2006/88/CE only one parasite is included (*Gyrodactylus salaris*)
  - No parasite is included in the lists of OIE of notifiable fish diseases
  - Once sacrificed, if bad condition is detected, fish must be removed from the market (93/140/EC)



Aquacen

Formaldehído 380 mg/ml
Concentrado para solución para baño

Formaldehído 380 mg/ml
Concentrate for dip solution

AQUACEN FORMALDEHIDO 380 mg/ml
Concentrado para solución para baño
Rodaballo *(Psetta maxima)*

COMPOSICIÓN CUALITATIVA Y CUANTITATIVA
Sustancia activa:
Formaldehído.....380 mg/ml
Excipientes, c.s.

ESPECIES DE DESTINO
Peces: Rodaballo *(Psetta maxima)*, dorada *(Sparus aurata)*

INDICACIONES
Rodaballo: Control de la parasitosis externa por *Philasterides dicentrarchi*. Se reduce la mortalidad de los animales infestados, pero no se elimina totalmente la infestación. El tratamiento no es efectivo una vez el parásito ha penetrado en el interior del pez.
Dorada: Tratamiento y control de parasitos externa por *(Sparicotyle chrysophrii)*

POSOLOGÍA Y VÍA DE ADMINISTRACIÓN
Efectuar baños con 95 g de formaldehído/1000 L de agua, equivalente a 250 ml de AQUACEN FORMALDEHIDO 380 mg/ml / 1000 L de agua, durante una hora. Los baños se realizarán una vez a la semana durante un máximo de 3 aplicaciones consecutivas.
En doradas se considera una aplicación única.

TIEMPO DE ESPERA
Carne: cero grados-día.

PRESENTACIONES:
Envases de 25 l, 200 l y 1.000 l.

Nº AUTORIZACIÓN COMERCIALIZACIÓN: 2127 ESP.
Medicamento sujeto a prescripción veterinaria. Administrar bajo control o supervisión del veterinario

AQUACEN FORMALDEHÍDO 380 MG/ML
Concentrate for dip solution
Turbot and sea bream

QUALITATIVE AND QUANTITATIVE COMPOSITION
Active substance
Formaldehyde.....380 mg/ml

TARGET SPECIES
Turbot: *(Psetta maxima)* and sea bream *(Sparus aurata)*

INDICATIONS
Turbot: Control of external parasitosis by *Philasterides dicentrarchi*. At the recommended dose and posology, the mortality of infested animals is reduced, but the infestation is not completely eliminated. The treatment is not effective once the parasite has penetrated inside the fish.
Sea bream: Treatment and control of external parasitosis by *Sparicotyle chrysophrii*.

DOSAGE AND ROUTE OF ADMINISTRATION
Dip with 95 g of formaldehyde/1000 L of water, equivalent to 250 ml of AQUACEN-FORMALDEHYDE 380mg/ml / 1000 L of water, for one hour. In gilthead is considered a single application while in turbot, dipping will be done once a week for a maximum of 3 consecutive applications.

WITHDRAWAL PERIOD
Zero degree-days

PACK SIZES
25 l, 200 l and 1.000 l.

MARKETING AUTHORIZATION NUMBER: 2127 ESP.
Medicinal product subject to veterinary prescription. To be administered by a veterinary or under their direct responsability.

cenavisa
LABORATORIOS

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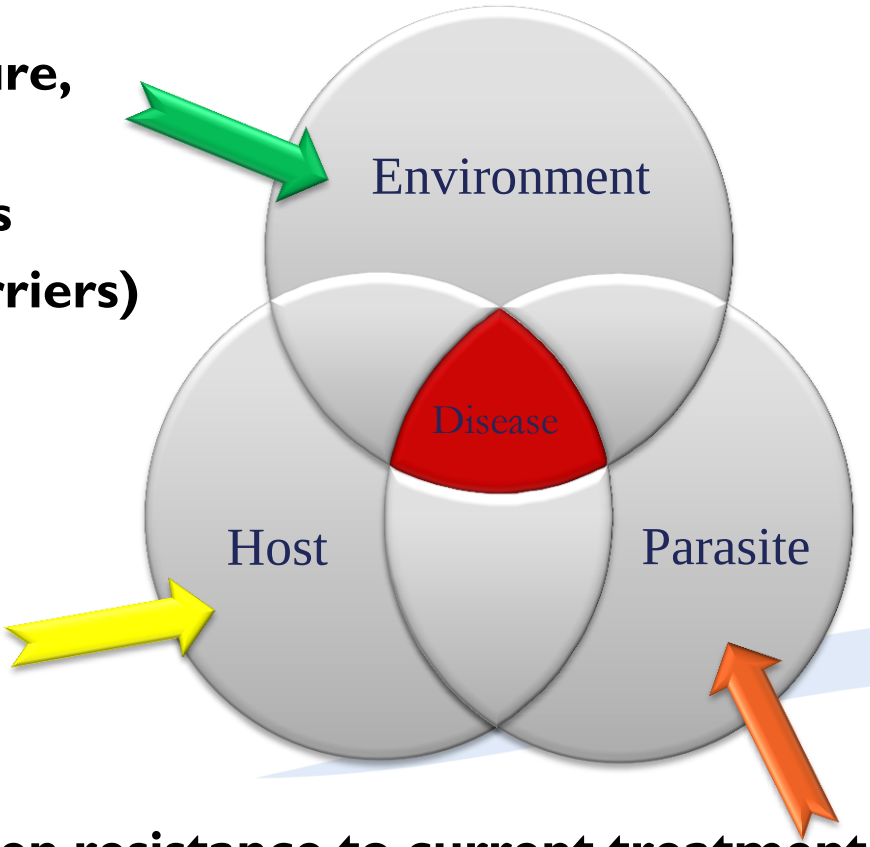
Emerging parasitoses: why?

- Stressful culture conditions
- Water quality: salinity, temperature, pollution, turbidity
- Favouring aquaculture procedures
- Introduction of exotic species (carriers)
- Changes in food supply
- Climate change



- Lower immunocompetence
- Lower resistance threshold
- Increase of sensitive populations

- Pathogen resistance to current treatments
- Natural selection of pathogenic strains
- Better diagnostic methods

Culture systems

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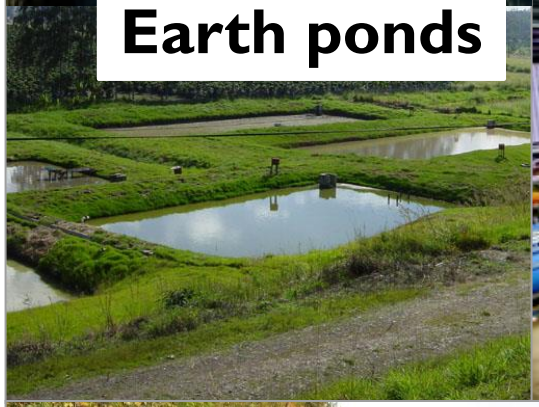
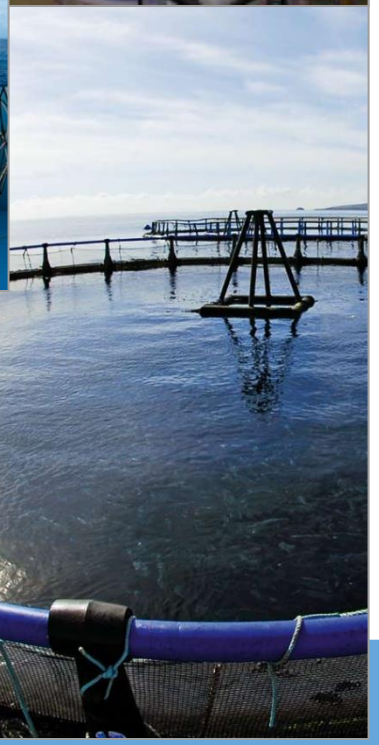
Earth ponds

Indoor tanks

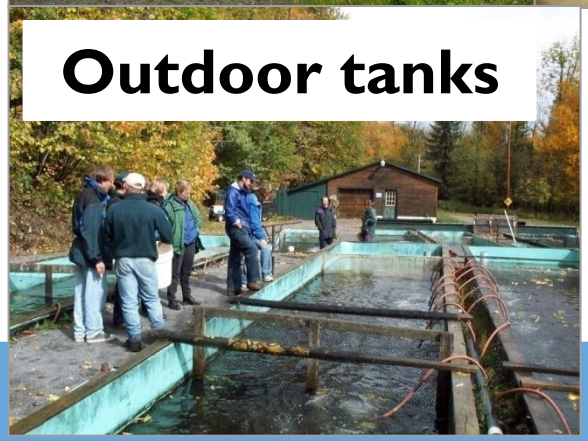
RAS





Sea cages

Outdoor tanks



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Sea cage culture: a paradise for parasites ?

- Non-controlled water
- Introduction of juveniles from other areas
- Acces to invertebrate intermediate hosts
- Biofouling in nets
- Contact with wild fish (natural or reservoir hosts)
- Non-controlled effluents (mucus casts, faeces, dead animals, escapees): parasite life cycles keep going…
- Treatments are difficult and expensive

Ectoparasites

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Group/Species	Host site	Host
MONOGENEA		
Diplectanum aequans	Gills	ESB
Furnestinia echeneis	Gills	GSB
*Sparicotyle chrysophrii**	Gills	GSB
CRUSTACEA		
Anylocra physodes	Gills, skin	ESB, GSB
*Caligus minimus**	Oral cavity, skin	ESB, GSB
*Ceratothoa oestroides**	Oral cavity	ESB, GSB
*Lernanthropus kroyeri**	Gills	ESB
Nerocila orbingnyi	Gills, skin	ESB
PROTOZOA		
Amyloodinium spp.*	Skin, gills	ESB, GSB
Brooklynella hostilis	Gills	ESB, GSB
Cryptobia spp.	Gills	ESB, GSB
Cryptocaryon irritans	Gills	GSB
Neoparamoeba spp.	Gills	ESB, GSB
Trichodina spp.	Gills	ESB, GSB

* Included in ParaFishControl Project

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Endoparasites

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Group/Species	Host site	Host 
DIGENEA		
Cardicola aurata	Gills	GSB
APICOMPLEXA		
Cryptosporidium molnari	Stomach	GSB, ESB[1]
Eimeria dicentrarchi	Intestine	ESB
Eimeria sparis	Intestine	GSB
Goussia sparis	Intestine	GSB
MICROSPORIDIA		
Glugea sp.	Muscle	GSB
*Enterospora nucleophila**	Intestine	GSB
Pleistophora sp.	Muscle	GSB
MYXOZOA		
Ceratomyxa labracis	G. bladder	ESB
Ceratomyxa diplodae	G. bladder	GSB
Ceratomyxa sparusaurati	G. bladder	GSB
*Enteromyxum leei**	Intestine	GSB, ESB[1]
Kudoa sp.	Muscle	GSB
Kudoa iwatai	Systemic	GSB
Leptotheca sparidarum	Trunk kidney	GSB
Ortholinea auratae	U. bladder	GSB
Sphaerospora dicentrarchi	Systemic	ESB
Sphaerospora (ex. Polysporoplasma) sparis	Trunk kidney	GSB
Sphaerospora testicularis	Testis	ESB

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Ectoparasites

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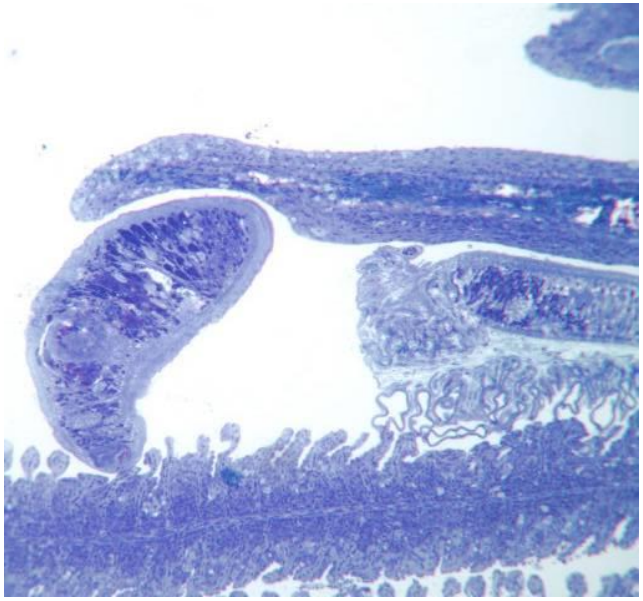

Sparicotyle chrysophrii

Ceratothoa oestroides

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Lernanthropus kroyeri

Dr. Panos Varvarigos,
Vet care, Greece

Endoparasites

Intestine

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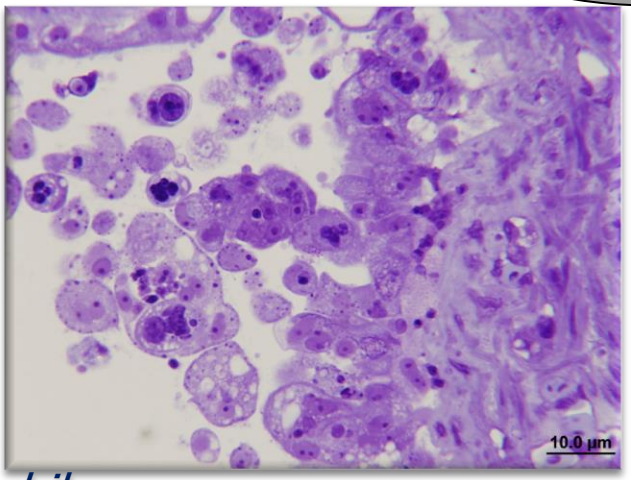
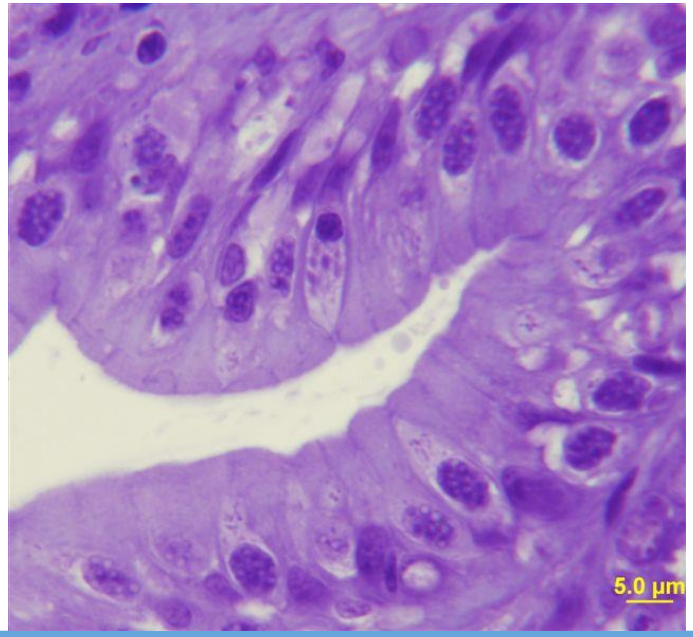
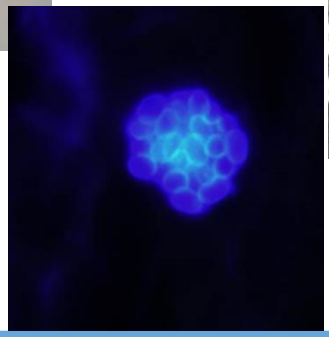
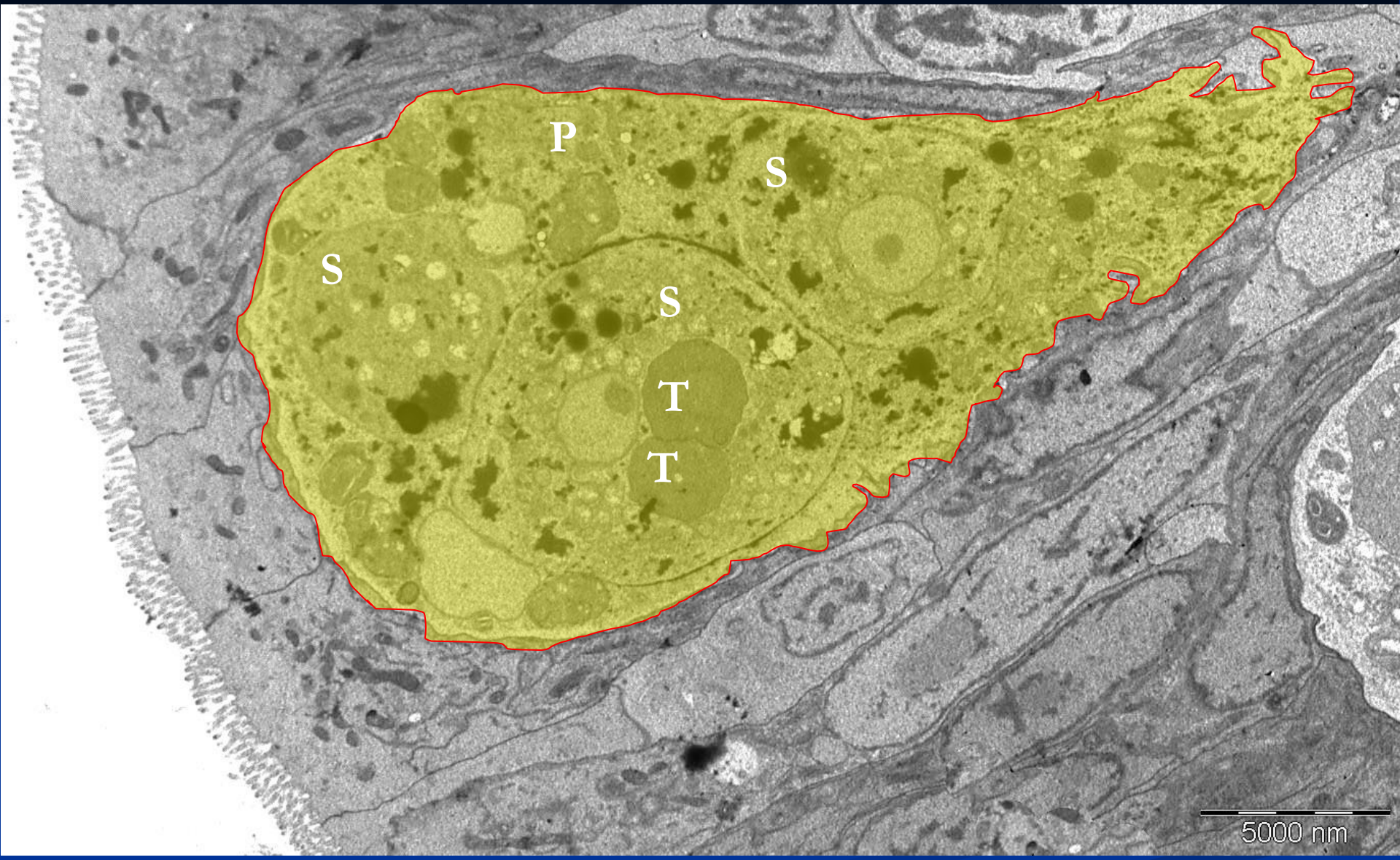
Enteromyxum leei



Enterospora nucleophila

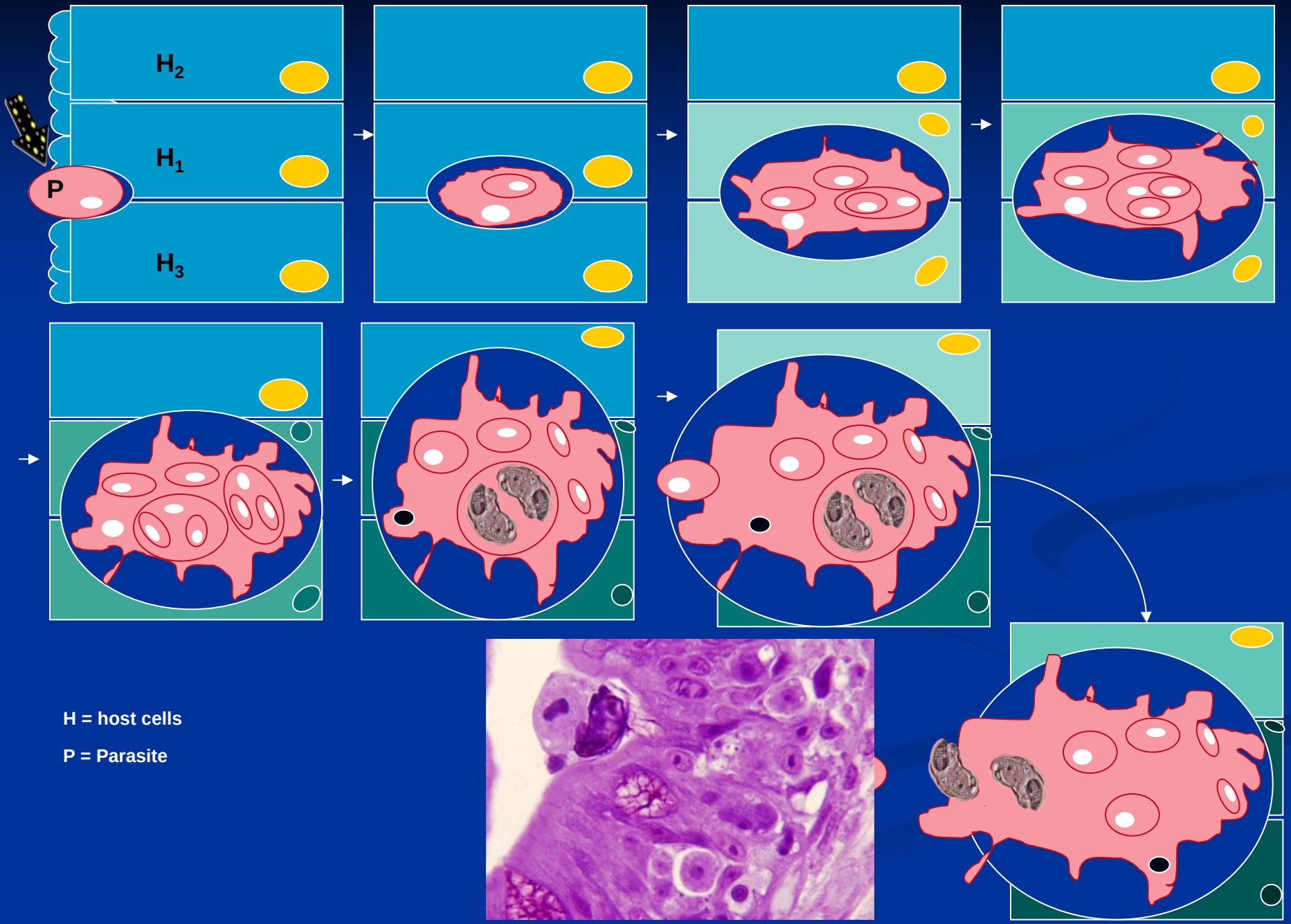






***E. leei* lives in the paracelullar space in the epithelial layer (mucosa)**

HYPOTHETICAL PROGRESSION OF *E. leei* trophozoites between epithelial gut cells

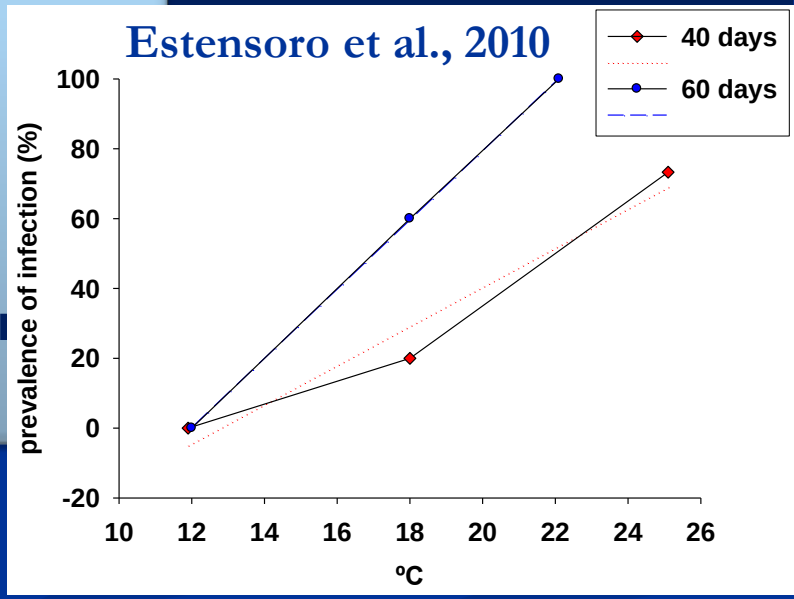


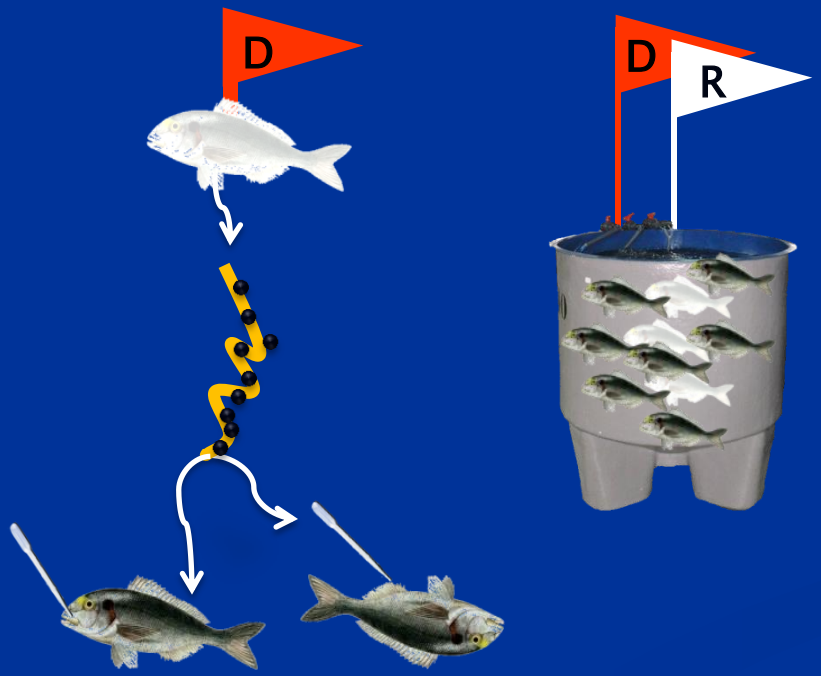
H = host cells

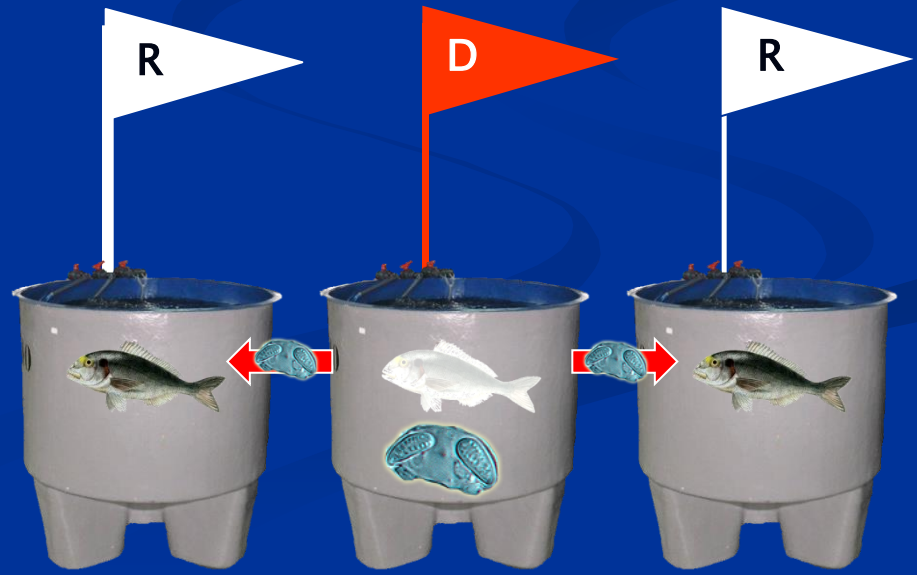
P = Parasite

Enteromyxum leei models

- **Fish-to-fish transmission: experimental transmission by**
  - **Effluent**
  - **Cohabitation**
  - **Perorally**
  - **Peranally**
- **Life cycle: unknown**
- **Infection and mortality: temperature depe**







Cryptosporidium molnari

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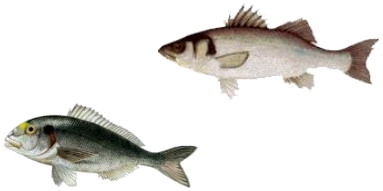
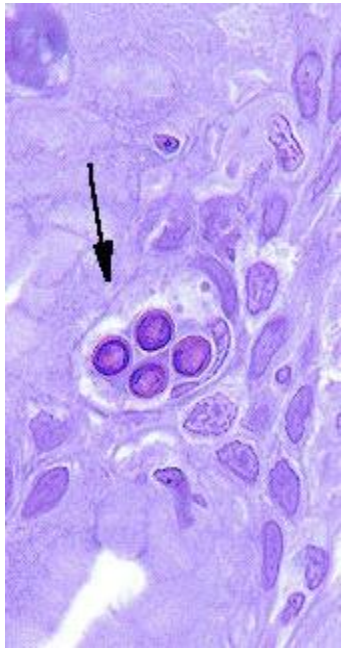
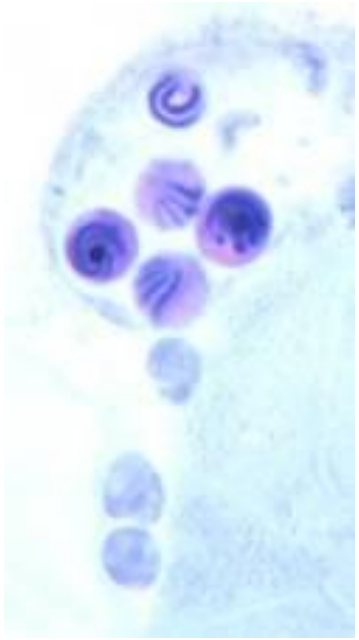
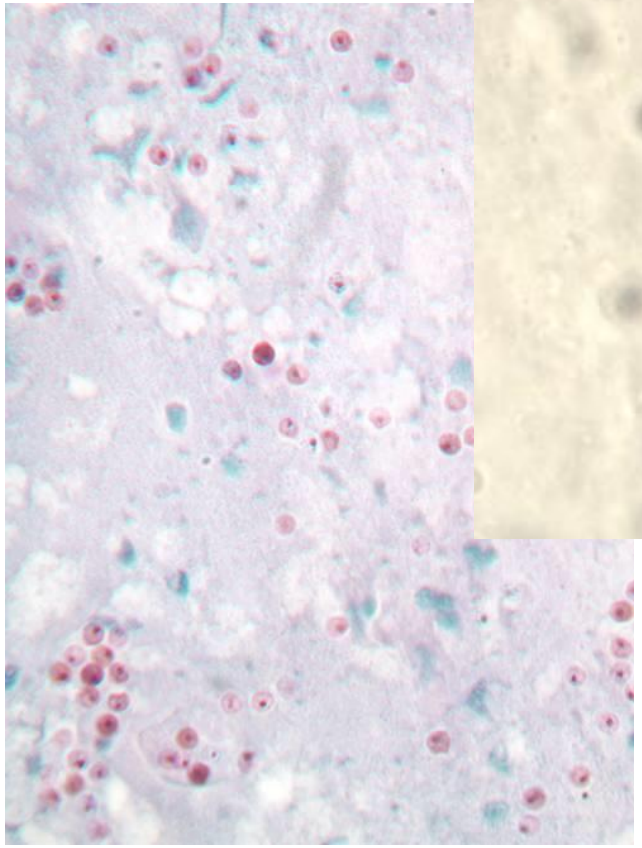
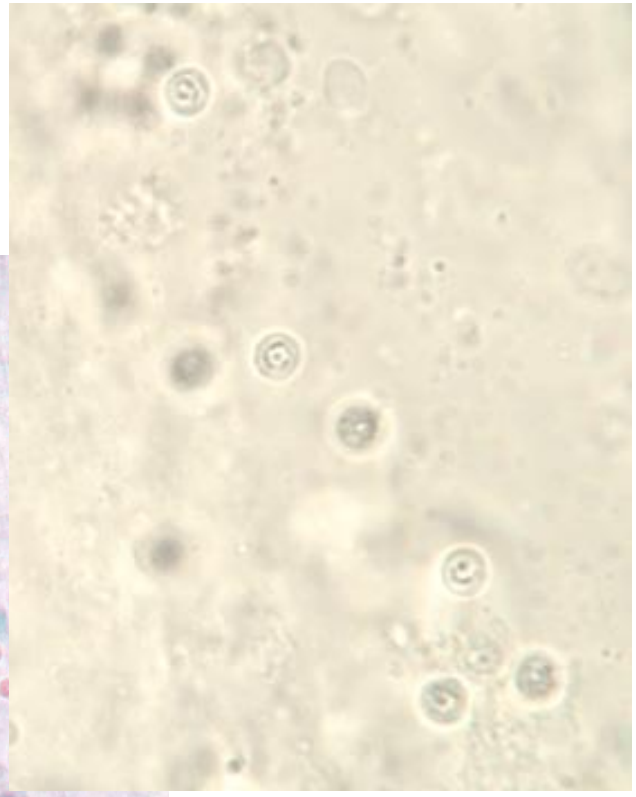


Stomach









Alvarez-Pellitero & Sitjà-Bobadilla, 2003

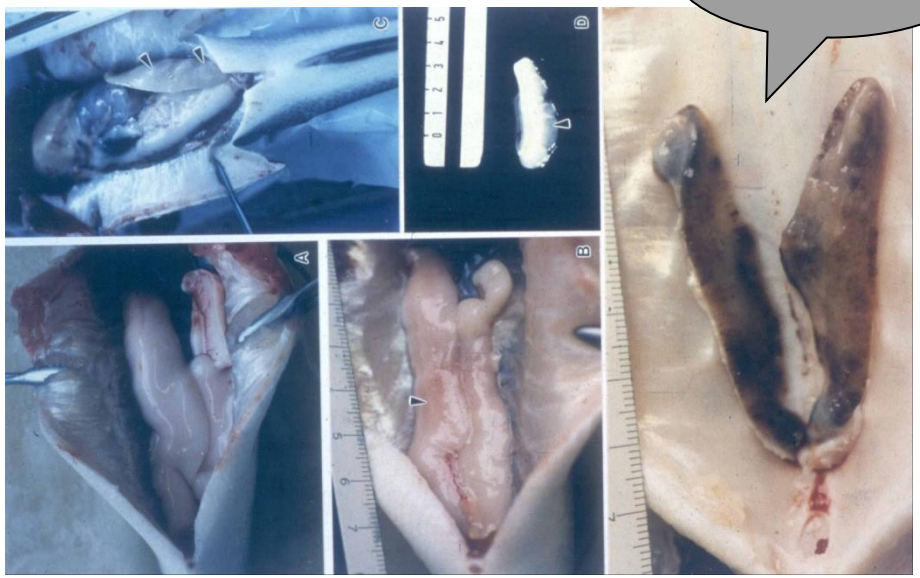
Sphaerospora dicentrarchi

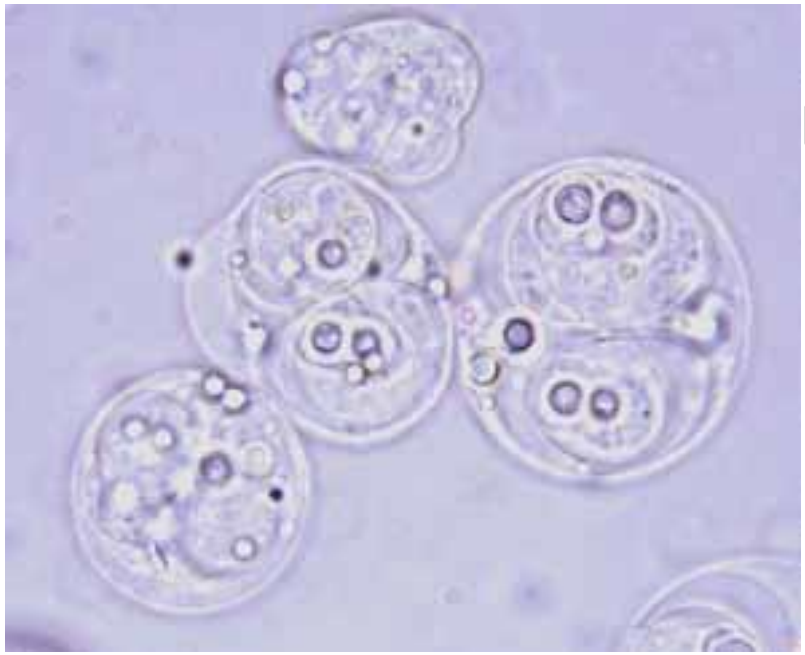
Systemic

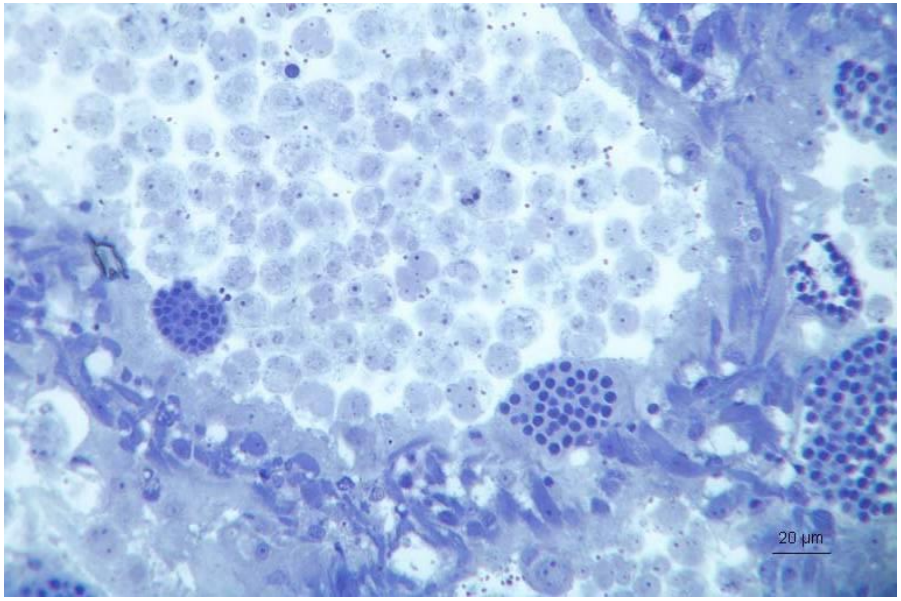
Sitjà-Bobadilla & Alvarez-Pellitero, 1992, 93

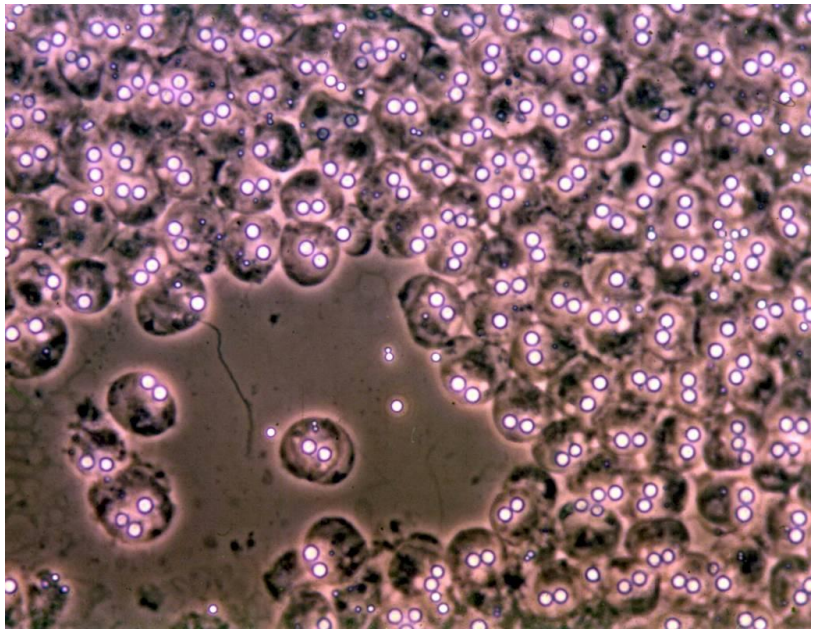
Sphaerospora testicularis

testis





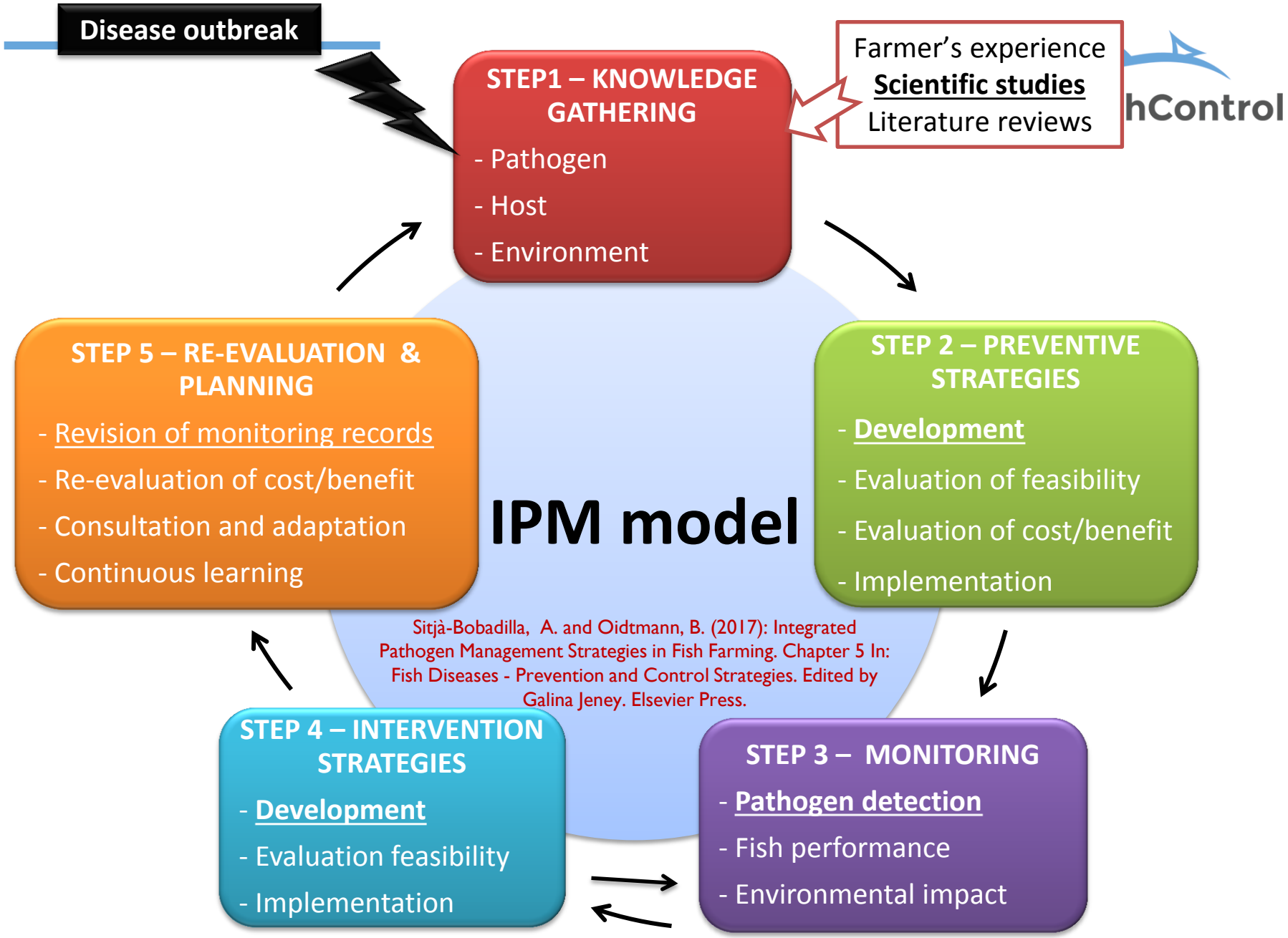




Sitjà-Bobadilla & Alvarez-Pellitero, 1990, 92, 93


SOLUTIONS!!

IPMS



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ParaFishControl

- **Advanced Tools and Research Strategies for Parasite Control in European farmed fish**
- 5 years collaborative project
- Total cost: 8 104 133.75 €
- EU contribution: 7 800 000 €
- **The overarching goal**: to increase the sustainability and competitiveness of European Aquaculture by improving understanding of fish-parasite interactions and by developing innovative solutions and tools for the prevention, control and mitigation of the major parasites affecting Atlantic salmon, rainbow trout, common carp, **European sea bass, gilthead sea bream** and turbot

Consortium overview

ParaFishControl

Expertise in:

- Parasitology
- Epidemiology
- Immunology
- Molecular biology
- Genetics
- Genomics
- Food safety
- Pathology
- Chemotherapy

Access to:

- research facilities
- biological resources
- host-parasite models
- vaccinology
- genomics
- proteomics
- transcriptomics

29 partners

13 countries

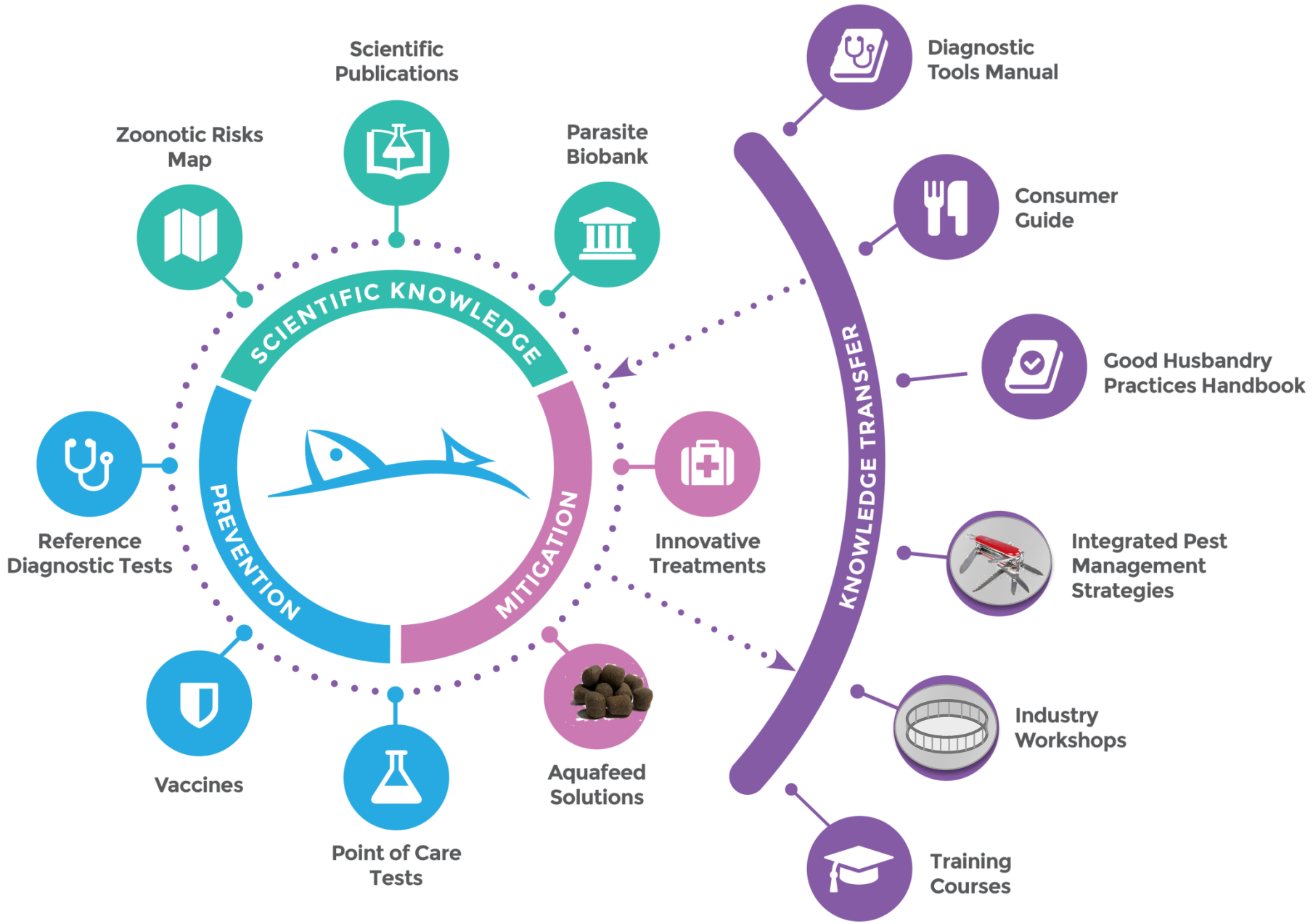
20

6

3

Project description

WP1	**Host-parasite interactions:** Study transcriptomes and determine key genes (NGS); Proteomics to determine key proteins of parasites and their hosts. Use data to identify potential drug and/or vaccine targets and develop diagnostic tests
WP2	**Wild-farmed fish parasite transfer:** Develop necessary molecular tools and collect data to help provide a basis for better/novel zooprophylactic strategies
WP3	**Prophylaxis: Vaccine development and testing** at lab and field trials and development of **immunostimulatory feeds** with *in vitro* tests and farm trials
WP4	**Diagnostics:** Lab tests with analytical optimisation; Reference diagnostic tests, validated methods in ringtests; Rapid on-site assessment, point-of care kits
WP5	**Innovative treatments:** Rapid to implement alternative treatments; Water- and fish rearing unit treatments; Optimised use of predator fish; Newly identified reagents for parasite treatment; Targeted treatments/immunotherapy
WP6	**Risk analysis and surveillance**: Biosecurity and IPMS; Tools for assessing economics of alternative control strategies; Future risks and sector level solutions and future challenges; Deposition of parasite samples and metadata in Biobank
WP7	**Fish product safety:** On-site detection of presence of zoonotic parasites based on validated/calibrated detection methods; Establishment of a Voluntary Control System; Good Practice Handbook for parasite-free culture
WP8	**Dissemination, technology transfer and take-up**
WP9	**Coordination and Management**

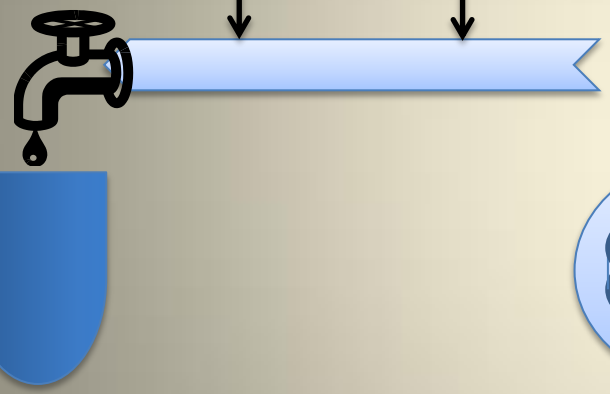


Expected outputs

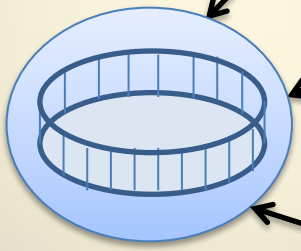
Strategies to reduce environmental risks

Water treatments

Selection of inflow sites



Inland facilities



Off-shore facilities

Selection of sites
- Type of bottom
- Distance to bottom
- Distance to the shore
- Distance to other facilities
- Sea currents

Timing of site use
- Season
- Fish age
- Fallowing
- Entering time

Avoidance of entrance of biological material
- Biofouling
- Wild fauna
- Pathogens

Strategies to reduce host risks

Management actions
- Improvement of rearing conditions
- Year-class separation
- Removal of infected /dead fish
- Farm hygiene
- Control of stock movements
- Quarantines
- Periodic health surveillance

Exploitation of the immune system
- Vaccination
- Immunostimulation
- Selection for resistant strains

Sitjà-Bobadilla, A. and Oidtmann, B. (2017): Integrated Pathogen Management Strategies in Fish Farming. Chapter 5 In: Fish Diseases - Prevention and Control Strategies. Edited by Galina Jeney. Elsevier Press.

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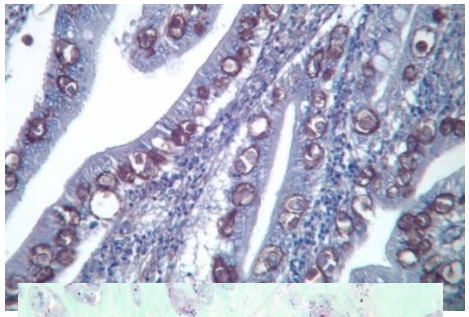
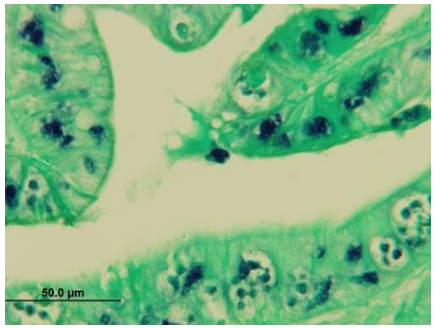
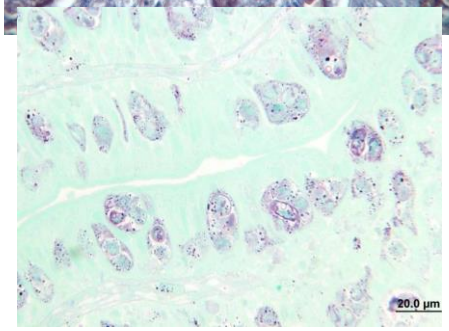
First: Parasite diagnosis





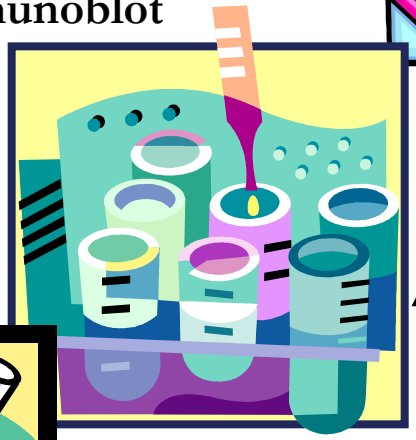
Tools available for *Enteromyxum*



PCR, Q-PCR
ISH

Immunoblot

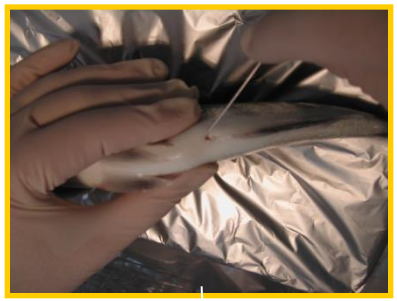
ELISA



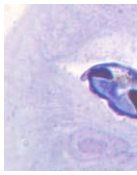
Molecular probes

IHC

Histochemistry

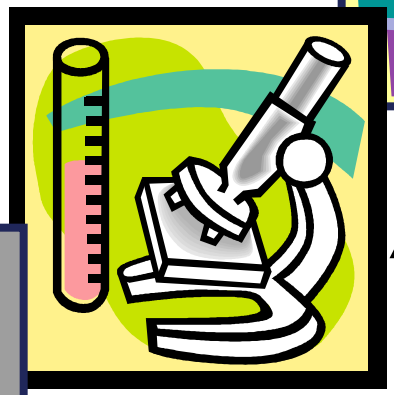


Non-lethal probing

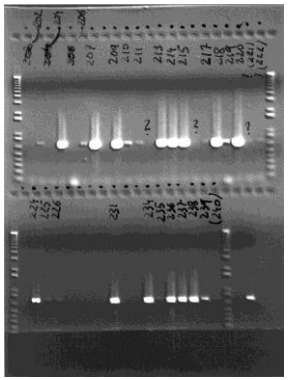


Histology

Fresh smears

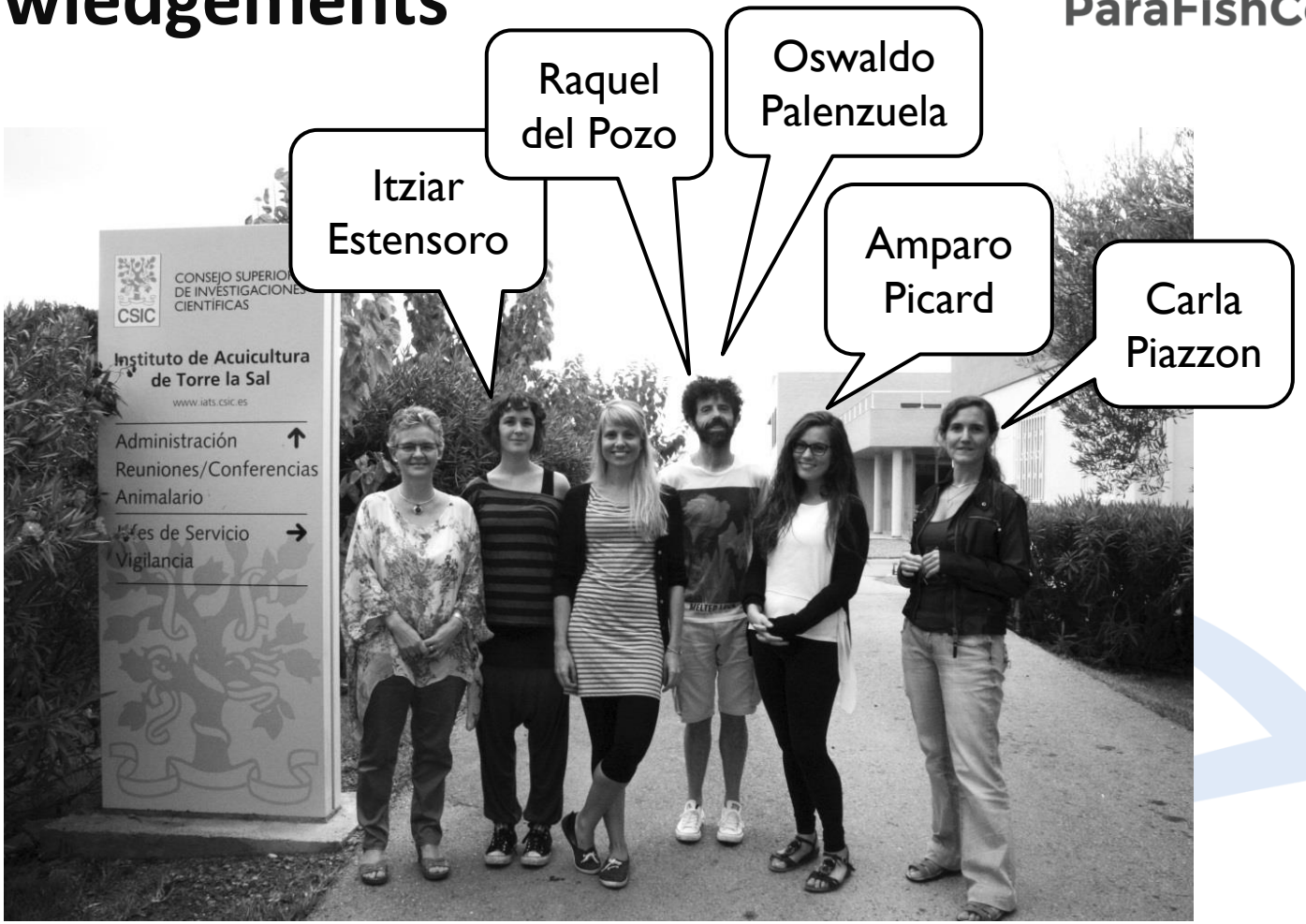


Immunoassays



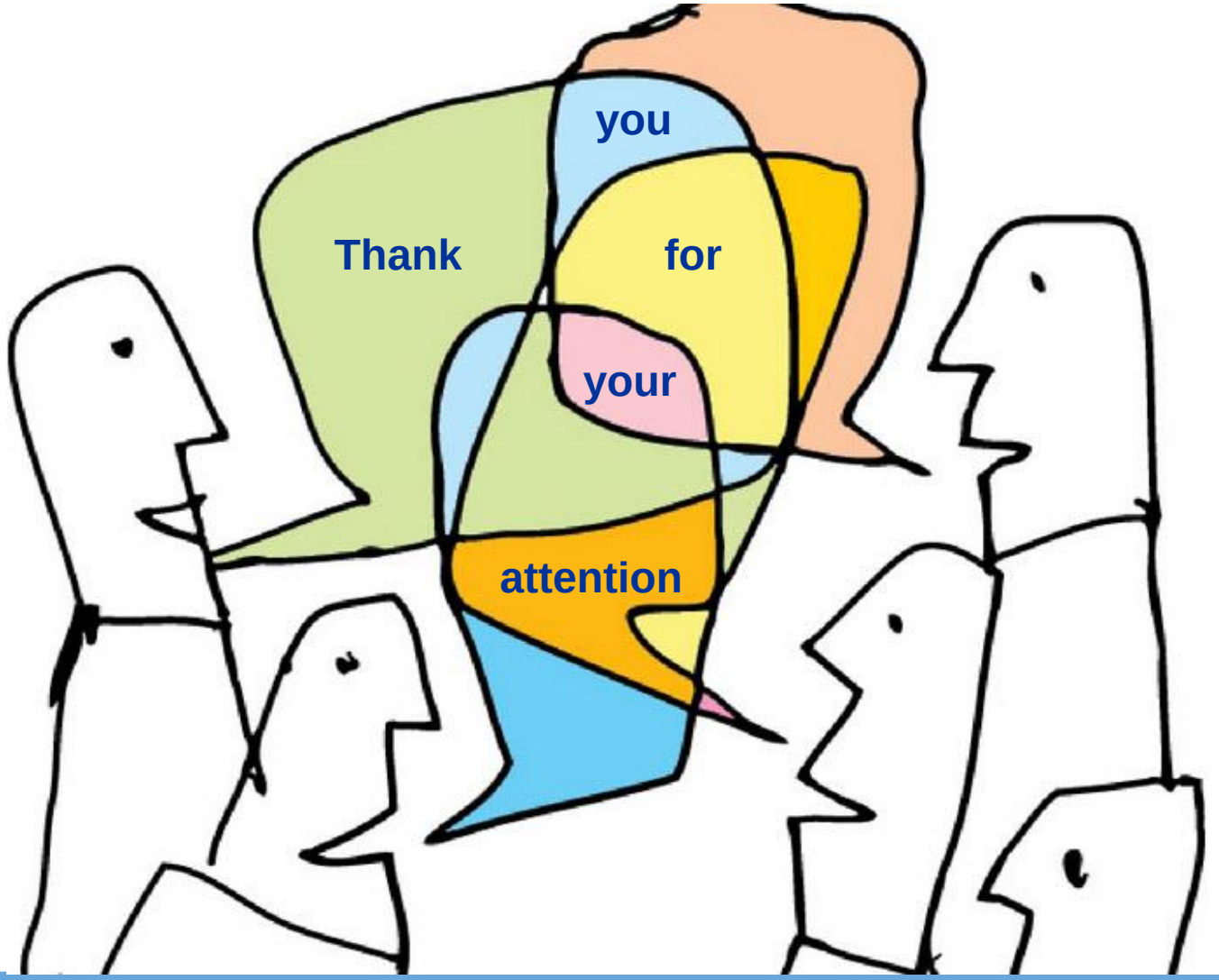
Microscopy

Acknowledgements



Fish Pathology Group

Collaboration with Nutrigenomics and Fish Growth Endocrinology Group


you
Thank
for
your
attention