INDUSTRIAL MEDITERRANEAN LARVAL CULTURE

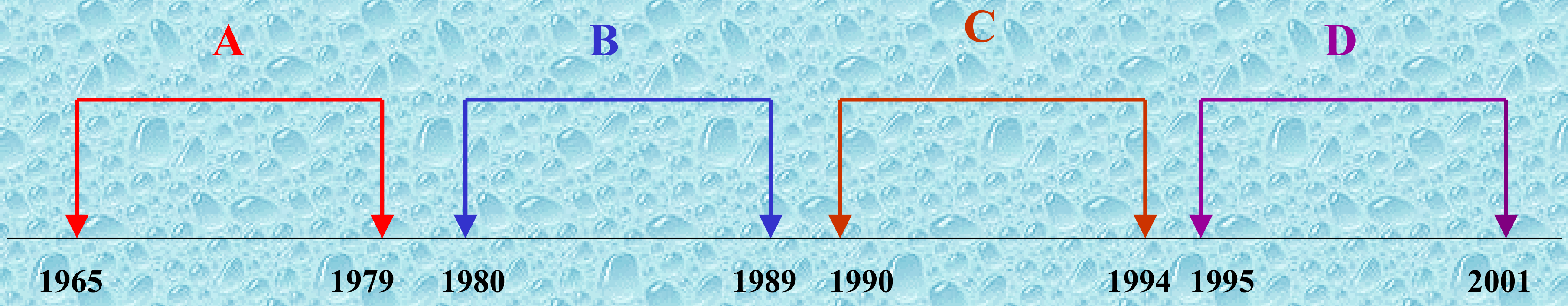
A success story

or

continuing struggle ?

MEDITERRANEAN FINFISH MARICULTURE

Evolution of an Industry



A=Research, B=Predevelopment, C= Development, D=Maturation

MEDITERRANEAN FISH PRODUCTION 1990 - 1994

FRY (in mil.)	1990	1991	1992	1993	1994
GREECE	14	23	37	60	70
TOTAL MEDITERRANEAN	25	35	53	78	90

READY PRODUCT (in tons)	1990	1991	1992	1993	1994
GREECE	1,600	2,500	6,000	8,500	13,500
TOTAL MEDITERRANEAN	5,620	8,460	14,550	19,870	37,180

Source: FEAP

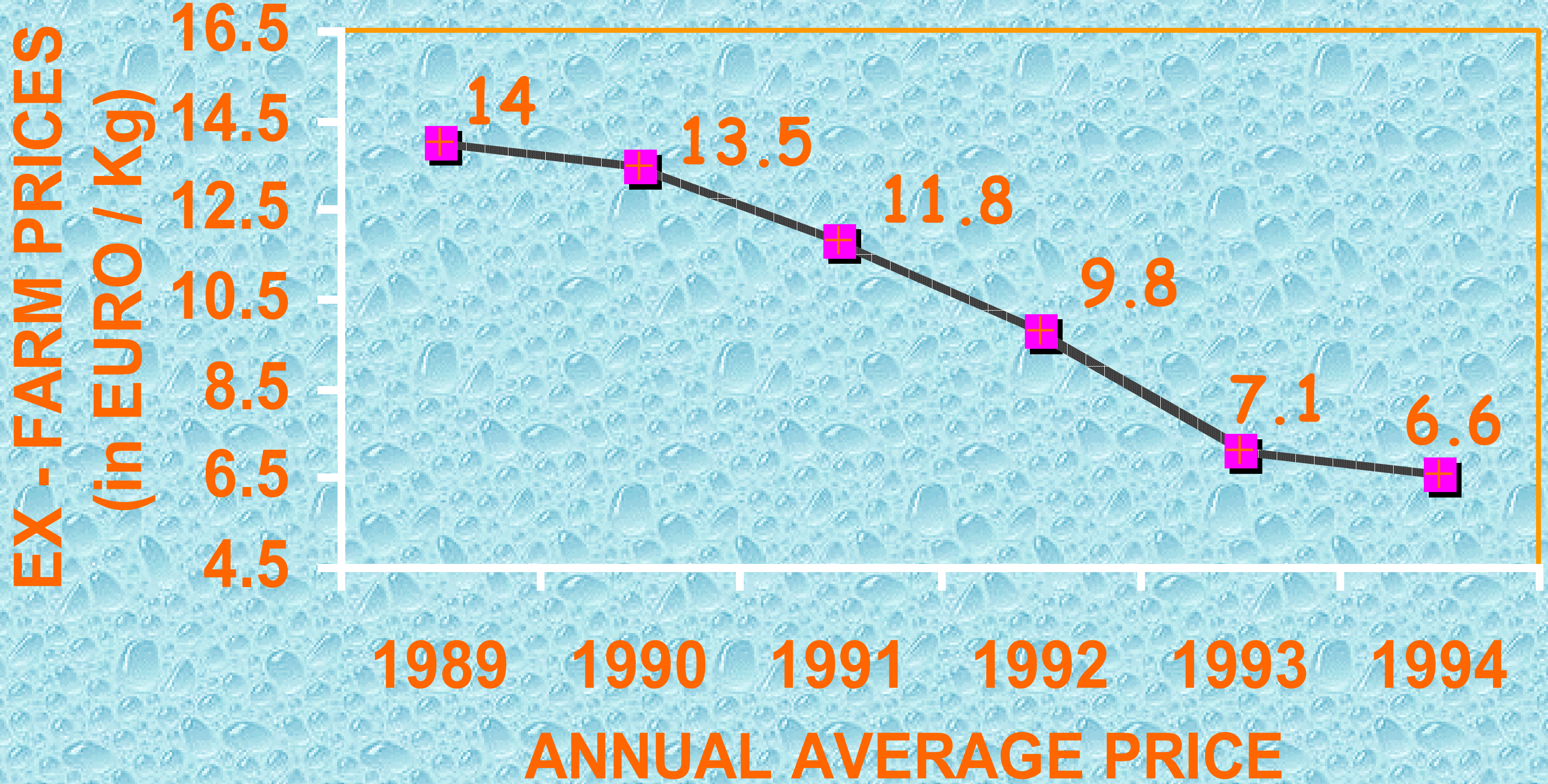
MEDITERRANEAN FISH PRODUCTION 1995 - 1999

FRY (in mil.)	1995	1996	1997	1998	1999
GREECE	96	95	100	160	187
TOTAL MEDITERRANEAN	184	228	295	376	451

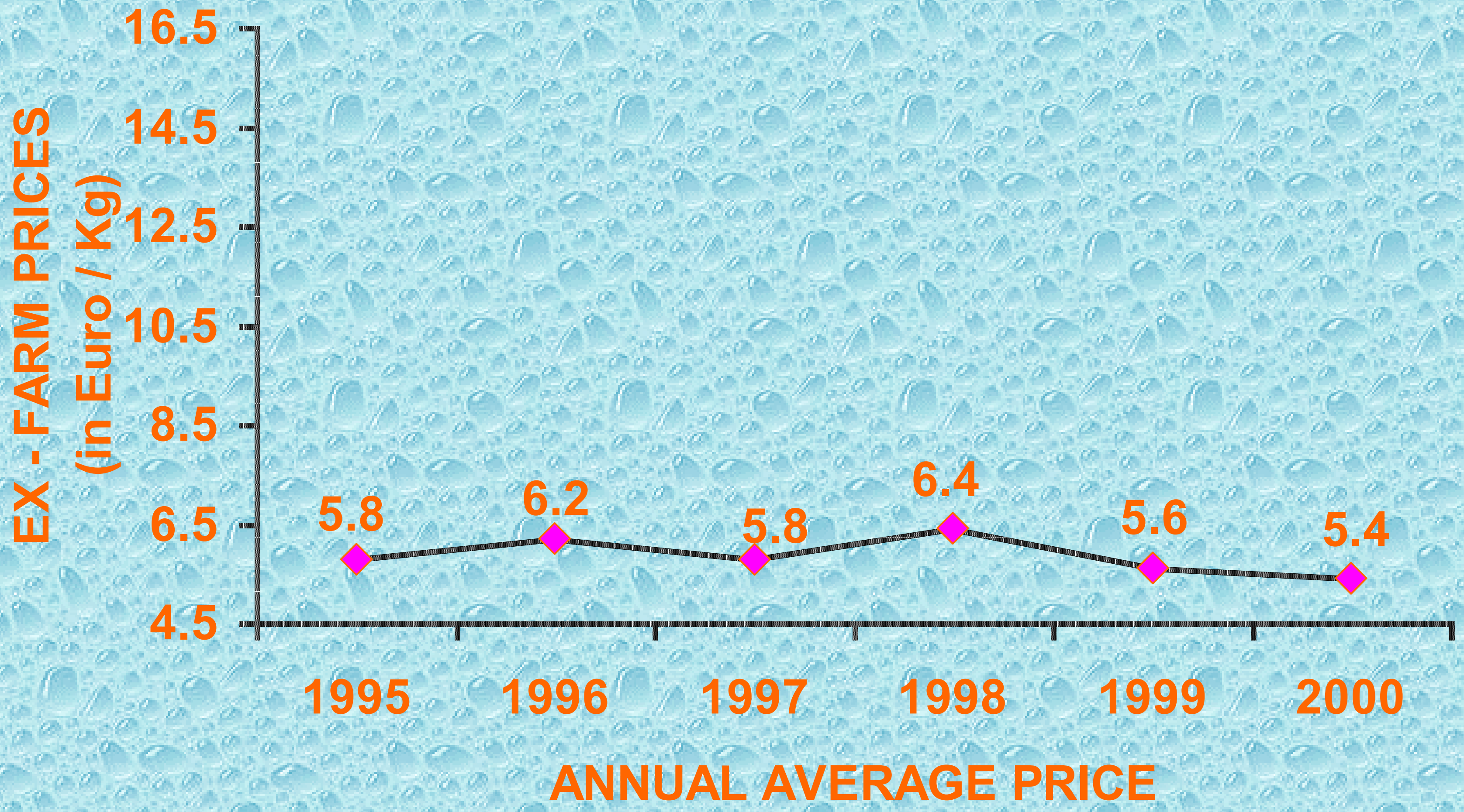
READY PRODUCT (in tons)	1995	1996	1997	1998	1999
GREECE	17,000	21,000	28,000	36,000	48,000
TOTAL MEDITERRANEAN	47,500	55,410	66,900	79,860	94,870

Source: FEAP

EX-FARM PRICE EVOLUTION OF SEA BREAM AND SEA BASS 1989 - 1994



EX-FARM PRICE EVOLUTION OF SEA BREAM AND SEA BASS 1995 - 2000



MEDITERRANEAN FRY PRODUCTION HISTORY

1991: Early days

- Low fry availability, high fry prices and short payment terms.
- Inexperience in the majority of farmers
- Problems associated with fry quality (deformities, losses during transport etc) were dealt with a large degree of tolerance.
- *Pasteuella* and *vibrio* were major problems as vaccines were not available yet.
- There were only a few hatcheries in business.
- Bass and bream were the only farmed species.

MEDITERRANEAN FRY PRODUCTION HISTORY

1992

- Awareness of fry quality and how this effects the end product starts becoming more established.
- Bacterial diseases were still common with poor antibiotic management.
- Parasities common in cage farms, due to high densities and lack of use of net antifouling.
- The first steps were taken to produce new species such as *Puntazzo puntazzo, Diplodus sargos* and *Dentex dentex*.

MEDITERRANEAN FRY PRODUCTION HISTORY

1993:

- The first incidences of sea bass mortality showing nervous symptoms without a causative agent being readily identifiable.
- Marked increase in fry output from all Mediterranean hatcheries resulting in a considerable drop in fry prices.
- *Puntazzo puntazzo* starts having disease problems, mainly with external parasites in cage farms.
- Other new species such as *Pagrus pagrus* and *Pangellus erythrinus* are produced but despite excellent growth results there are noticeable problems in the colour of the finished product.

MEDITERRANEAN FRY PRODUCTION HISTORY

1994:

- Increased production as many farms increase mechanisation.
- This year we have the first incidences of bad debts from wholesalers.
- The first incidences of high mortality in *Puntazzo* due to *myxosporideans* for which no treatment is available.
- There were further increases in fry production with the first intensive Mediterranean production of *Mugal chephalus* from Riopesca.

MEDITERRANEAN FRY PRODUCTION HISTORY

1995

- Wide incidences of disease this year and high VNN mortality in Greek farms.
- *Pasteurellosis* and *Vibrio* were still common, but vaccines start to be developed.

1996

- High production of table fish results in low prices.
- Lower Greek fry production results in increased imports and fry prices fall even lower.
- There are many cases of fry deformities in bream and Rickettsia in seabass fry.

MEDITERRANEAN FRY PRODUCTION HISTORY

1997

- Low fry and ready product prices continue into the year.
- The introduction of Atlantic bream breeding stock into Greek fry production improves the poor winter growth shown by the native Mediterranean stock.

MEDITERRANEAN FRY PRODUCTION HISTORY

1998

- Numerous hatcheries (more than 15) and over 200 ongrowing farms established within Greece.
- Greek drachma depreciation drives ready product prices up. (450 – 600 g size bream at 7.57€/kg).
- This is the year when all farmers increased their fry stocking.
- Noda virus was first reported in the Saronikos Gulf with *Rickettsia* in seabass increasing cage mortalities.

MEDITERRANEAN FRY PRODUCTION HISTORY

1999

- Fry stocking continued at a high level but competition is high between hatcheries. Lowest ever ready product prices during December (450 – 600 g size bream at 2.72 €/kg).
- Fry customers start to complain and *Ricketsia* incidences in bass fry continue to put downward pressure on fry prices.
- *Rickettsia* becomes a problem in larger bass.

MEDITERRANEAN FRY PRODUCTION HISTORY

2000

- *Lymphocystis* occurs in bream throughout the Med causing mortalities. Low ready product prices drive fry prices to an all-time low and it is one of the worst years for bream fry mortality.

2001

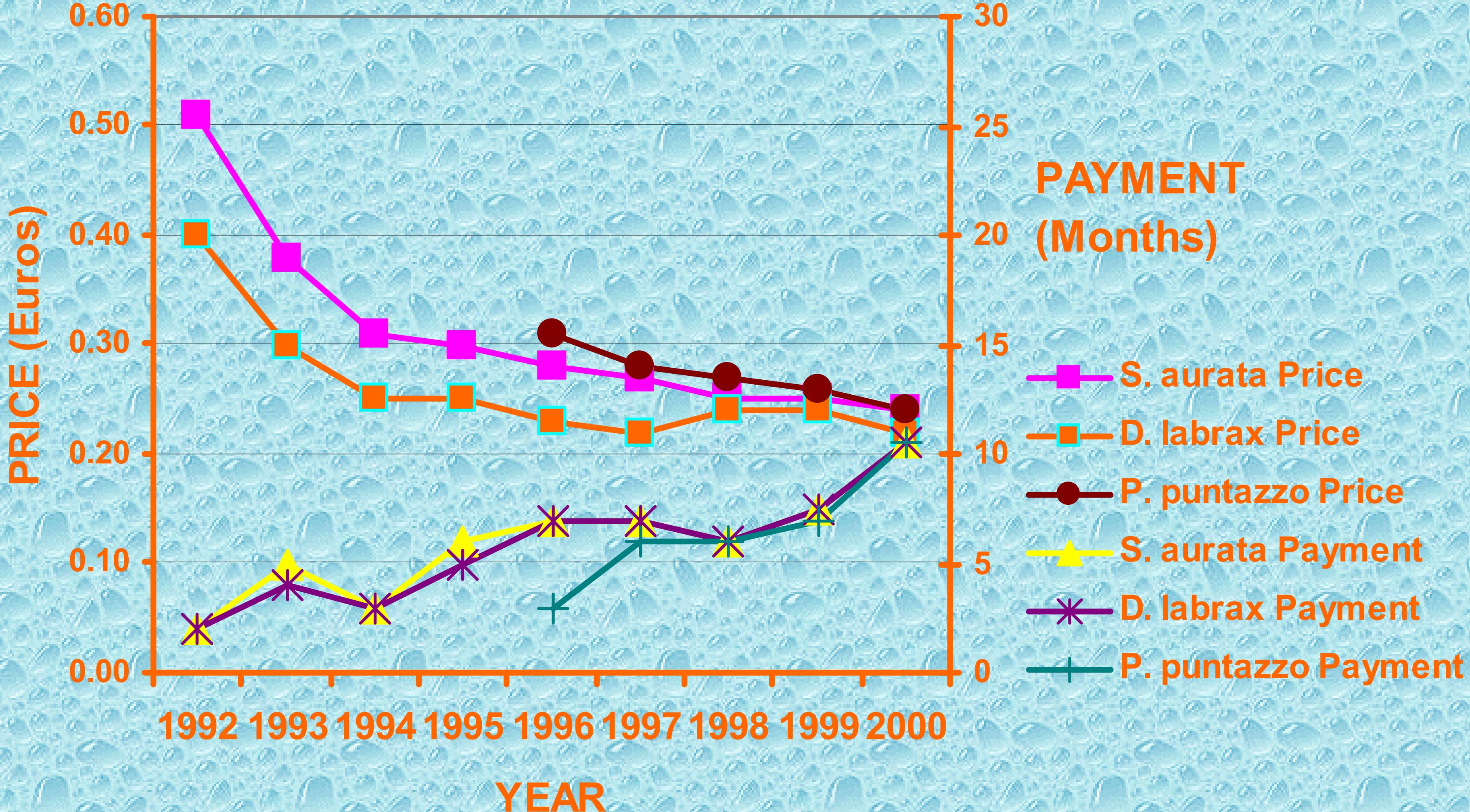
- This year started with higher fry prices which were driven up by high Artemia prices. However it is likely to end with the lowest price ever recorded.

AVERAGE GREEK FRY PRICES

	Sparus aurata		*D. labrax*		*P. puntazzo*	
YEAR	PRICE (Euros)	PAYMENT (Months)	PRICE (Euros)	PAYMENT (Months)	PRICE (Euros)	PAYMENT (Months)
1992	0.51	2	0.40	2		
1993	0.38	5	0.30	4		
1994	0.31	3	0.25	3		
1995	0.30	6	0.25	5		
1996	0.28	7	0.23	7	0.31	3
1997	0.27	7	0.22	7	0.28	6
1998	0.25	6	0.24	6	0.27	6
1999	0.25	7.5	0.24	7.5	0.26	7
2000	0.24	10.5	0.22	10.5	0.24	10.5

Source: Selonda Marketing Dept.

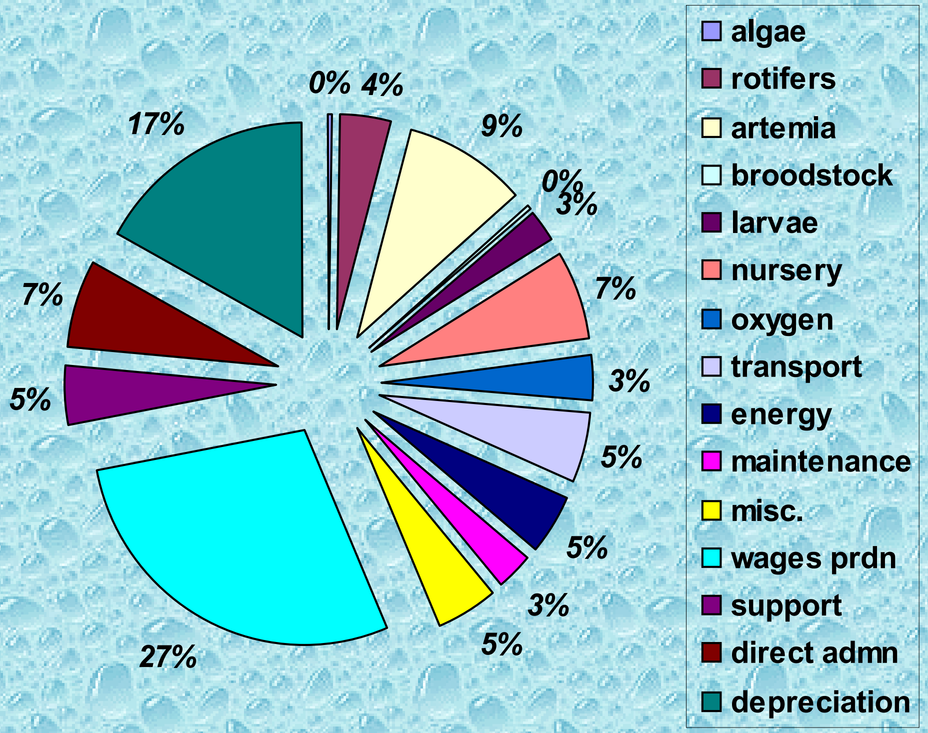
AVERAGE GREEK FRY PRICES



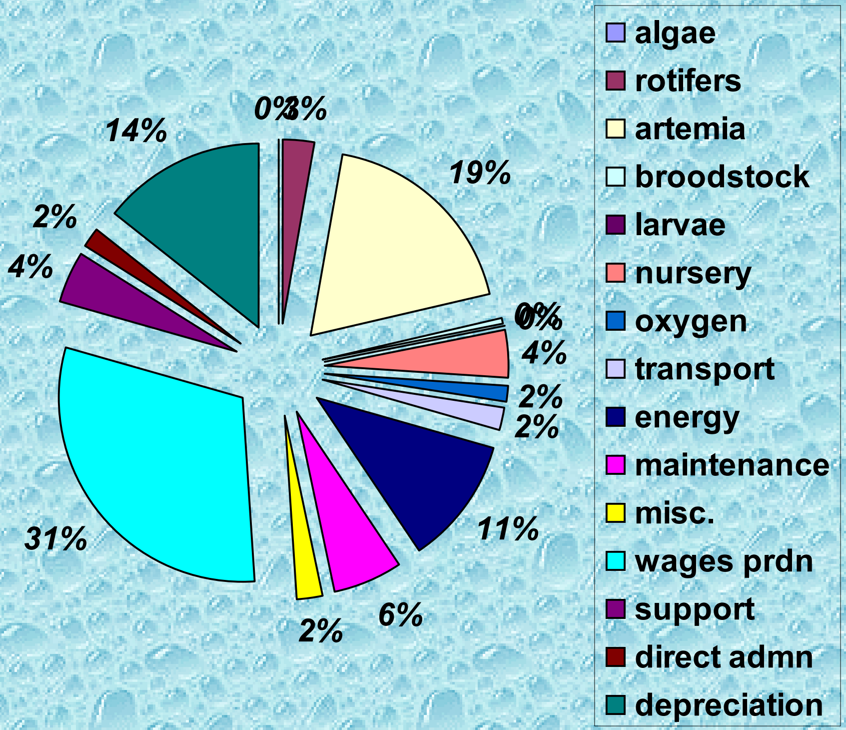
MEDITERANEAN FRY PRODUCTION COSTS

Large 0.12 – 0.16 €   Small 0.16 – 0.27 €

LARGE HATCHERY PRODUCTION COST (%)



SMALL HATCHERY PRODUCTION COST (%)



STRATEGY FOR THE FUTURE

ADD VALUE TO YOUR PRODUCT BY:

- Improving your fry quality.
- Undertake a fry production risk assessment to ensure a reliable fry supply to your customers.
- Participate in a breeding program.

WHAT ARE ONGROWERS LOOKING FOR IN QUALITY FROM A FRY PRODUCER ?

1. Disease resistant fry
   - Have they been vaccinated ?
   - Fry produced from disease resistant strains?

2. Ability of the fry to grow in the growout phase
   - Does the producer test or measure his fry against a benchmark before delivering them to you ?
   - What has been the growth from previous batches he has delivered to you ?

WHAT ARE ONGROWERS LOOKING FOR IN QUALITY FROM A FRY PRODUCER ?

3. Quality of service from the hatchery
   - History of delivery on time !
   - Numbers & mean weights are as stated !
   - Traceability & hatchery production information !
4. Appearance of the fry
   - What are the % of deformities !

     cranial, jaw shape, skeletal, gill covers etc

FRY QUALITY

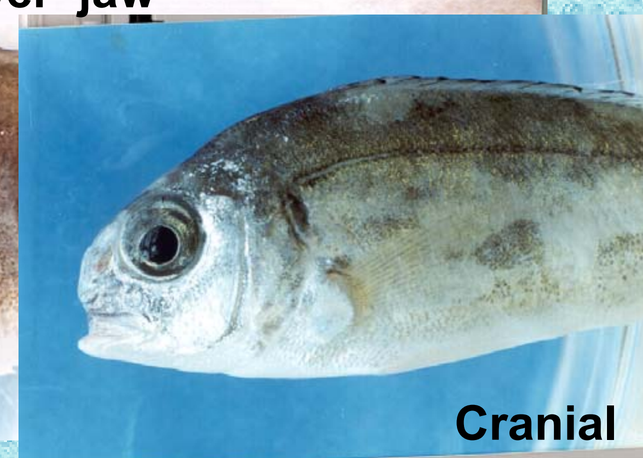
AVOIDING THESE TYPES OF DEFORMITY

Spinal

Lower jaw

Tail

Gill



Cranial

RISK ASSESSMENT

RISKS

- Disease outbreaks in hatchery production
- High incidence of deformities in production
- Failure of equipment or water treatment systems
- Production of poor quality fry which do not grow
- Marketing failures such as low price, unsold fry and low customer satisfaction.

Prevention is better than cure but if a problem does occur it needs dealing with at once!

FRY QUALITY

KEY ELEMENTS TO RISK-FREE INDUSTRIAL FRY PRODUCTION

- Hatchery Water Treatment & Management
- Genetic diversity through a breeding program
- Disease control and management
- Broodstock, larval and juvenile nutritional control

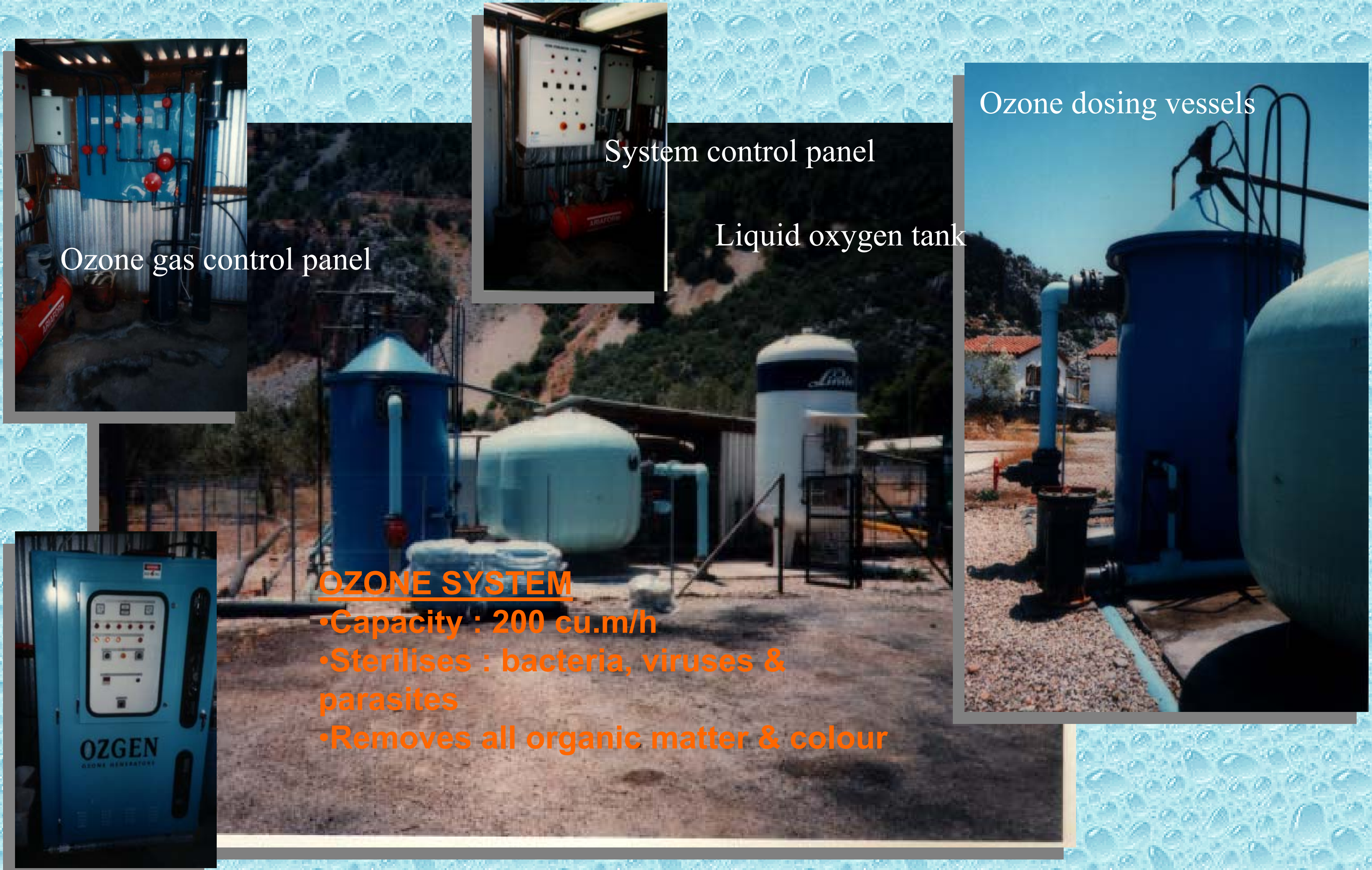
HATCHERY WATER TREATMENT SYSTEMS

THE HEART OF A FRY PRODUCTION SYSTEM

They must be:

- Reliable with minimal maintenance and low operating costs.
- Capable of sterilising incoming water not just disinfecting it.
- Controllable with minimal daily variations in temperature, salinity and total gas.

SEAWATER OZONATION SYSTEM



OZONE SYSTEM

- Capacity : 200 cu.m/h
- Sterilises : bacteria, viruses & parasites
- Removes all organic matter & colour

LARGE SCALE SEAWATER OZONATION SYSTEM

SEAWATER SAND & UV FILTRATION SYSTEM

LARGE CAPACITY NURSERY SYSTEM

SEAWATER RECIRCULATION SYSTEM

SYSTEM CAPACITY

- 200 cu.m/h flow rate
- Oxygenation to 16 mg/l
- Constant Temperature maintenance
- All fish & feed metabolites removed

GENETIC DIVERSITY

FISH TAGGING

- using Passive Inductive Tags for easy identification of fish to match with the DNA database.

PATERNITY ANALYSIS

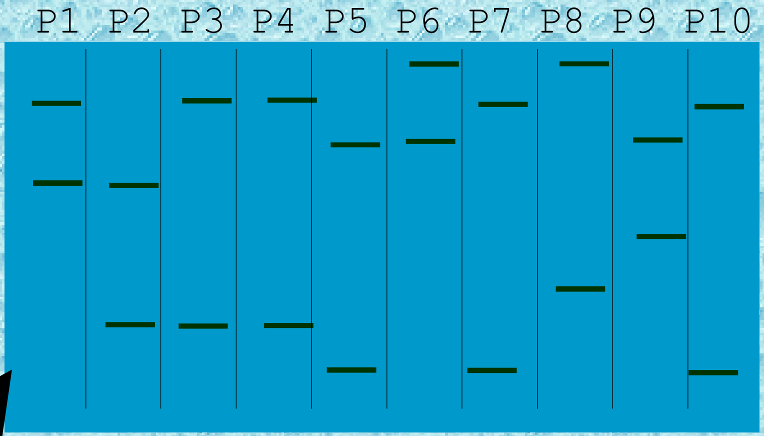
- using DNA technology (PCR) to determine genotypes. Used in selection program (database matching broodstock with fry)

INBREEDING ANALYSIS

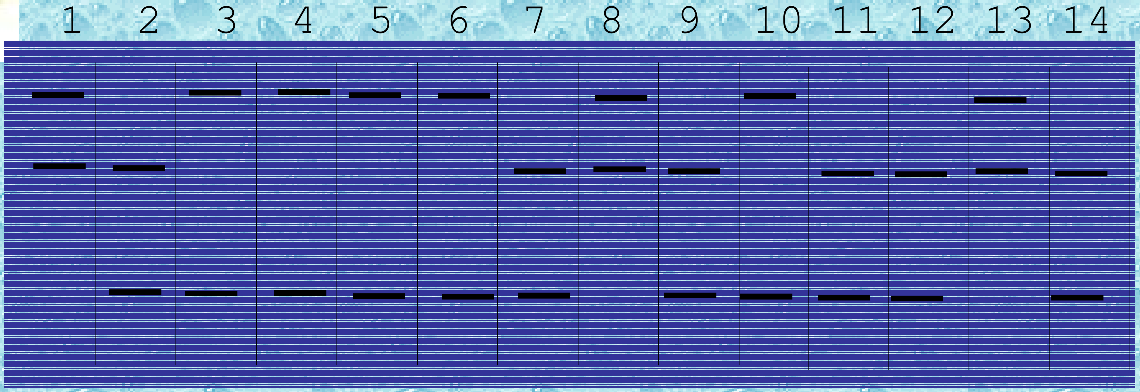
- using DNA technology to estimate genetic variation (guarantee of fry quality, guide in broodstock acquisition, discarding of fry batches)

Breeding Program

Paternity | Tagging | Inbreeding



Parents

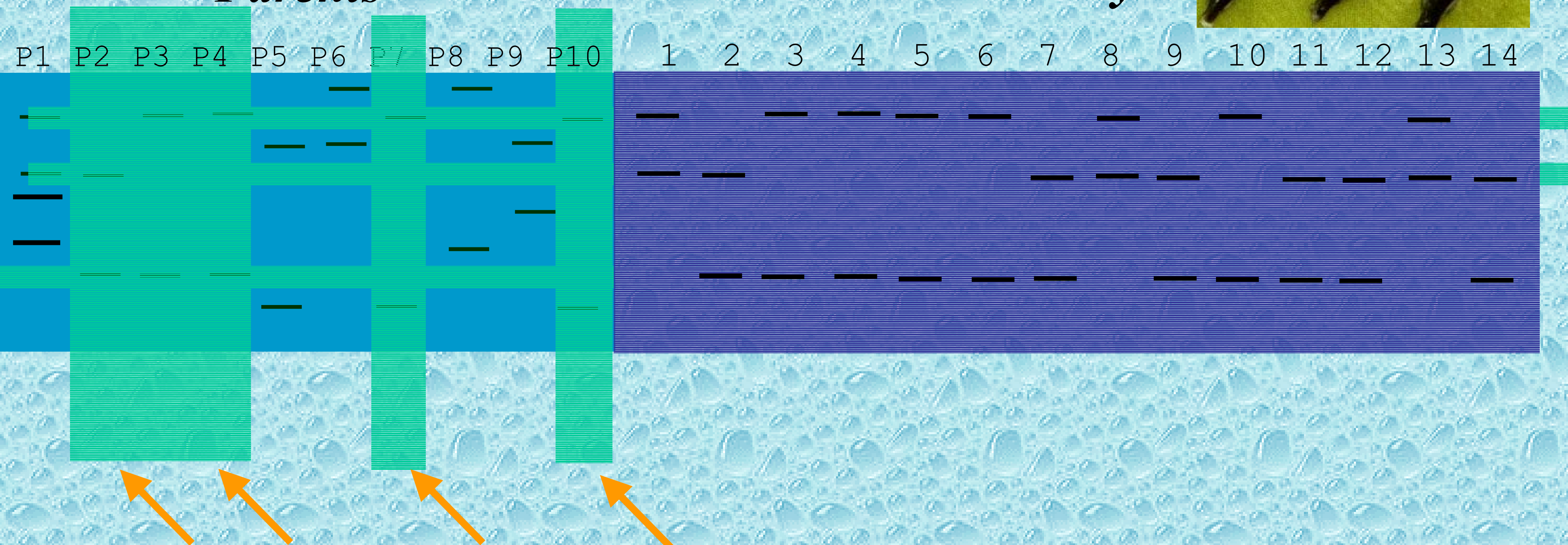


Fry

?

Parents

Fry

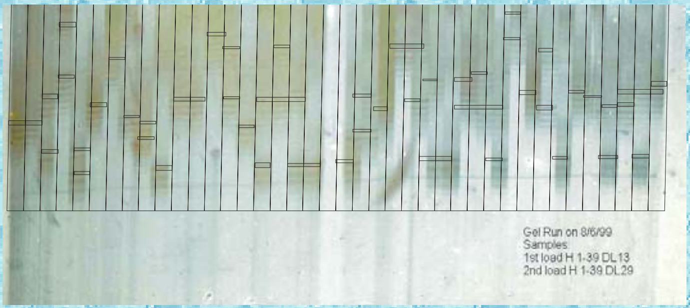


Parents of Fry

Paternity Analysis - Preliminary Results

- **Tank H, Seabass, Selonda Bay: 39 fish**
- **96 fry analysed: 48 good quality, 48 with deformities**
- **One primer used**

Broodstock

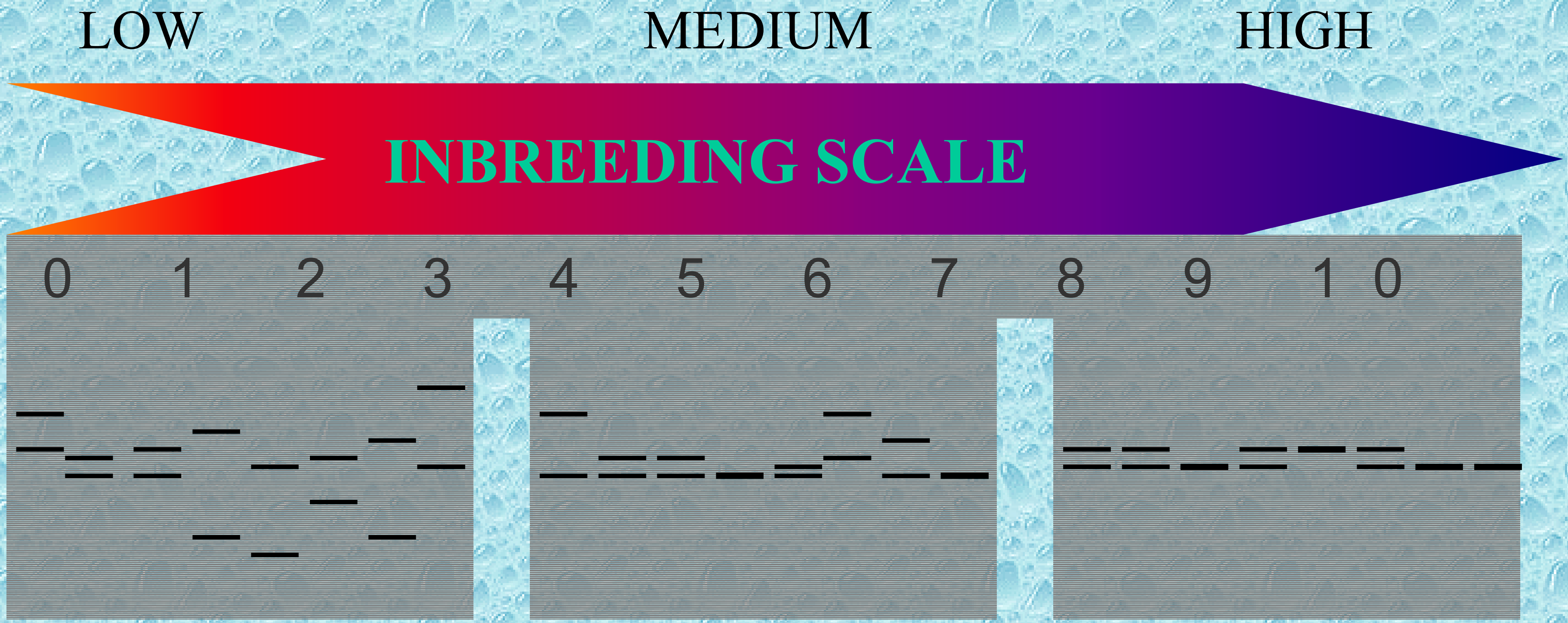


Fry

Deformed

Good

Inbreeding Scale



PATHOLOGY LABORATORY

DISEASE CONTROL REQUIRES:

- Prevention – regular checking of water treatment systems, sanitary audits and biosecurity.
- Rapid analysis of potential problems, fish mortality and water quality
- Rapid diagnosis – histology, bacteriology and virology within one or two days.
- Monitoring of any outbreaks to assess the effectiveness of treatments

PATHOLOGY LABORATORY

Bacteriology and Parasitology Laboratory

- Culture isolation and identification of bacteria and antibiograms in order to choose the best treatment.
- Parasite observation in fresh smears of fish tissue for external or internal parasites.

Molecular Biology Laboratory

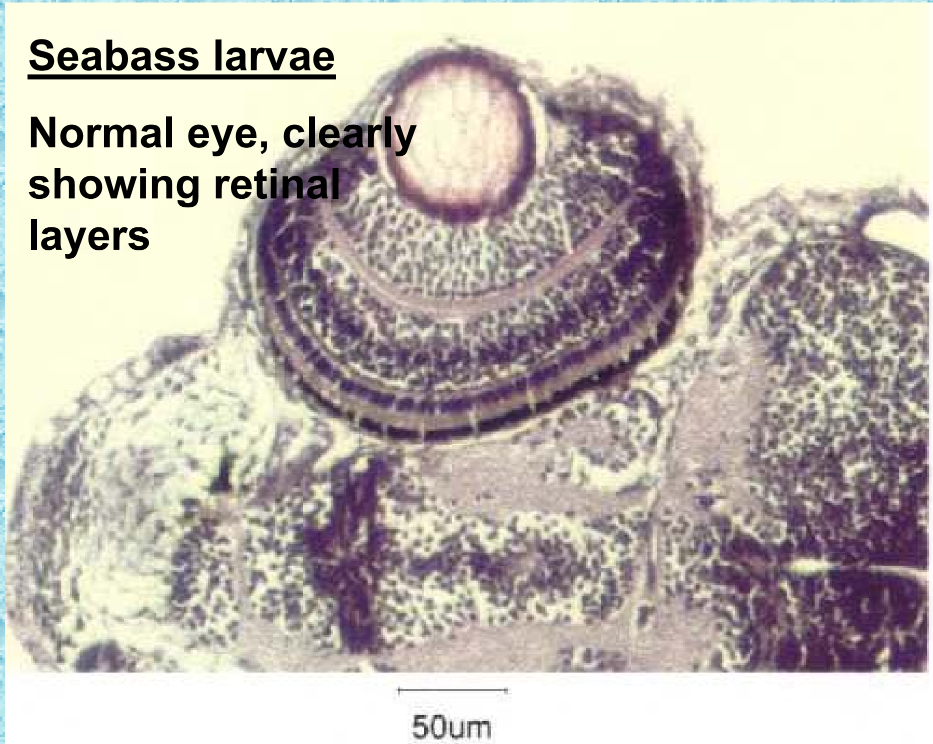
- PCR identification of virus and bacteria.

HISTOLOGY LABORATORY

- **USED AS A DIAGNOSTIC TOOL FOR:**

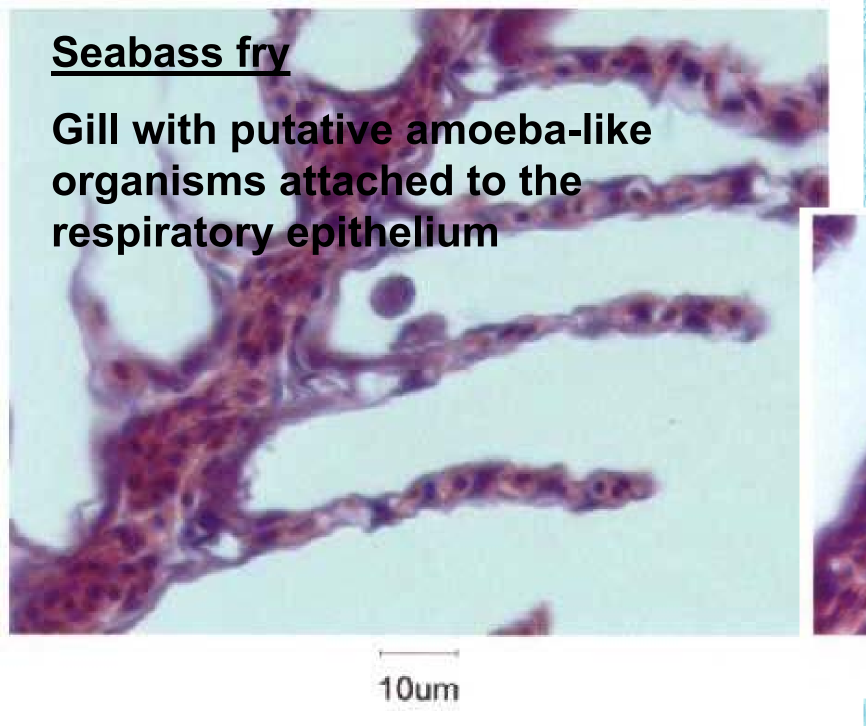
- Severity of lesions caused by different pathological agents
- Malfunction of organs
- Non pathological agents such as nutritional problems, lack of nutrients, excess of others etc.
- Toxicity from environmental problems
- Early tracing of deformities in larvae
- Observation of larvae & fry organ development and deformities.
- Immunohistochemistry techniques for immunology

SOME EXAMPLES



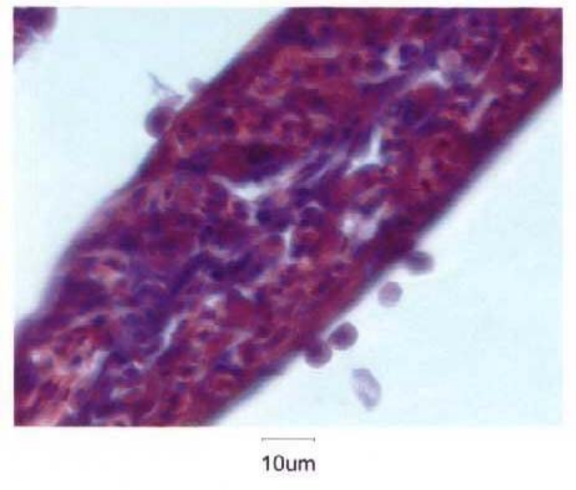
Seabass larvae

Normal eye, clearly showing retinal layers



Seabass fry

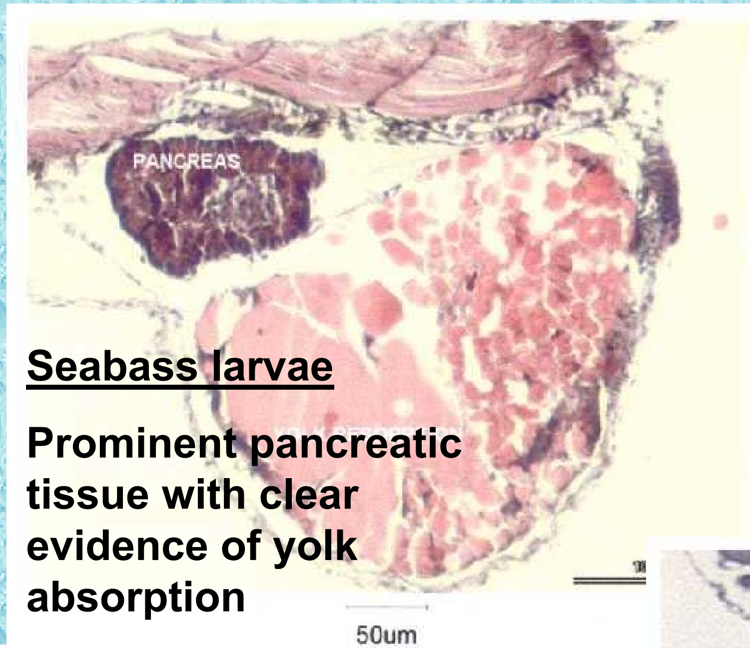
Gill with putative amoeba-like organisms attached to the respiratory epithelium



Seabass fry

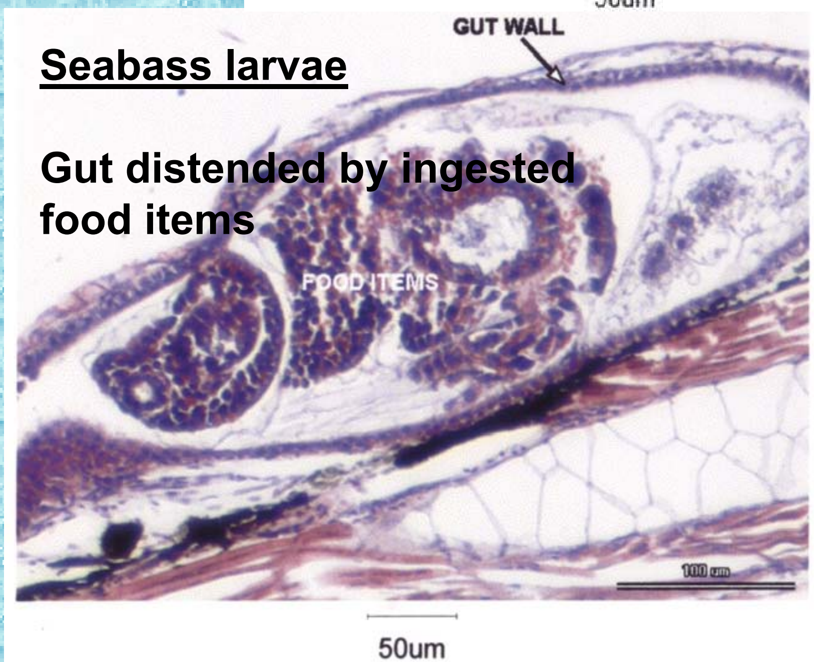
Showing putative amoeba

SOME EXAMPLES



Seabass larvae

Prominent pancreatic tissue with clear evidence of yolk absorption



Seabass larvae

Gut distended by ingested food items

Seabass larvae

Abnormal larva with two heads, four eyes clearly seen

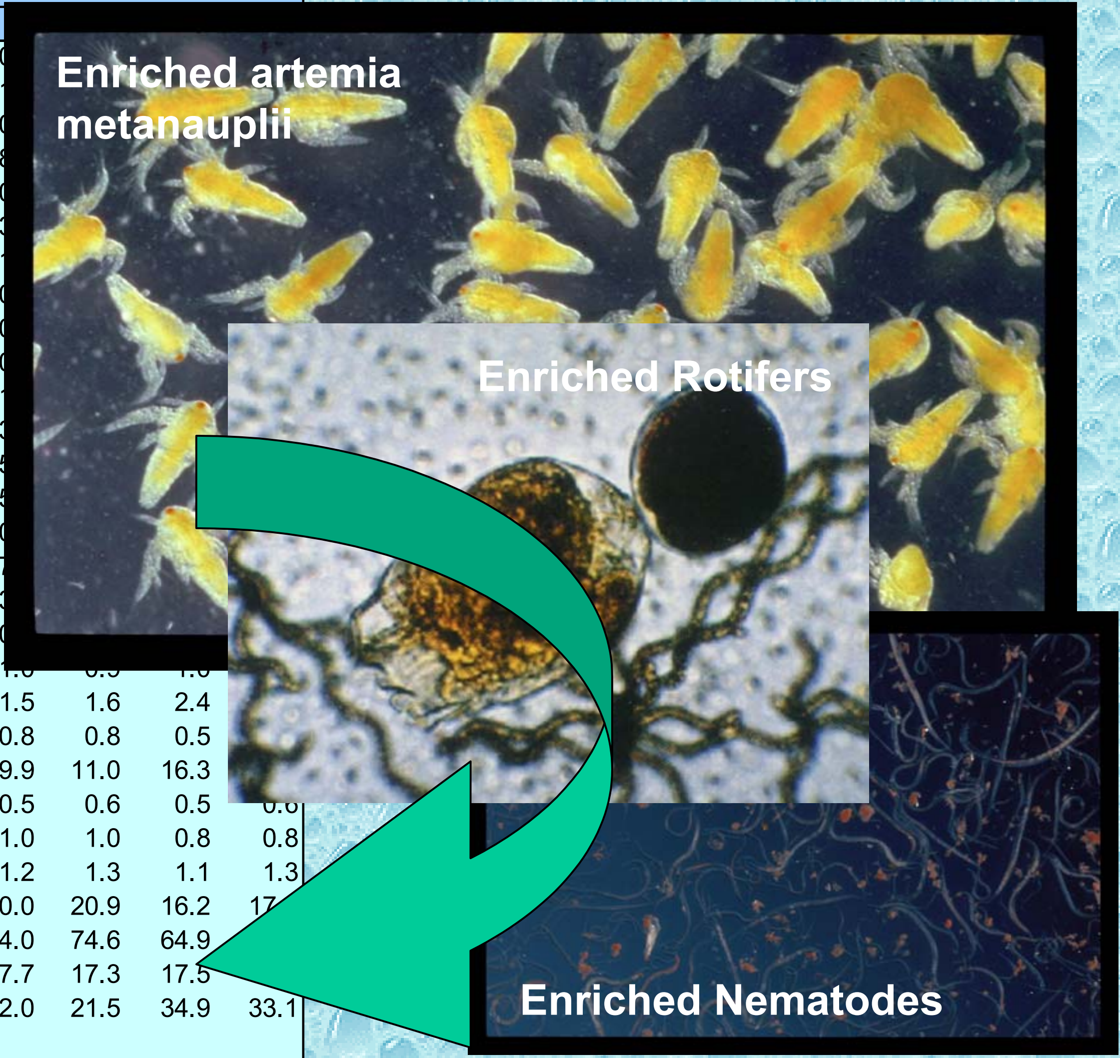
NUTRITIONAL MANAGEMENT

A KEY ELEMENT IN QUALITY FRY

- Checking your live feed enrichment system.
- Analysing problems such as deformities and low disease resistance in the context of nutrition.
- Assessing the performance of feeds at your hatchery, using your production system.

NUTRITIONAL MANAGEMENT

FATTY ACID ANALYSIS				Samples				
FFA Type	*1*	*2*	*3*	*4*				
C:14:0	1.3	1.7	0.9	1.1				
	0.5	0.4	0.4	0.3				
	0.4	0.3	0.2	0.2				
C:16:0	10.8	12.3	9.6	10.4				
C:16:1	0.9	1.0	1.0	0.8				
C:16:1	2.9	3.2	2.7	2.4				
C:16:1	0.9	0.6	0.5	0.5				
C:16:2	0.5	0.4	0.3	0.3				
C:16:3	1.0	0.8	0.8	0.7				
C:17:0	0.5	0.4	0.4	0.3				
C:16:4	1.3	1.1	0.9	0.8				
C:18:0	3.7	3.4	3.2	3.2				
C:18:1	17.7	19.6	20.4	18.8				
C:18:2	4.5	5.6	5.7	5.4				
C:18:3	1.2	1.0	1.0	0.9				
C:18:4	13.7	10.8	13.8	12.0				
C:20:0	3.1	2.5	3.0	2.5				
	1.1	1.1	1.0	1.2				
	1.3	1.0	0.4	0.4				
C:20:1	1.5	1.8	1.9	1.9	1.5	1.6	2.4	
C:20:4	0.4	0.5	0.6	0.6	0.8	0.8	0.5	
C:20:5 (EPA)	8.0	9.7	10.5	11.1	9.9	11.0	16.3	
C:22:1	1.2	0.7	0.6	0.9	0.5	0.6	0.5	
C:21:5	1.0	0.9	1.1	1.1	1.0	1.0	0.8	0.8
C:23:5	1.1	1.1	1.1	1.2	1.2	1.3	1.1	1.3
C:22:6 (DHA)	19.7	18.1	17.9	20.9	20.0	20.9	16.2	
S PUFA	70.0	69.6	74.2	73.7	74.0	74.6	64.9	
S SAT	20.2	20.9	17.7	18.1	17.7	17.3	17.5	
S MONO	25.1	26.9	27.1	25.3	22.0	21.5	34.9	33.1
DHA/EPA								



INDUSTRIAL MEDITERRANEAN LARVAL CULTURE

A success story YES !

But Mediterranean hatcheries will have to be vigilant and resourceful or they will struggle