Nutrition and reproduction of the pacific oyster *Crassostrea gigas* : main results of the European project GIGANUGA (Gigas Nutrition and Gametogenesis)

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[5]University of Santiago de Compostela : Spain

Project FAIR CT.96.1852 (France, Belgium, spain)

5 aspects were studied :

- Cellular reproductive and storage cycles
- Biochemical level : compare natural reproductive cycle and hatchery conditioning at two seasons
- Define deficiencies and problems
- Evaluate possibilities to supplement hatchery conditioning standard diet or low cost diet using emulsions or other particules
- Evaluate possibility to solve the question of fall conditioning

GIGANUGA 1:

CELLULAR ASPECTS OF REPRODUCTIVE AND STORAGE TISSUE CYCLES OF *CRASSOSTREA GIGAS.*

C. Heude Berthelin [(1)], J. Espinosa [(2)], O. Garcia[(2)], G. Hernandez [(2)],

K. Kellner [(1)] and M. Mathieu [(1)]

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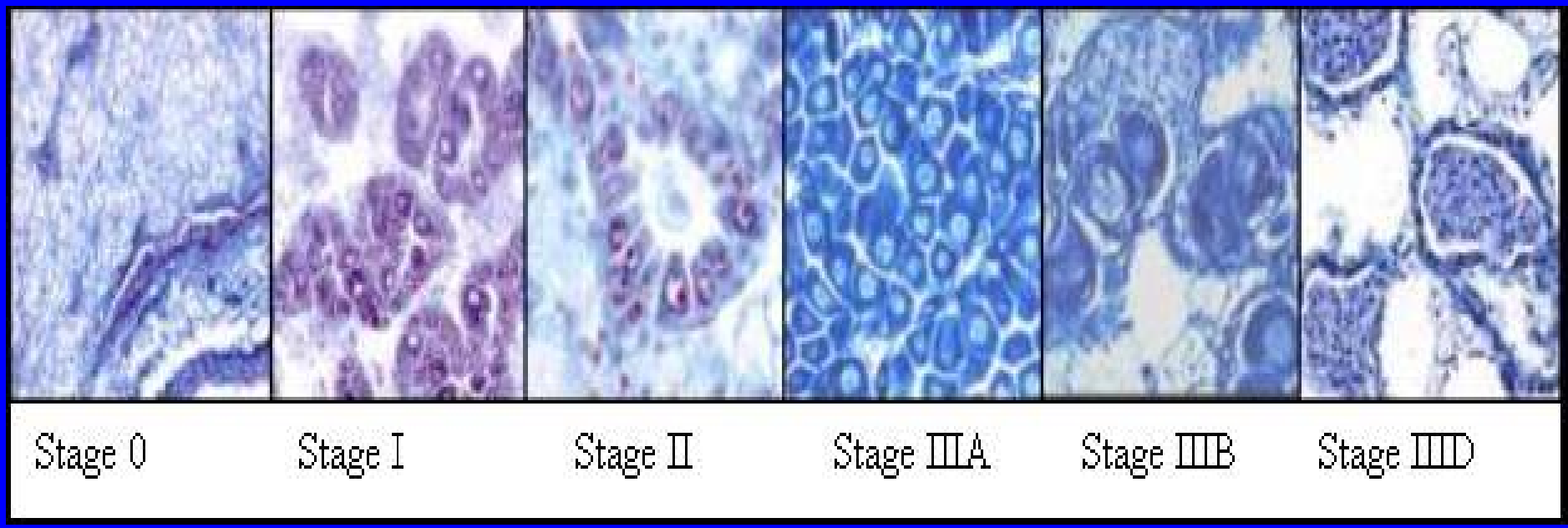
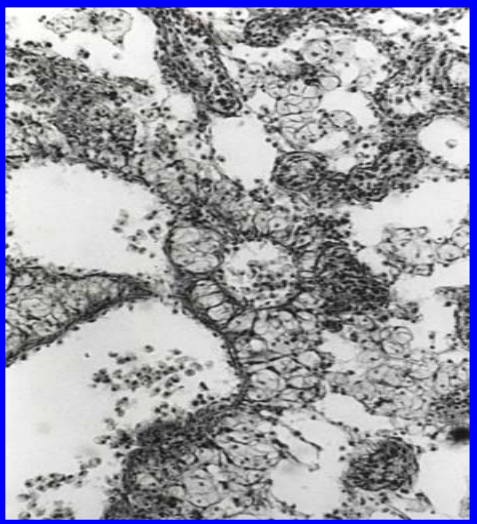
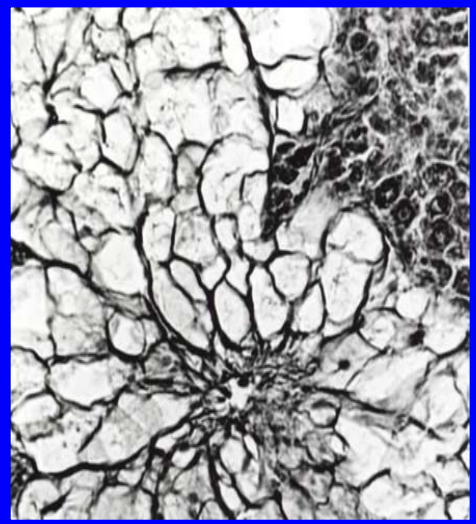
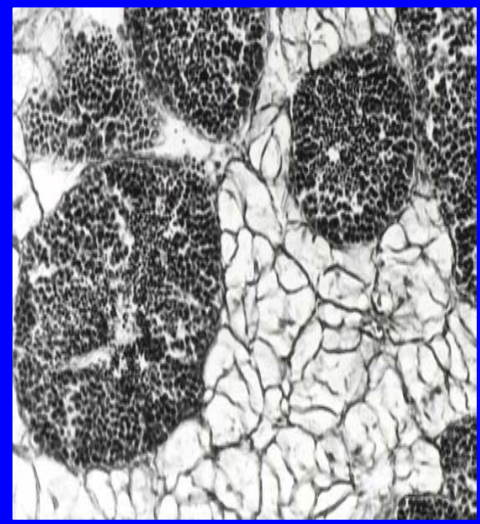
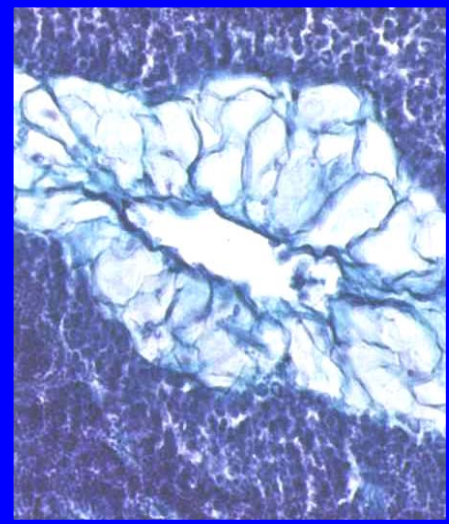
Course of the oyster gametogenesis



Month	J	F	M	A	M	J	J	A	S	O	N	D
Gonad	I/II	II	II	II	IIIA	II/IIIA	IIIA	IIIB	IIID	IIID/0	0/I	I

Cellular aspects of storage tissue development and mobilisation

stage A Stage B Stage C Stage D

Month	J	F	M	A	M	J	J	A	S	O	N	D
Storage	B/C	C	C	C	D	D	D	D	A	B	B	B
Gonad	I/II	II	II	II	IIIA	IIIA	IIIA	IIIB	IIID	IIID/0	0/I	I

GIGANUGA 2:

Nutrient storage and transfer during the reproductive cycle in nature and in hatchery of the Pacific Oyster *Crassostrea gigas*

Soudant P.[(1)], M. Caers[(2)], Y.Marty[(3)], E.Palacios, C.Van Ryckeghem[(2)], C. Heude Berthelin[(4)], JR Le Coz[(1)], C.Quere[(1)], C.Seguineau[(1)], J.Moal[(1)], JF.Samain[(1)]

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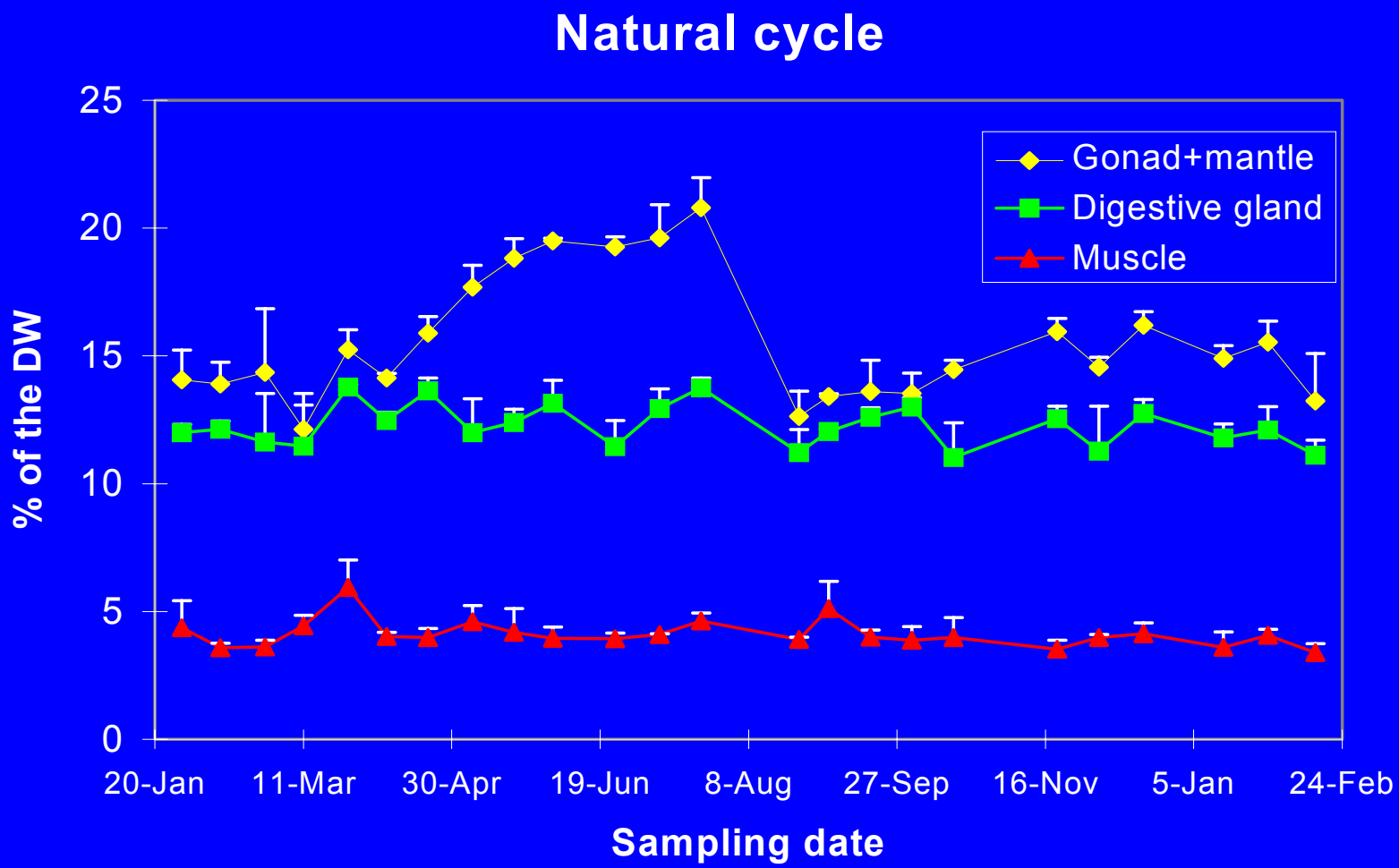
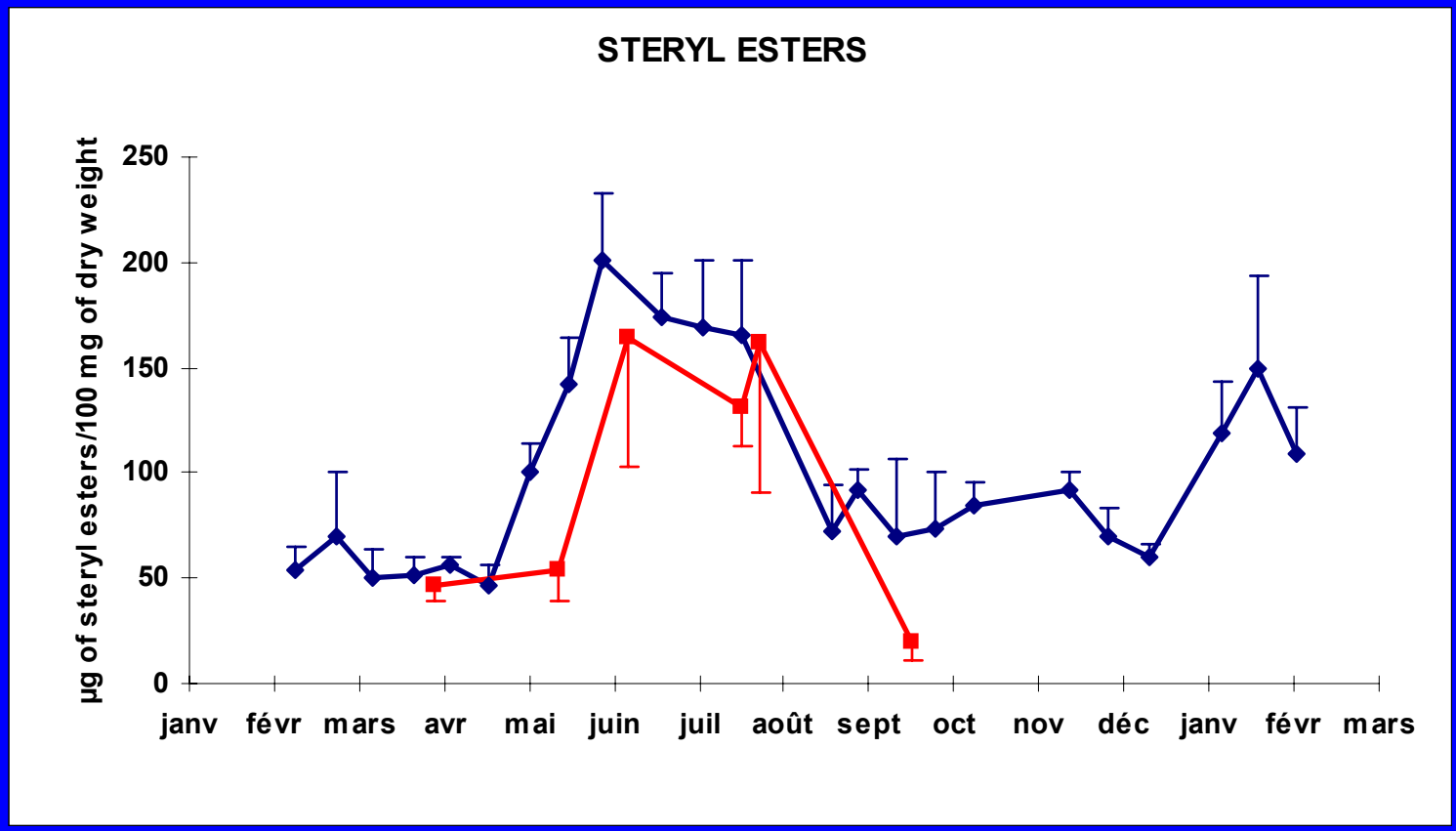
[2] ARC, Laboratory of Aquaculture , University of Gent, Rozier 44, 9000 Gent, Belgium
[3]UMR/CNRS 6521, Université de Bretagne Occidentale, BP 809, 29285 Brest, France
[4] IBBA ,Biologie et Biotechnologies Marines, Université de Caen, 14032 Caen, France

1/ Natural cycle : lipids

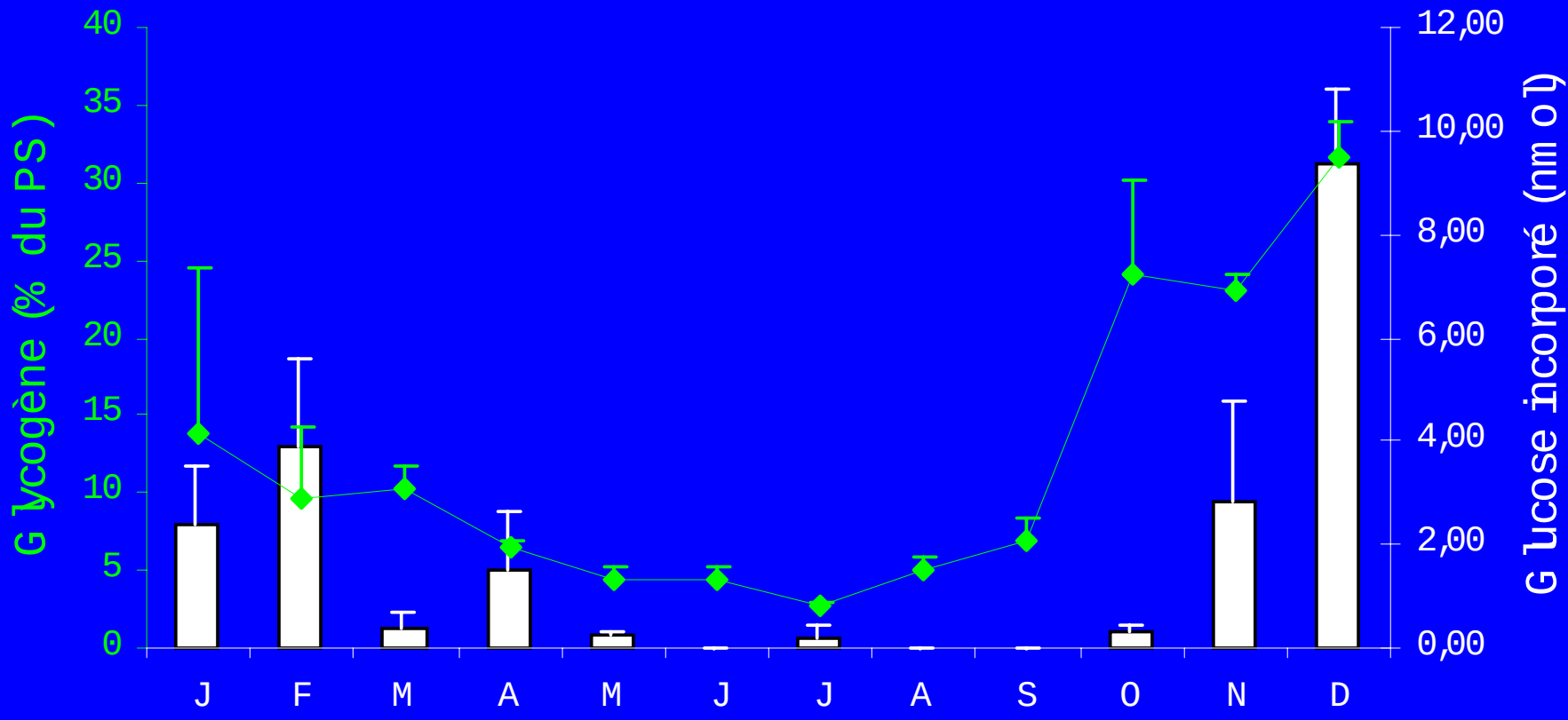
Total lipid percentage



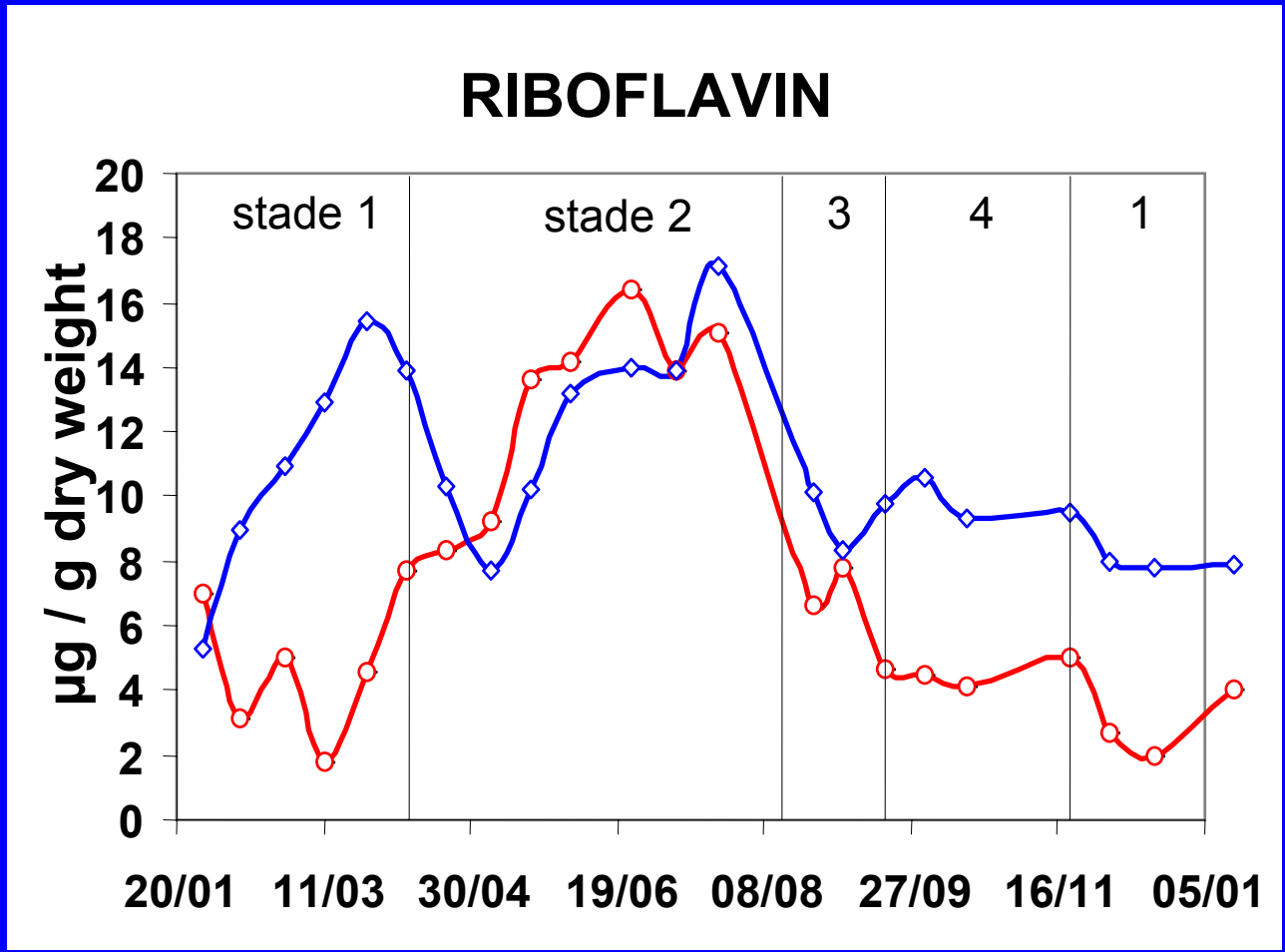
1/ Natural cycle : sterols 97-98



Glycogen metabolism in vesicular cell during gametogenesis

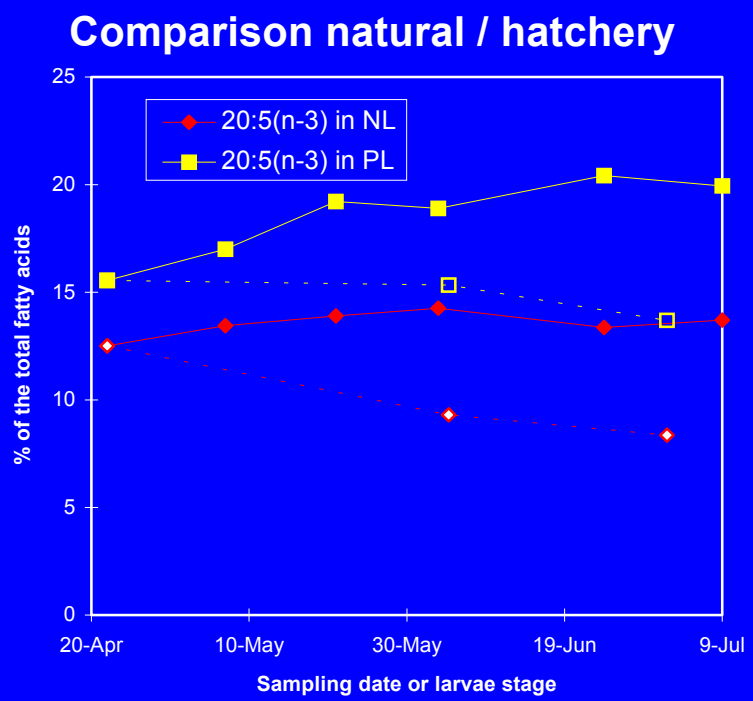


1/ Natural cycle : thiamine and riboflavin

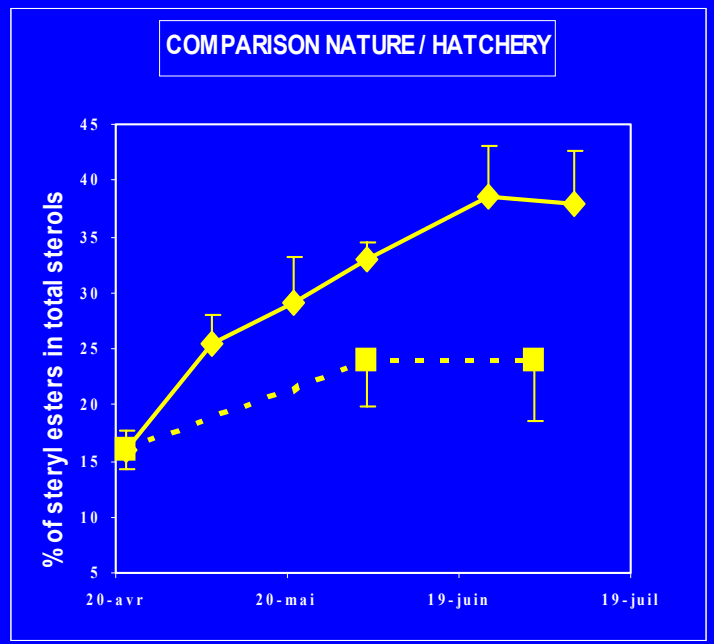


2/ Deficiencies : comparison Nature-Hatchery: Spring period

PUFAs

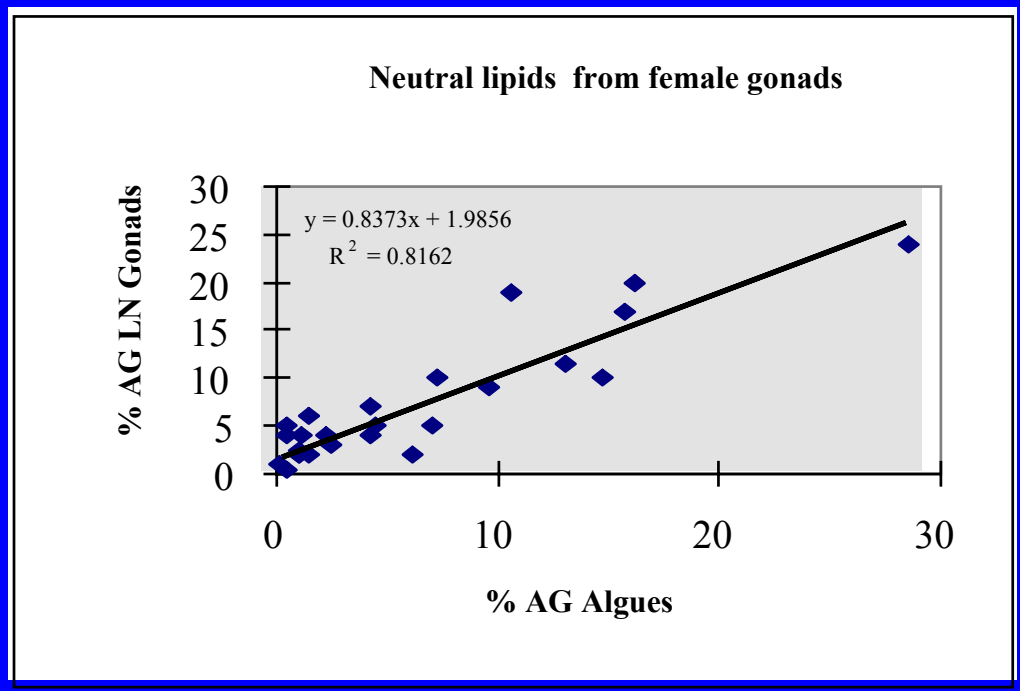


Steryl Esters

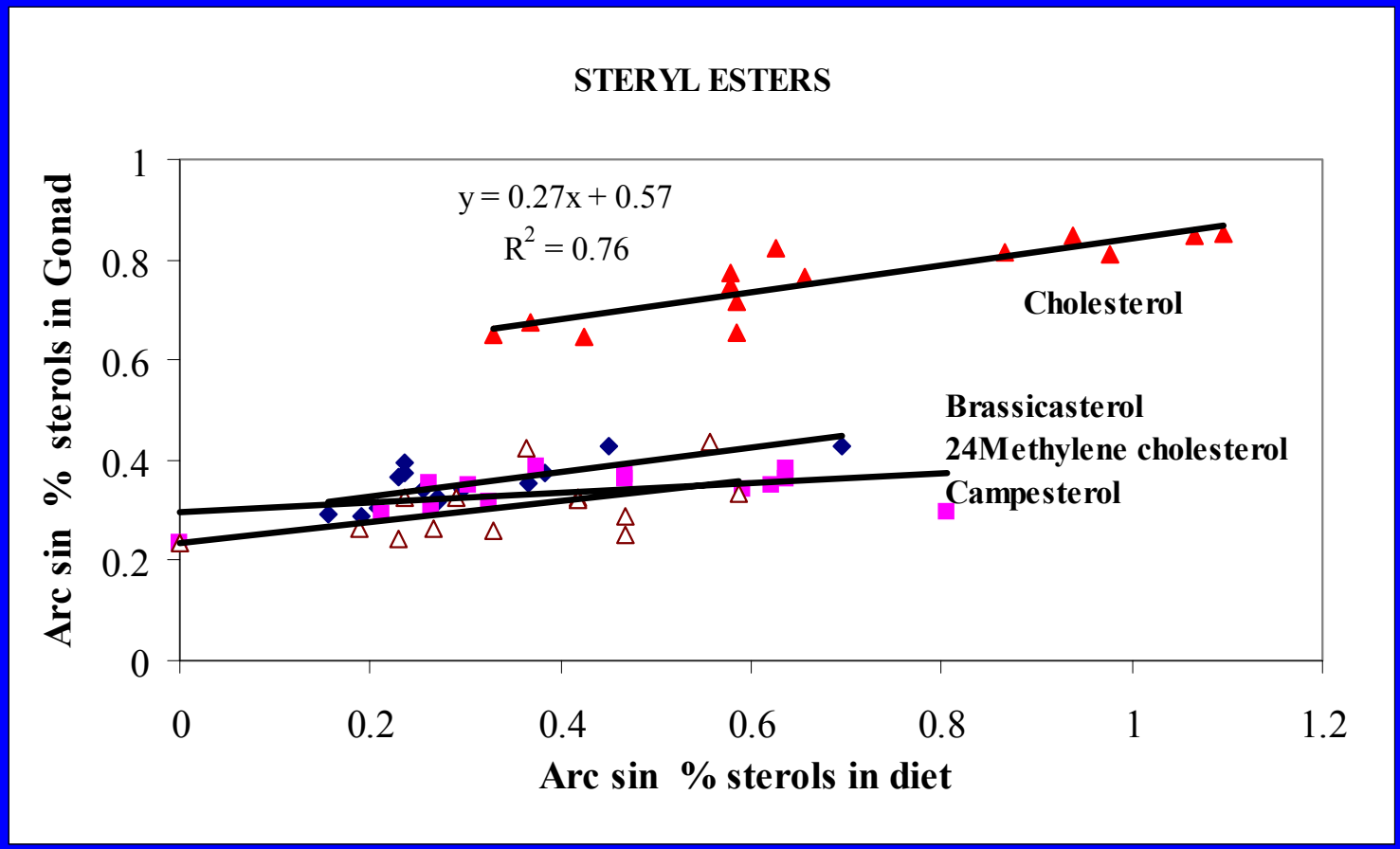


•2/ Relation between diet quality and gonad composition : PUFAs

Information from gonad neutral lipids (fatty acids)



2/ Relation between diet quality and gonad composition : sterols

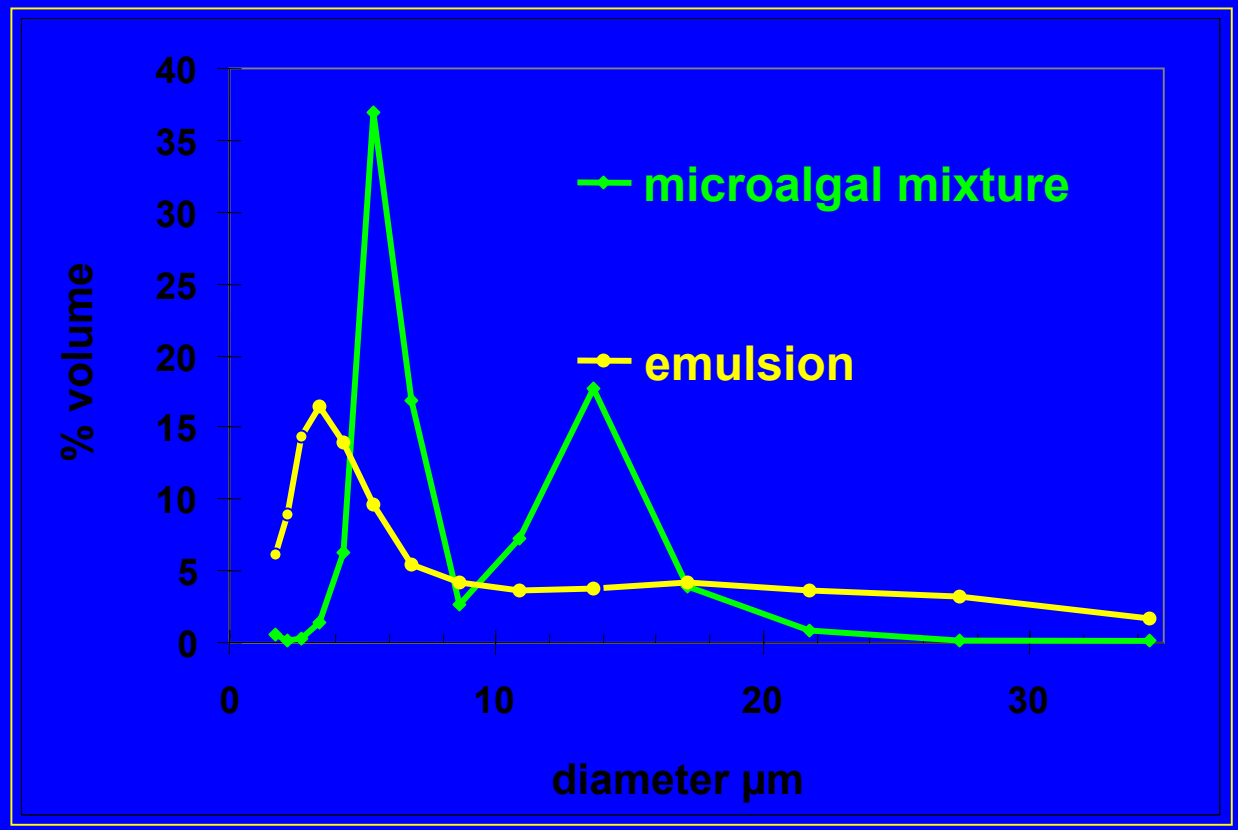


Giganuga 3:
Advances in liposoluble and hydrosoluble compound supplementation for broodstock and larvae of the Pacific oyster *Crassostrea gigas*

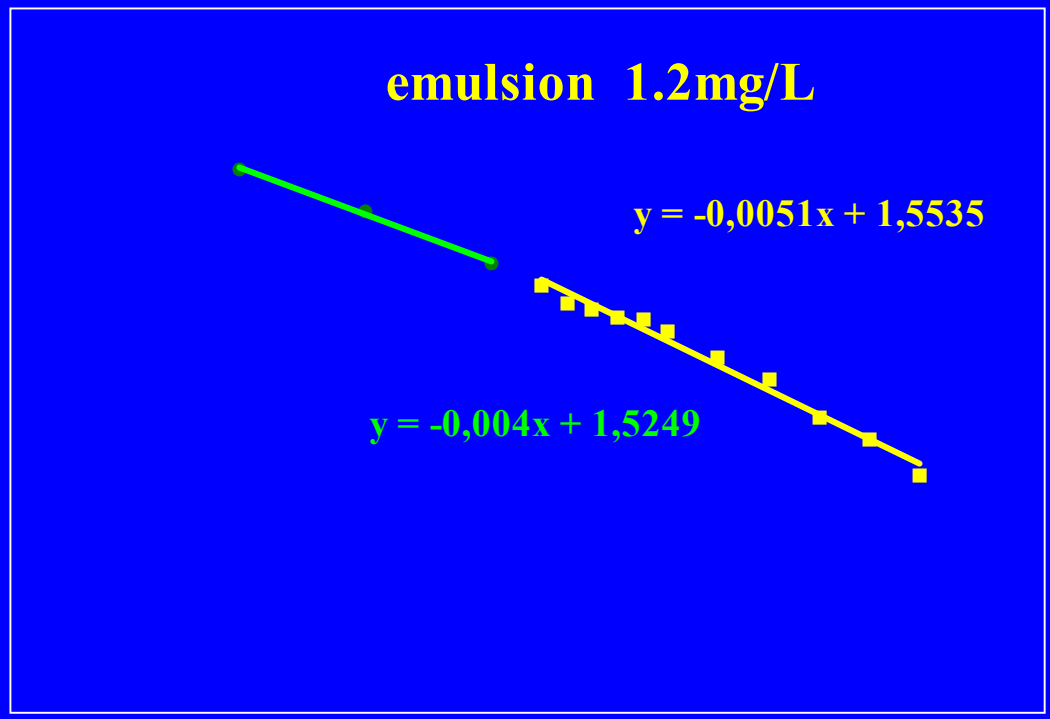
Seguineau(1), M.Cansell(2), P.Soudant(1), C.Langdon(3), B.Ponce Pinon(4), M.Val Sanles(4), J.R.Le Coz(1), C.Quere(1), J.Moal(1), M.Caers(5), P.Coutteau(6), P.Sorgeloos(5), J.F.Samain(1)

1 *IFREMER Brest, Physiologie des Invertébrés, BP 70, 29280 Plouzané, France;*
2 ISTAB, Université Bordeaux I, avenue des Facultés, 33405 Talence, France
3 Hatfield Marine Science Center, 2030S Marine Science Drive, Newport, OR 97365
4 Facultad de Farmacia, Universidad de Santiago de Compostela, Espana
5 ARC, Laboratory of Aquavculture, University of Gent, Rozier44, 9000Gent, Belgium
6 INVE Technologies NV Oeverstraat7-9200 Baasrode, Belgium

EMULSION AND ALGAL SIZE



EFFECT OF EMULSION CONCENTRATION ON ALGAL FILTRATION

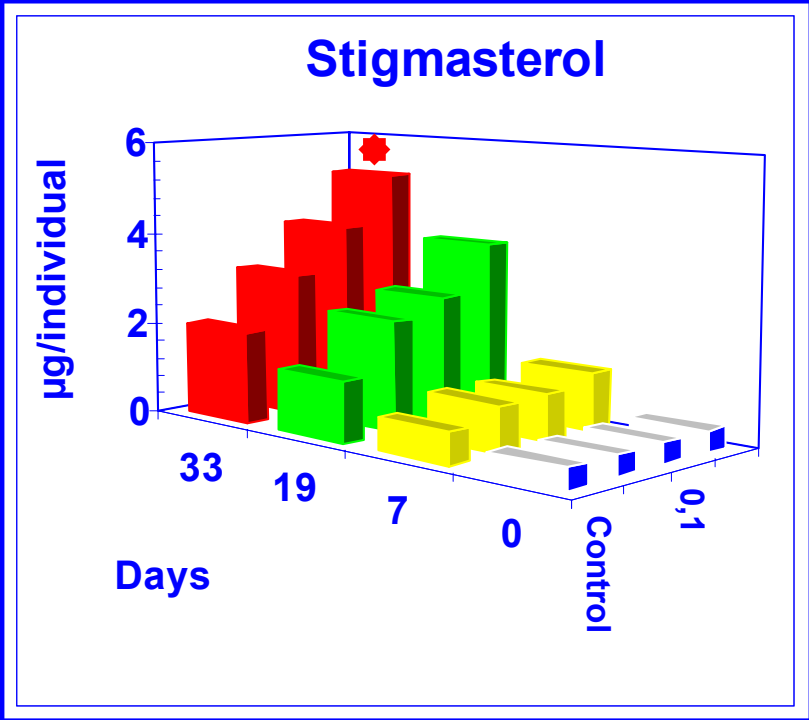


algae

algae + emulsion

❖No algal filtration pertubation for emulsion concentration < 1.2 mg/L

EMULSION ASSIMILATION EXPERIMENT ON SPAT

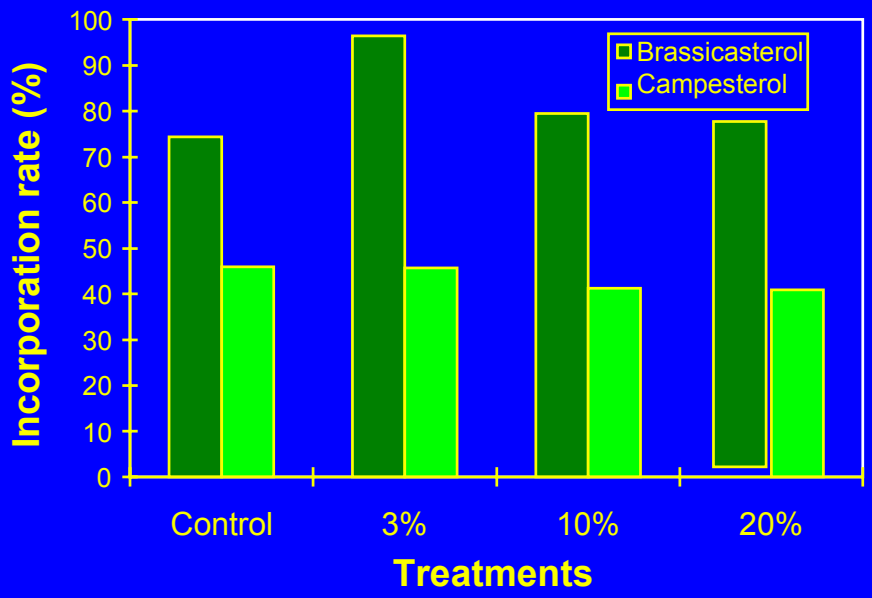


- assimilation was dose and time dependent

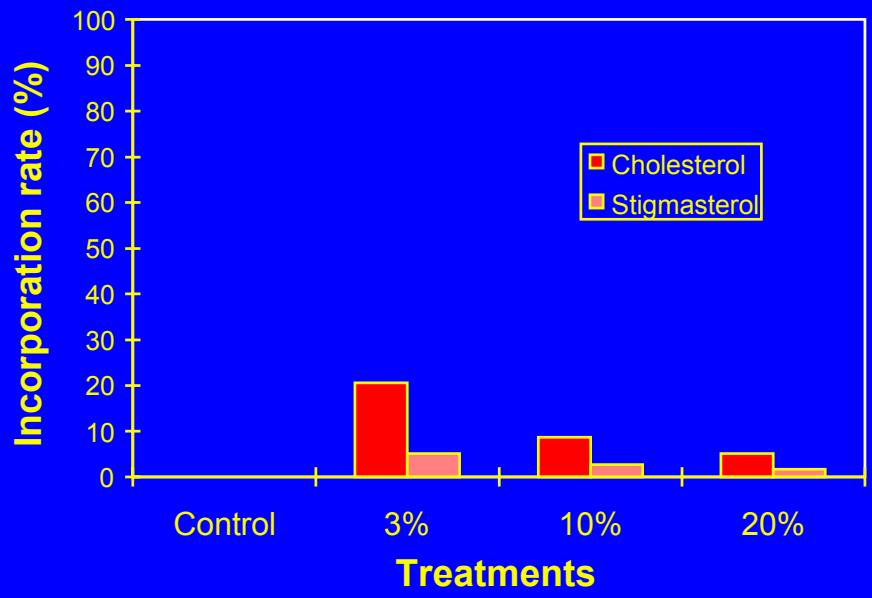
Emulsion: 0%, 3%, 10%, 20%

2/ Emulsion supplementation : absorption efficiency was low

Absorption rate of sterols



From microalgae



From emulsion

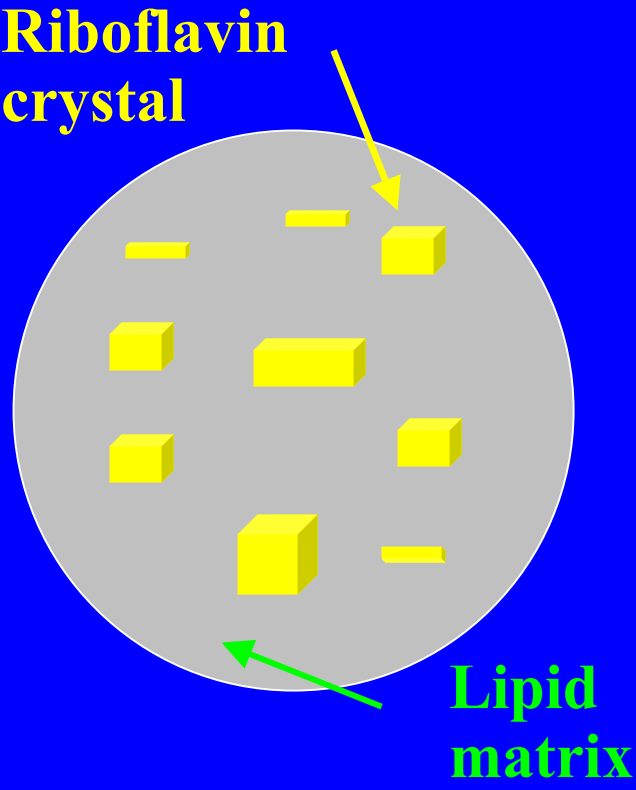
SPRAY BEADS

Incorporated materials

- dissolved in an aqueous phase
- dry particules

within a triglyceride bead composed of:

- 60% tripalmitin
- 40% fish oil

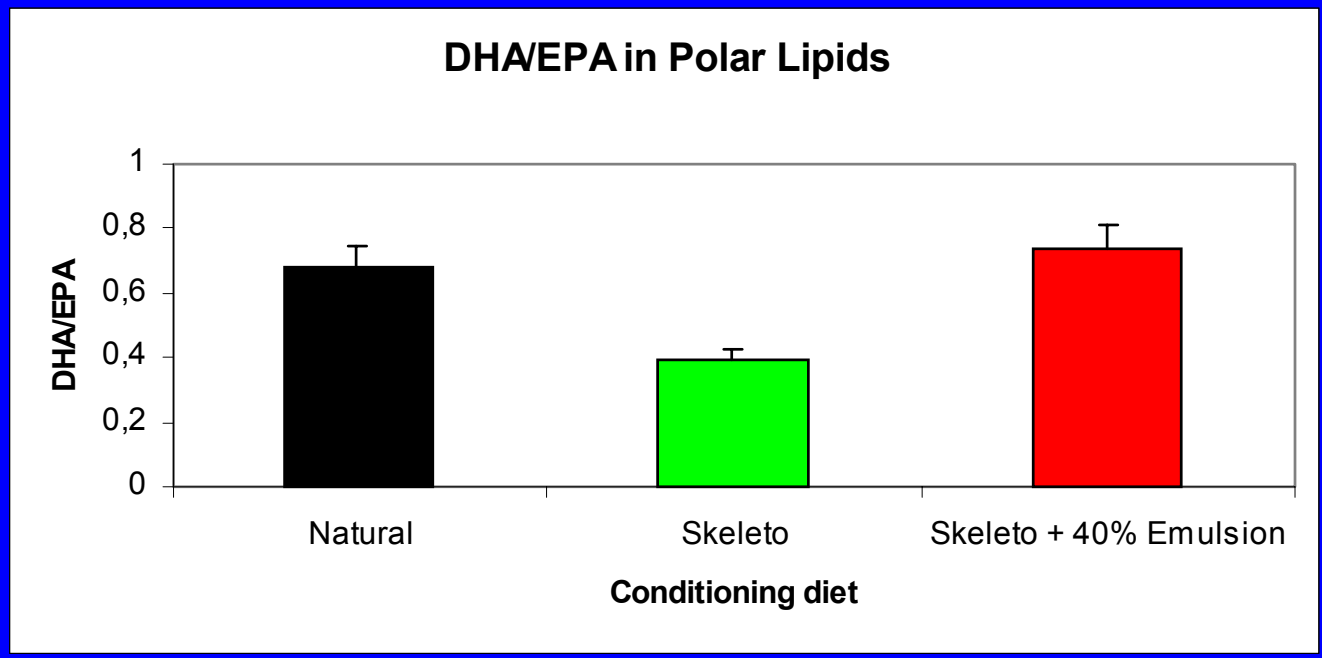


GIGANUGA 4: EFFECTS OF LIPID SUPPLEMENTATION DURING CONDITIONING OF *Crassostrea gigas* FED A STANDARD MIXED ALGAL DIET AND A LOW COST ALGAL DIET

M.Caers*[1], P.Soudant, E.Palacios, K. Curé*[1], P.Sorgeloos[1], J.R.Le Coz[2], C.Quere[2], Y.Marty[5], O. Garcia[3], J.Espinoza[3], C. Heude Berthelin[4], E.Danton[6], B.Diss[6], J.F.Samain[2], J.Moal[2]

3/ Spring : effect of emulsion doses on biochemistry

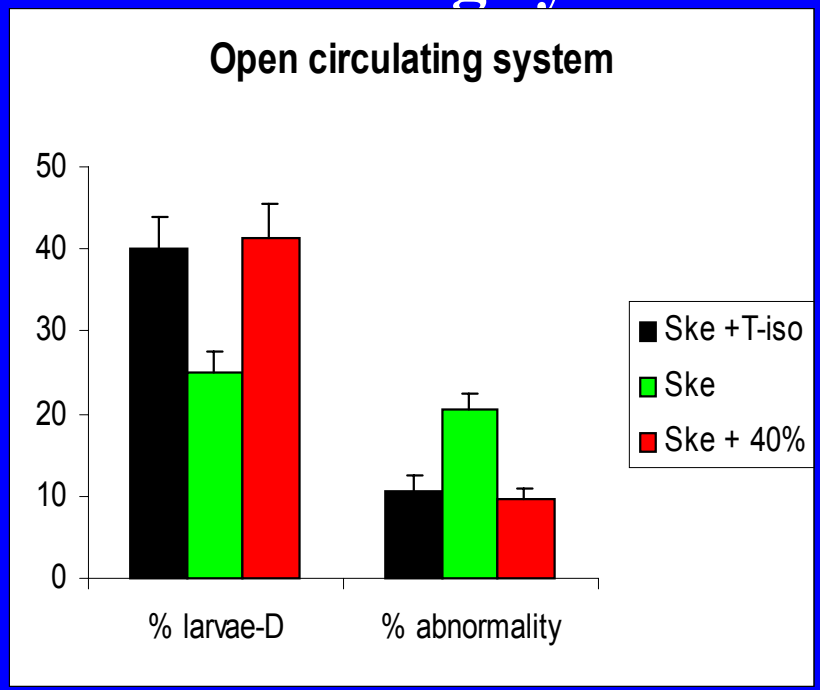
- No effect at 2.5, 5.0, 10% emulsion FA/DW algae (Hatchery diet)
- Positive effect at 20 and 40% emulsion and Skeletonema (Low cost diet)

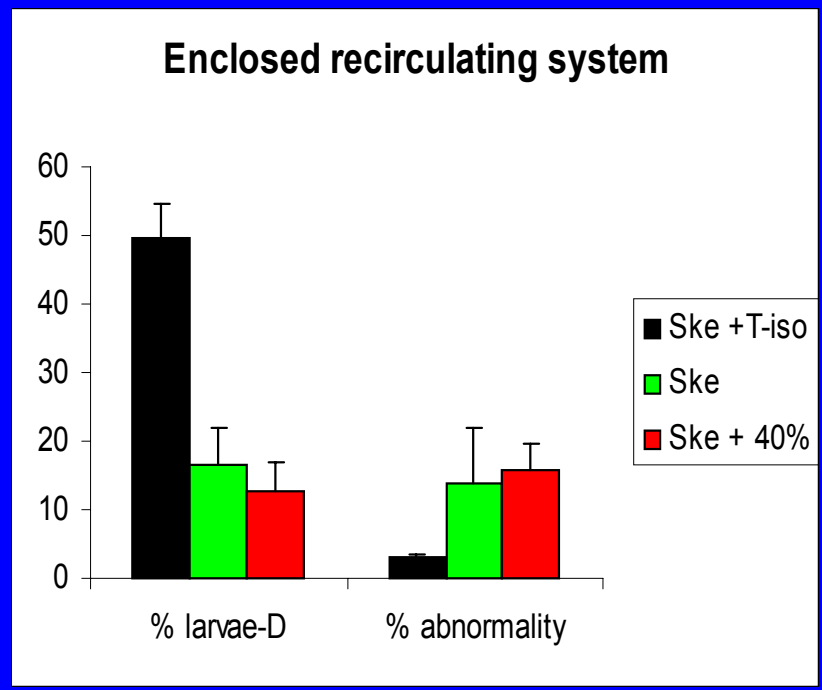


3/ Spring : biological effect

No biological effect at less than 10%

Some compensatory effect at 20 and 40%, but survival and fecundity were affected depending on rearing systems





gigas in fall, a combination of physical and nutritional factors?

Perspectives for a better reproduction process in hatcheries

- **J.F. Samain, M. Mathieu, C.Heude Berthelin, C.Cure, J. Espinosa, P. Soudant, E.Palacios, J.R.Le Coz, C.Quéré, J. Moal**

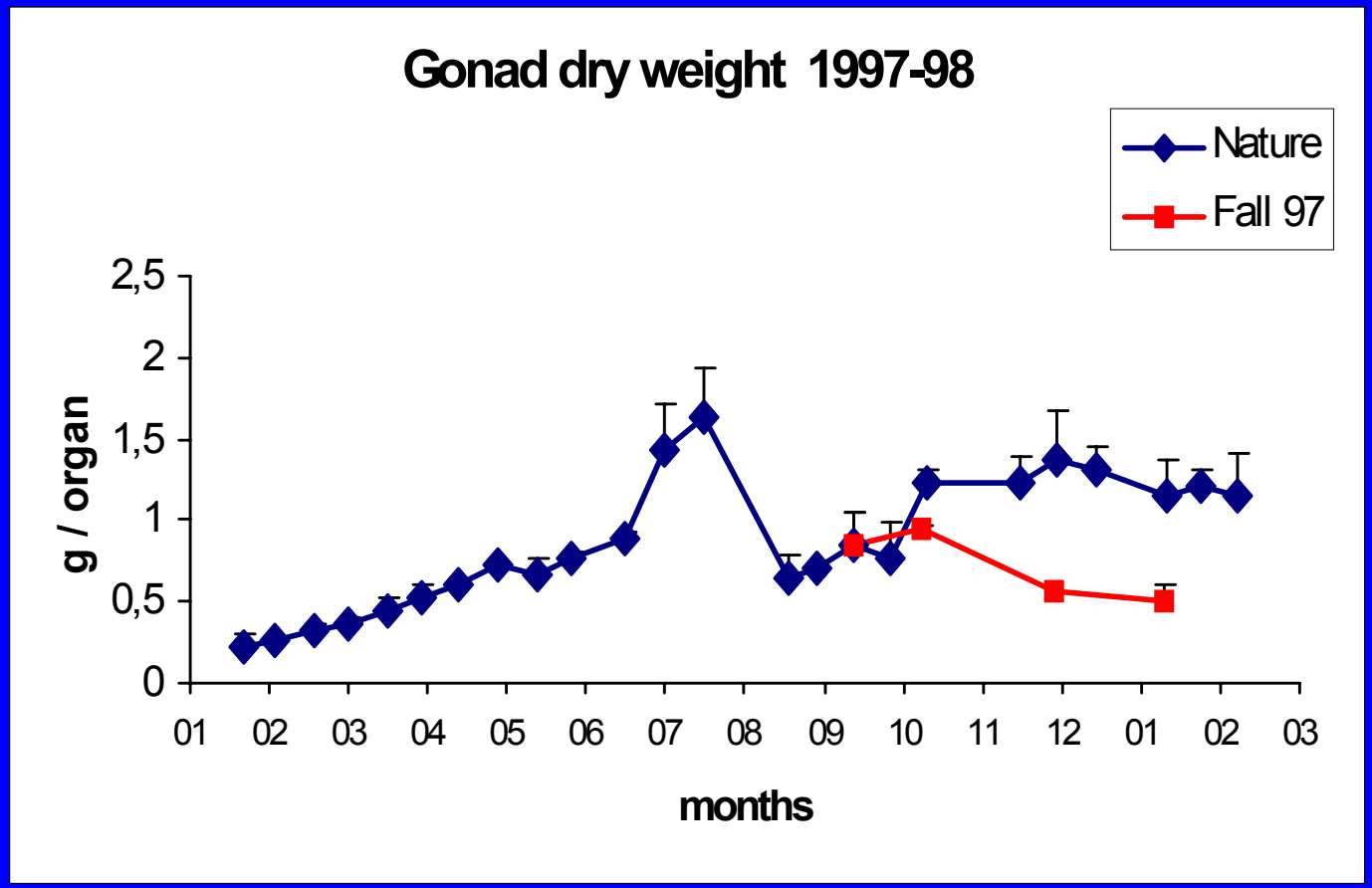
3/ Hatchery conditioning in spring/ fall :

In spring hatchery conditioning was normal

In fall, hatchery conditioning after spawning was impossible

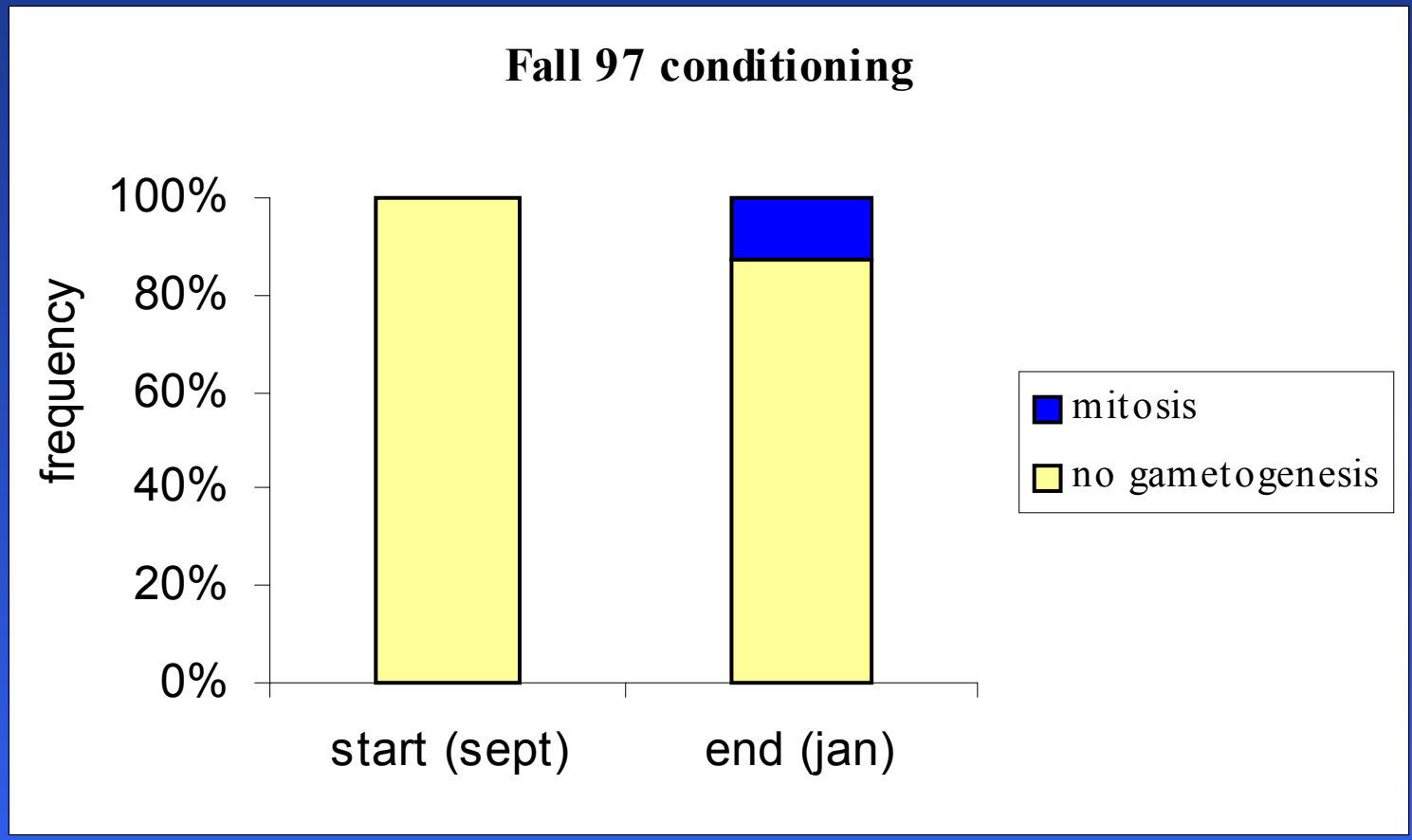
- No effect of the increase in temperature and food

Problems in fall conditioning:



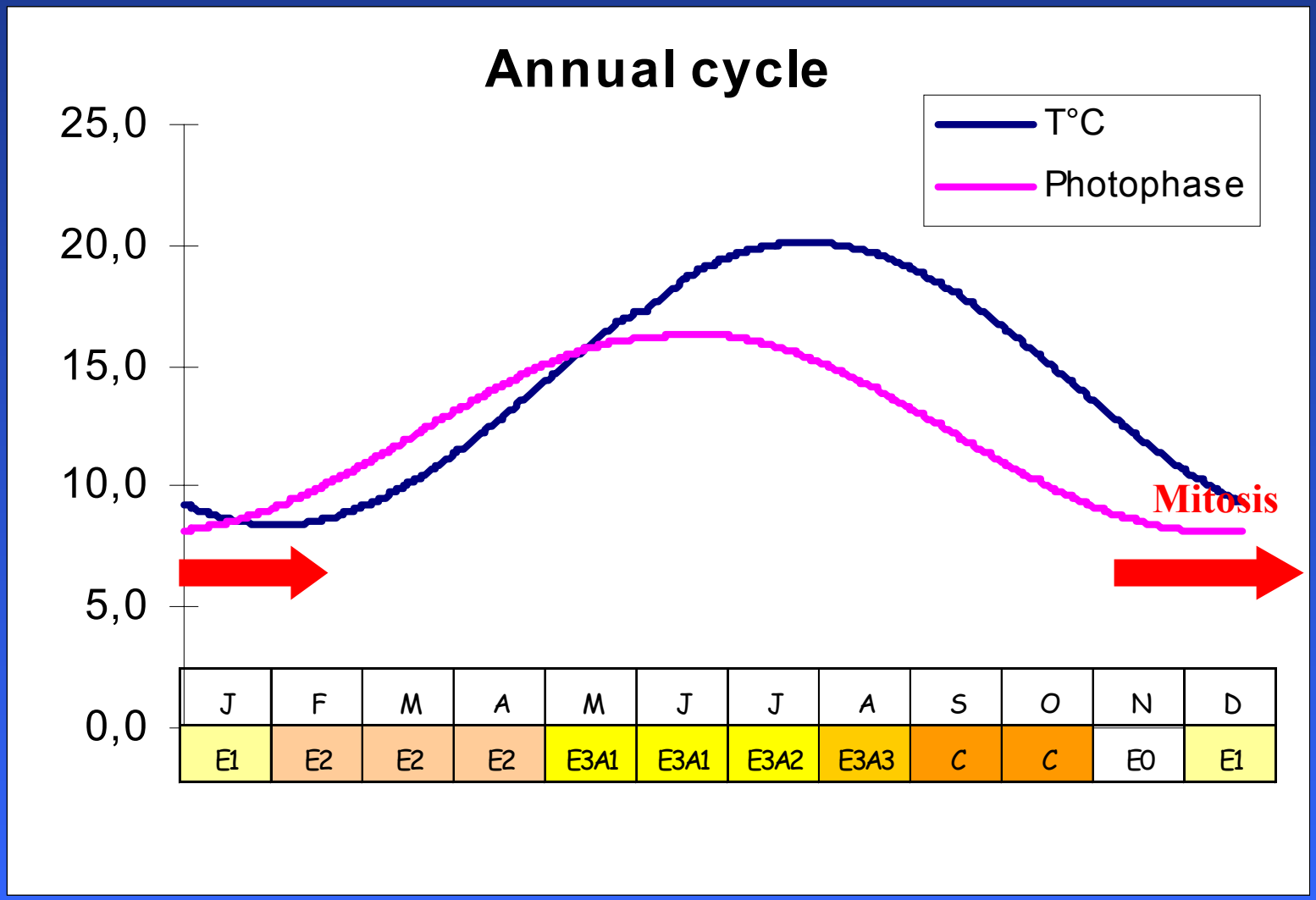
Conditioning in fall did not allow storage restoration

Problems in fall conditioning:



Histology : no gametogenesis was observed (C stage).

Availability of oogonia ?



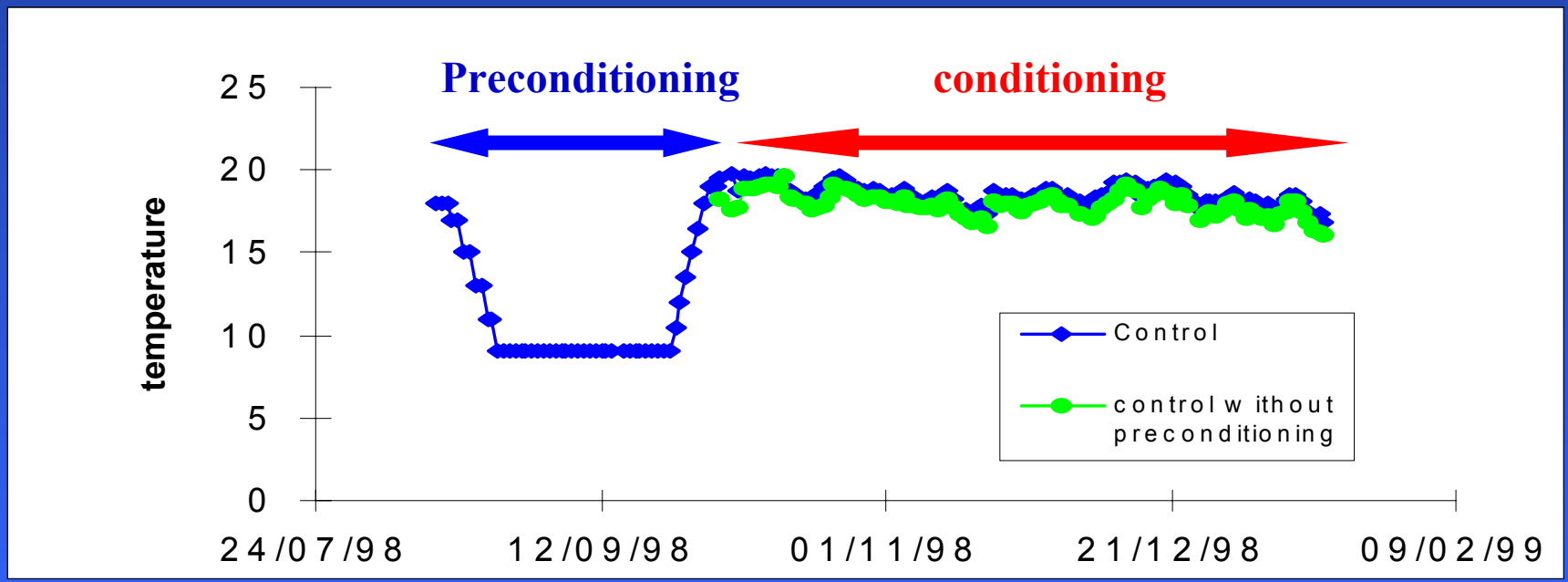
Hypothese : all oogonia were mobilized for the main spawning during summer.

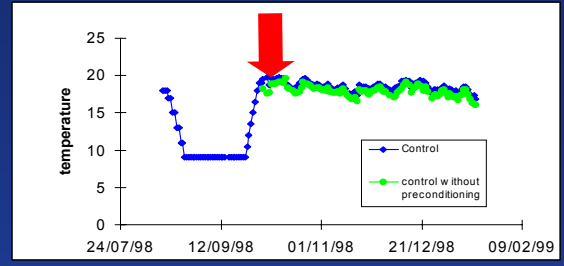
Are temperature and low photoperiod necessary for reinitiation of the sexual cycle?

Protocol :

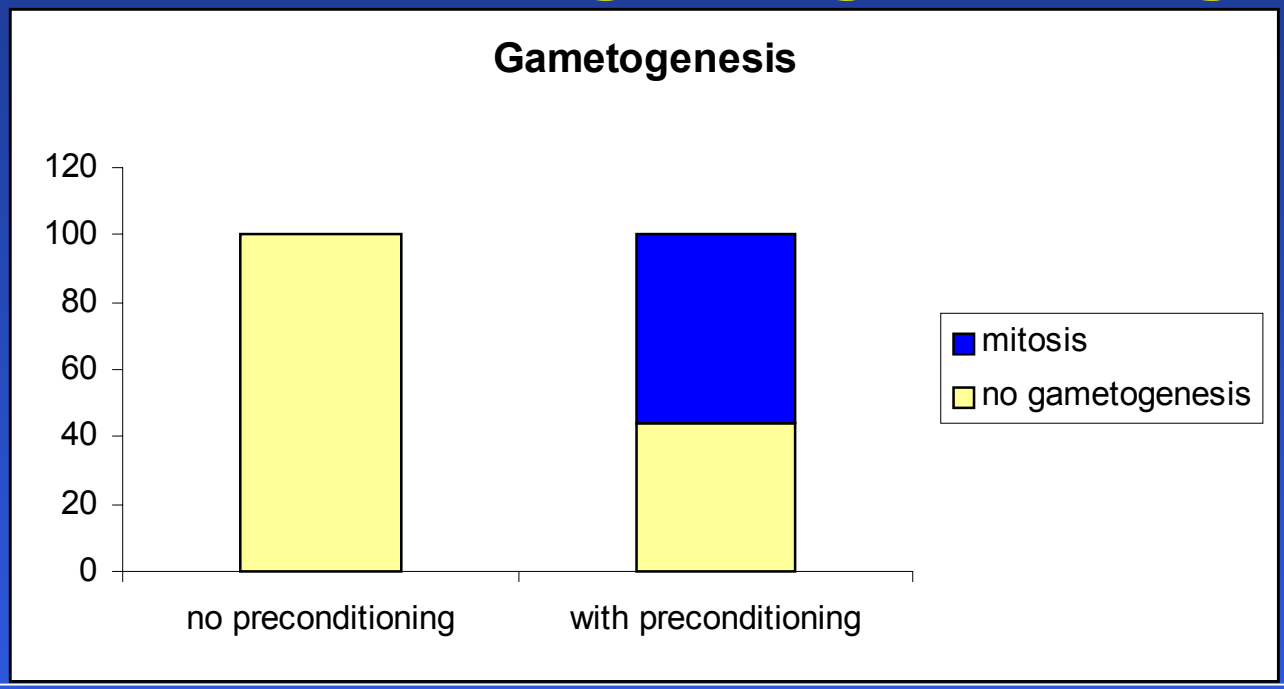
Preconditioning : 4 weeks at 9°C, decreasing photoperiod. Algal mixture.

Then, conditioning at 19°C and high photoperiod. Algal mixture +/- emulsion

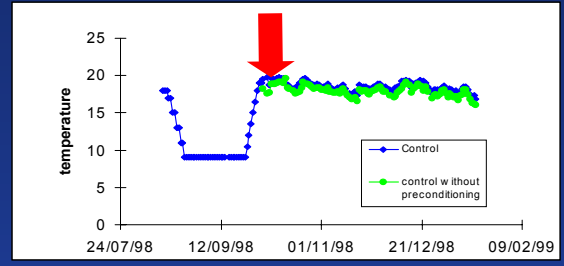




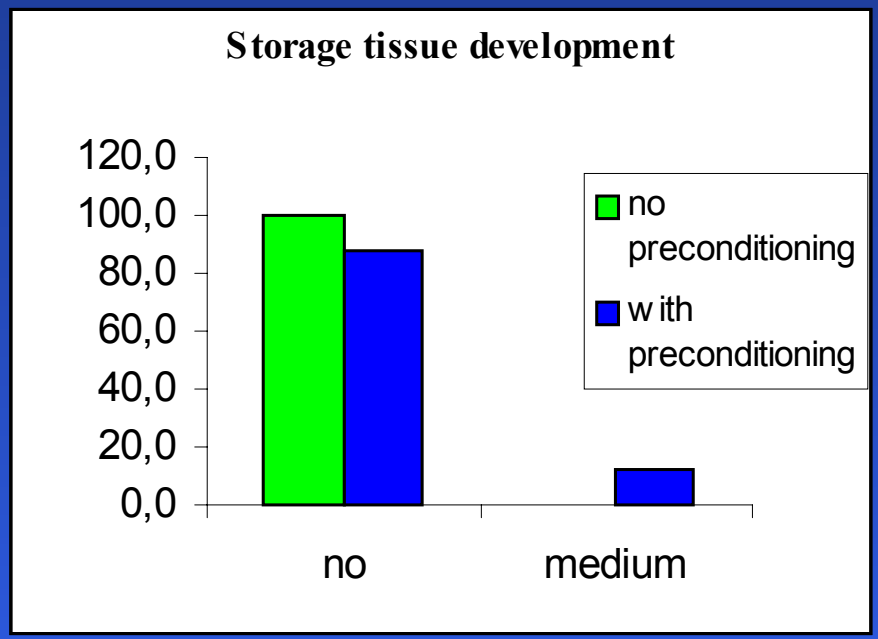
1/ Preconditioning on gametogenesis

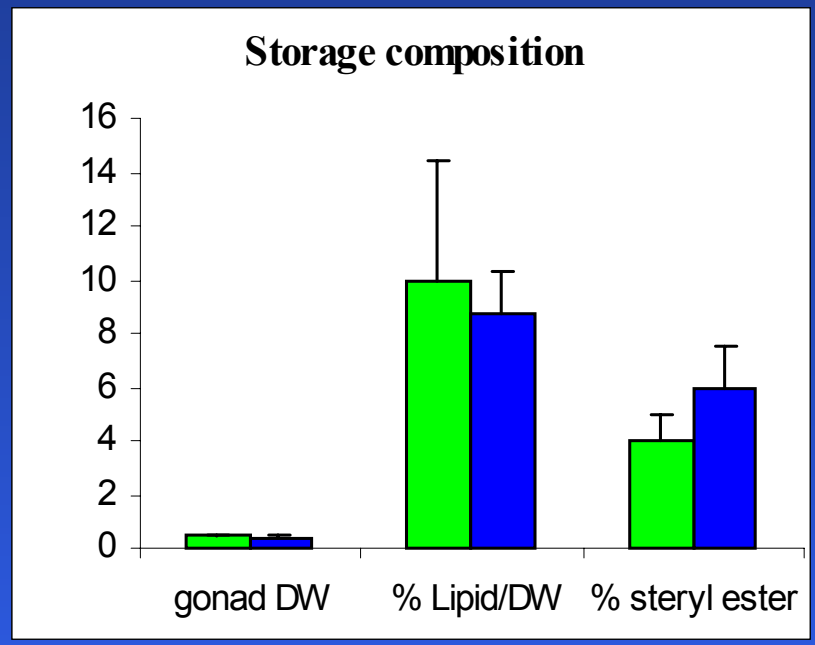


In fall, a decrease of temperature and photoperiod allowed the initiation of a new gametogenesis cycle



1/ Preconditioning on storage

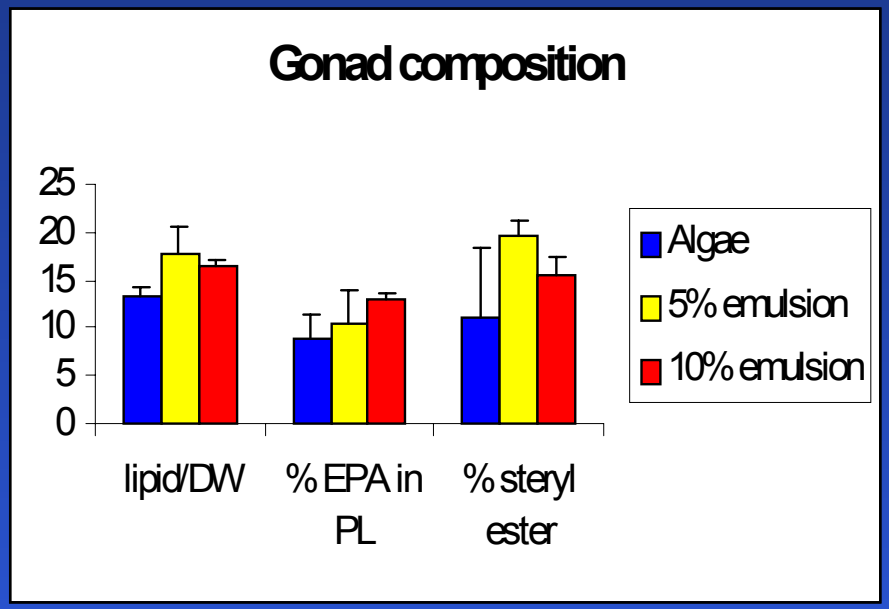


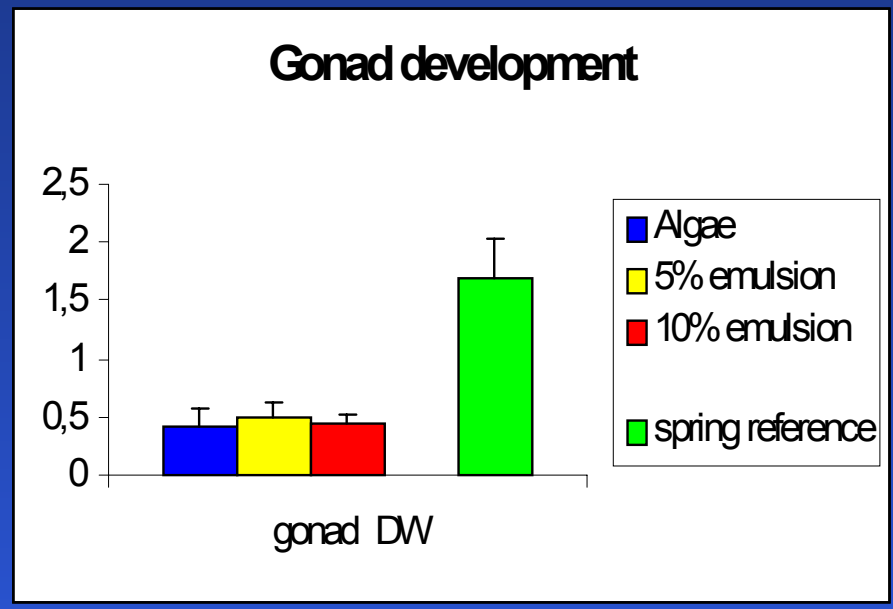


No storage tissue restoration

No gain in DW, lipid, and steryl esters.

3/ Fall : Effect of supplementation on gonad biochemistry and weight

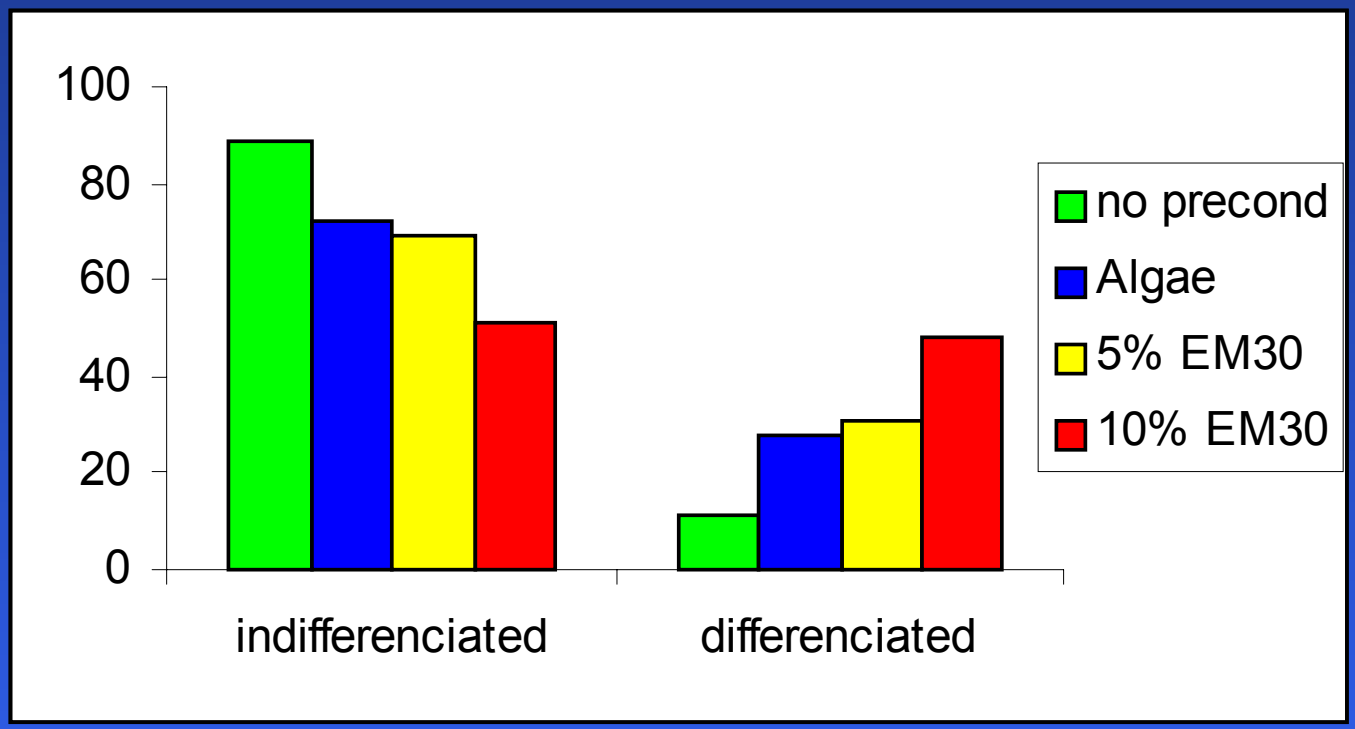




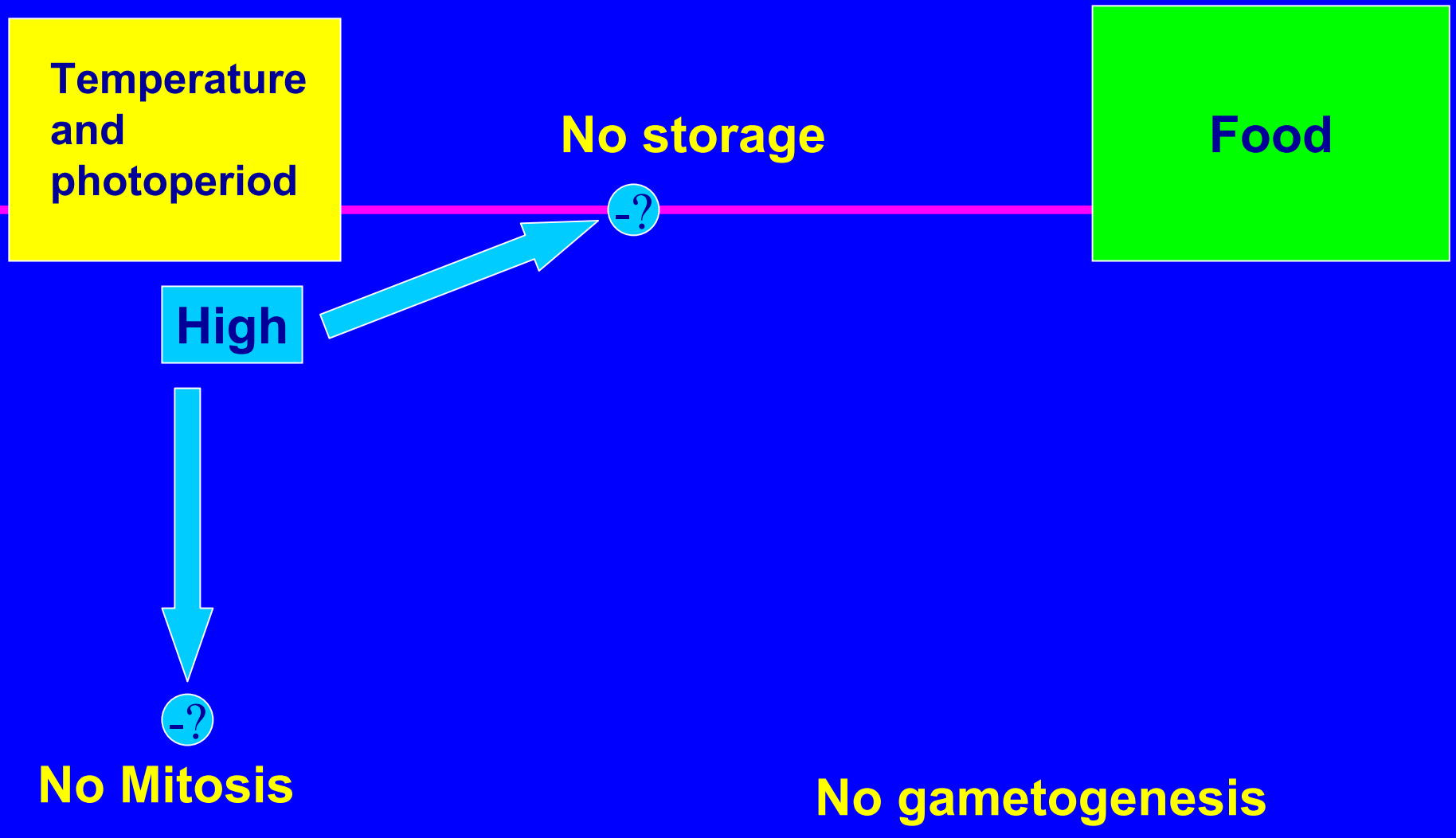
Emulsion increased vitellogenesis (biochemical criteria)

However, weak gonad development

3/Fall : effect of supplementation on gametogenesis



emulsion accelerated vitellogenesis rate


Temperature and photoperiod
No storage
Food
High
-?
-?
No Mitosis
No gametogenesis

Temperature and photoperiod

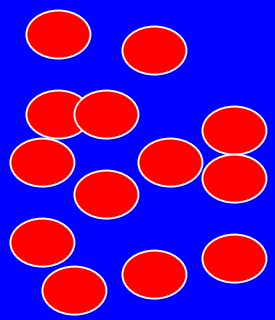
No storage

Food

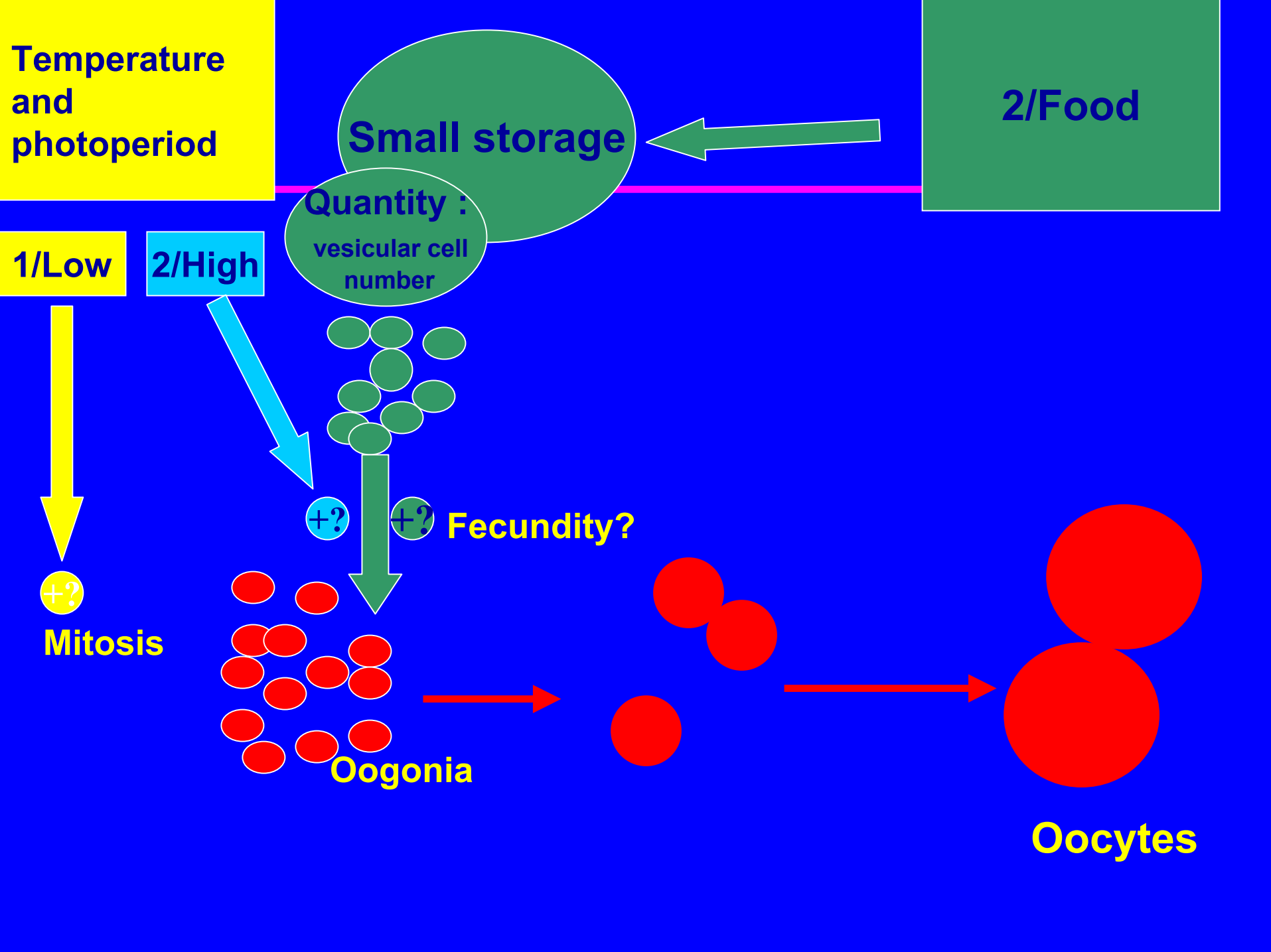
1/Low

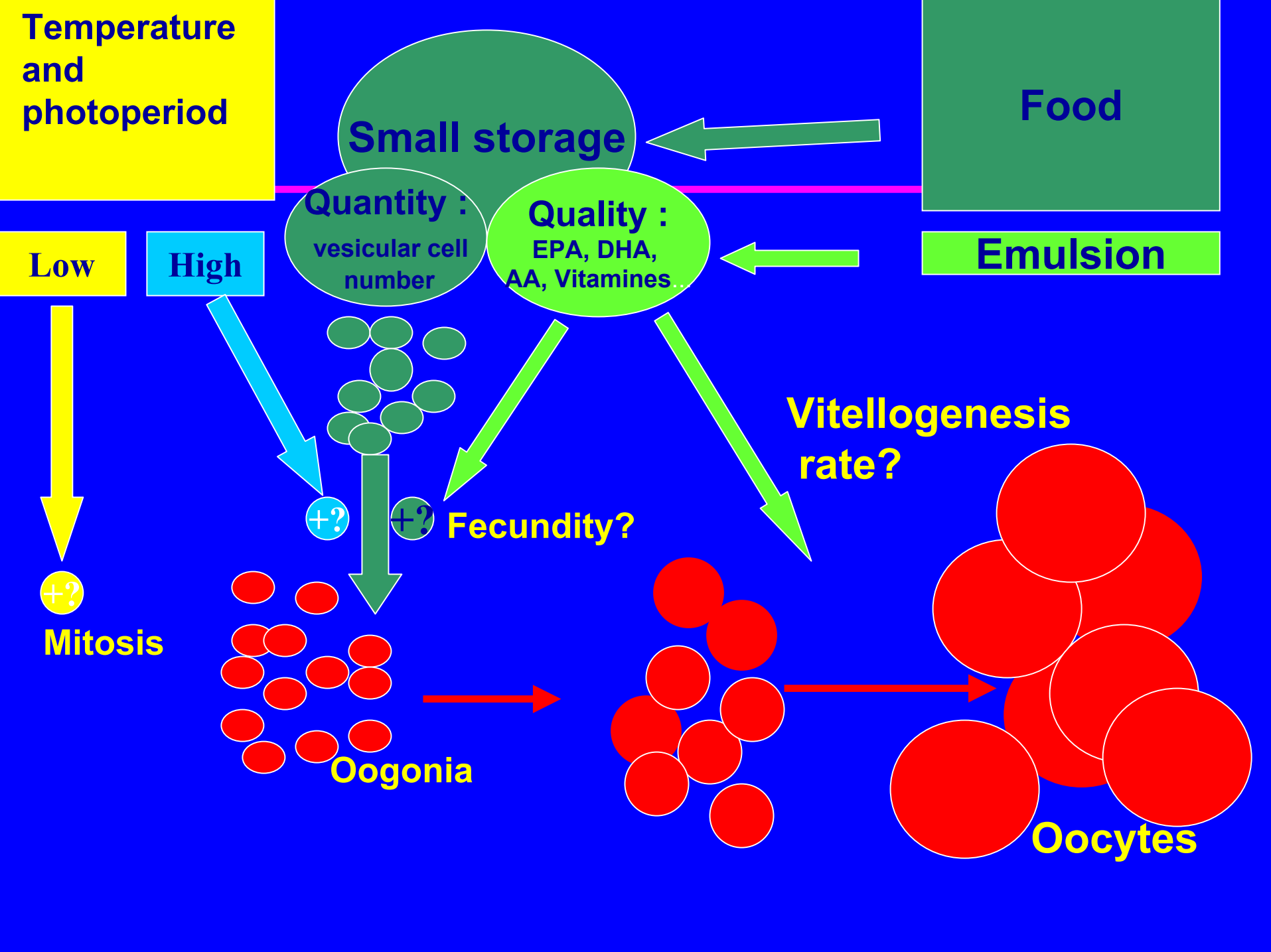
+?

Mitosis



Oogonia


Temperature and photoperiod
Small storage
2/Food
Quantity :
vesicular cell number
1/Low
2/High
+?
+?
Fecundity?
+?
Mitosis
Oogonia
Oocytes


Temperature and photoperiod
Small storage
Food
Quantity : vesicular cell number
Quality : EPA, DHA, AA, Vitamines...
Emulsion
Low
High
+?
+?
Fecundity?
Vitellogenesis rate?
+?
Mitosis
Oogonia
Oocytes

Conclusions...

The reproductive cycle of *C.gigas* is well characterized in Marennes Oleron on cellular and biochemical aspects.

Gonial mitosis should be re-initiated at fall by external factors as temperature-photoperiod. Regulations are understudy.

But storage control is not yet documented

...Conclusions ...

Deficiencies in essential nutriments can be evidenced comparing natural and hatchery processes : PUFAs, Sterols, Vitamins

Promising results were obtained using emulsions :

- » At spring, deficiencies of monospecific algal diet can be compensated, but problems of doses and nutriments should be solved
- » At fall, emulsion stimulates vitellogenesis rate, but control of storage is not yet solved

...Conclusions :

Other particules as spraybeads or liposomes encapsulating hydrosoluble compounds are understudy (vitamins).

These techniques are promising for a better understanding of essential nutriments for reproduction of bivalves all over the year, and using a low cost algal diet.

But other non nutritional factors affecting storage, gonial mitosis should be investigated and need more cooperative researches.

Contributions :

- **Experiments :** IFREMER Brest and La Tremblade
- **Histology :** J.Espinosa, O.Garcia, Univ. Santiago de Compostella, Espagne, M.Mathieu IBBA Caen
- **Biochemistry of essential nutriments :** IFREMER Brest, Y.Marty, UMR CNRS 6521 UBO Brest, P.Sorgeloos, P.Coutteau ARC Gent, Belgique
- **Glycogen metabolism :** M.Mathieu et al. Univ.Caen
- **Supplementation technics :** P.Sorgeloos, P.Coutteau ARC Gent, Belgique, M.Cansell, Univ.Bordeaux, France, C.Langdon, Oregon Univ. USA
- **Hatcheries :** SATMAR, Guernesey Sea Farm