Variance of reproductive success in the European flat oyster *Ostrea edulis* assessed by microsatellite-based parentage analyses in a natural population and in hatchery

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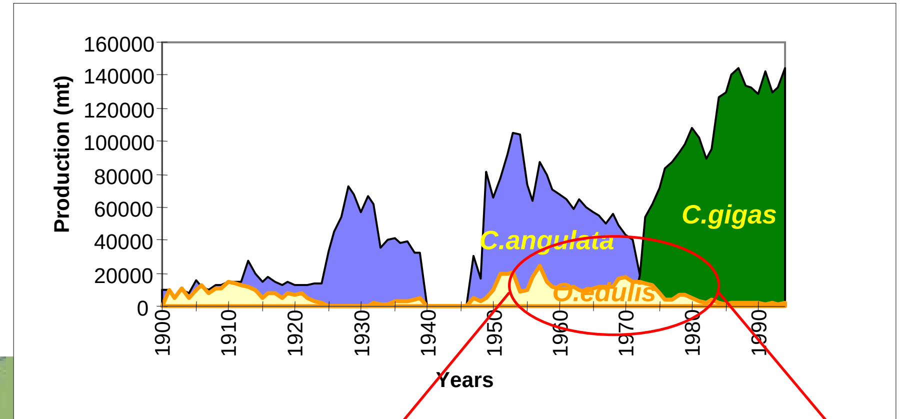
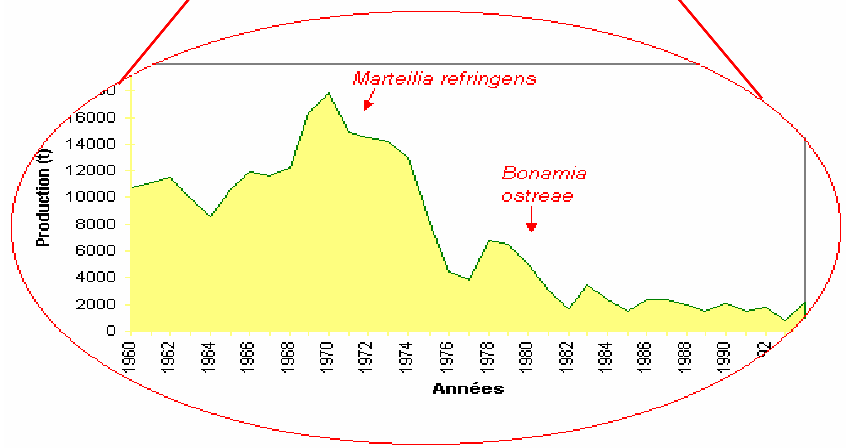
Ostrea edulis:
the native european flat oyster

(JAZIRI, 1985)





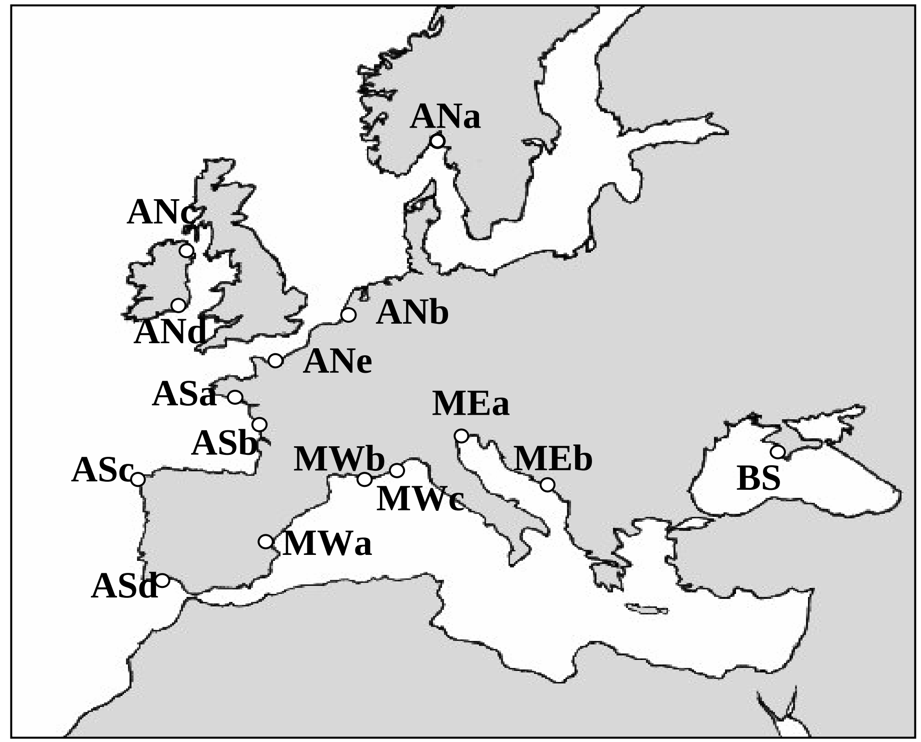
Ostrea edulis in 2004 :

World production = 5.100 t/y
French production = 1.500 t/y

• Spatial distribution ?

Sampling:

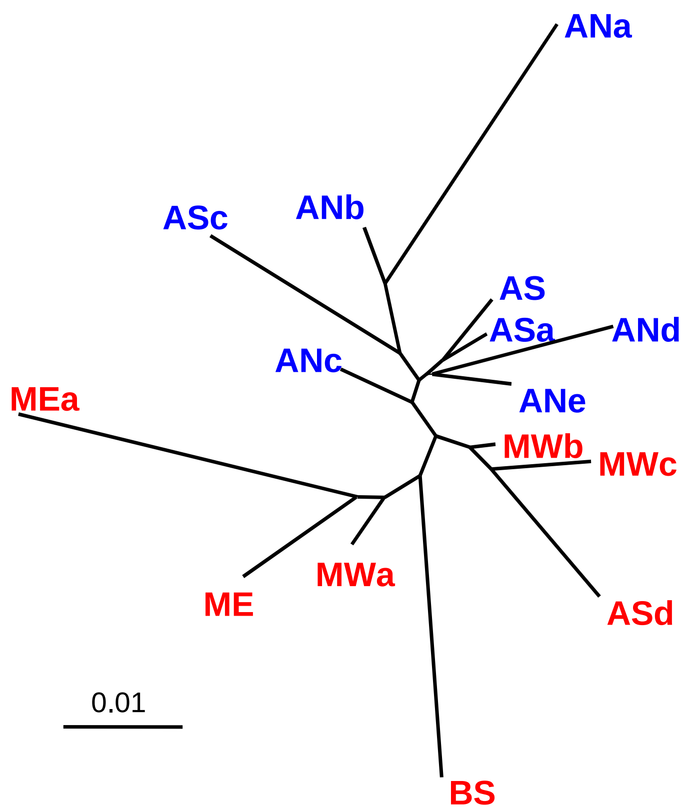
15 populations sampled
14 to 50 individuals per location



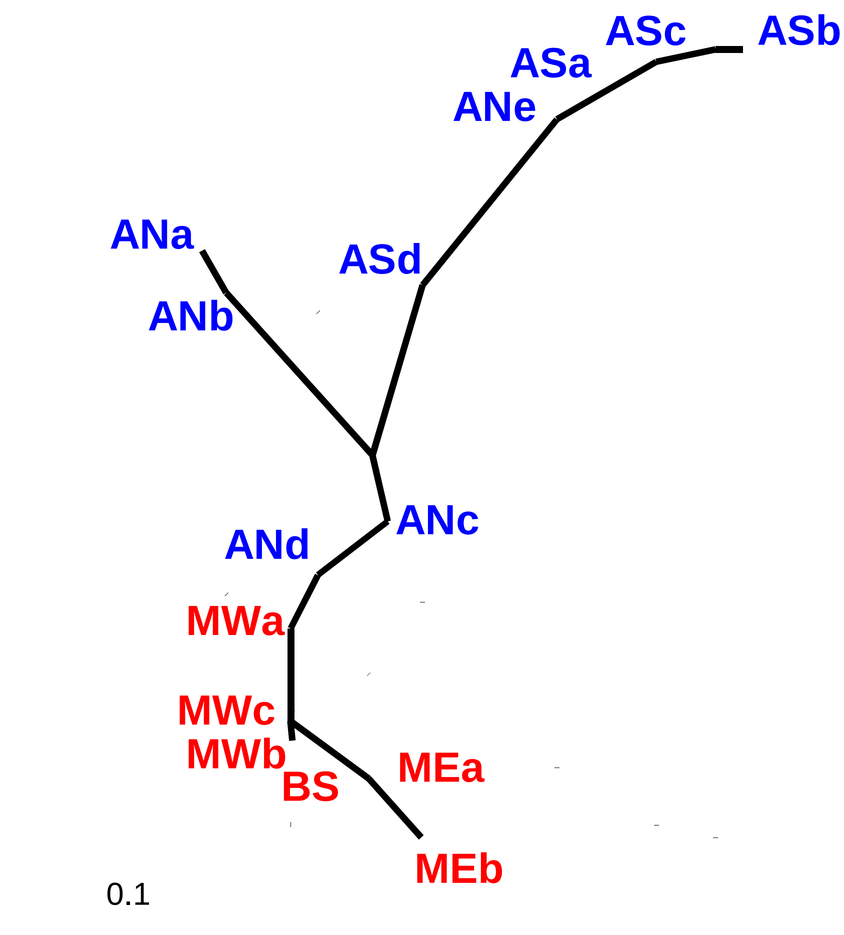
Markers:

- Allozyme loci (Saavedra *et al.*, 1993, 1995)
- microsatellite loci (Launey *et al.*, 2002)
- 12S rRNA SSCP (Diaz Almela *et al.*, 2004)

Mediterranean sea versus *Atlantic ocean* differentiation :

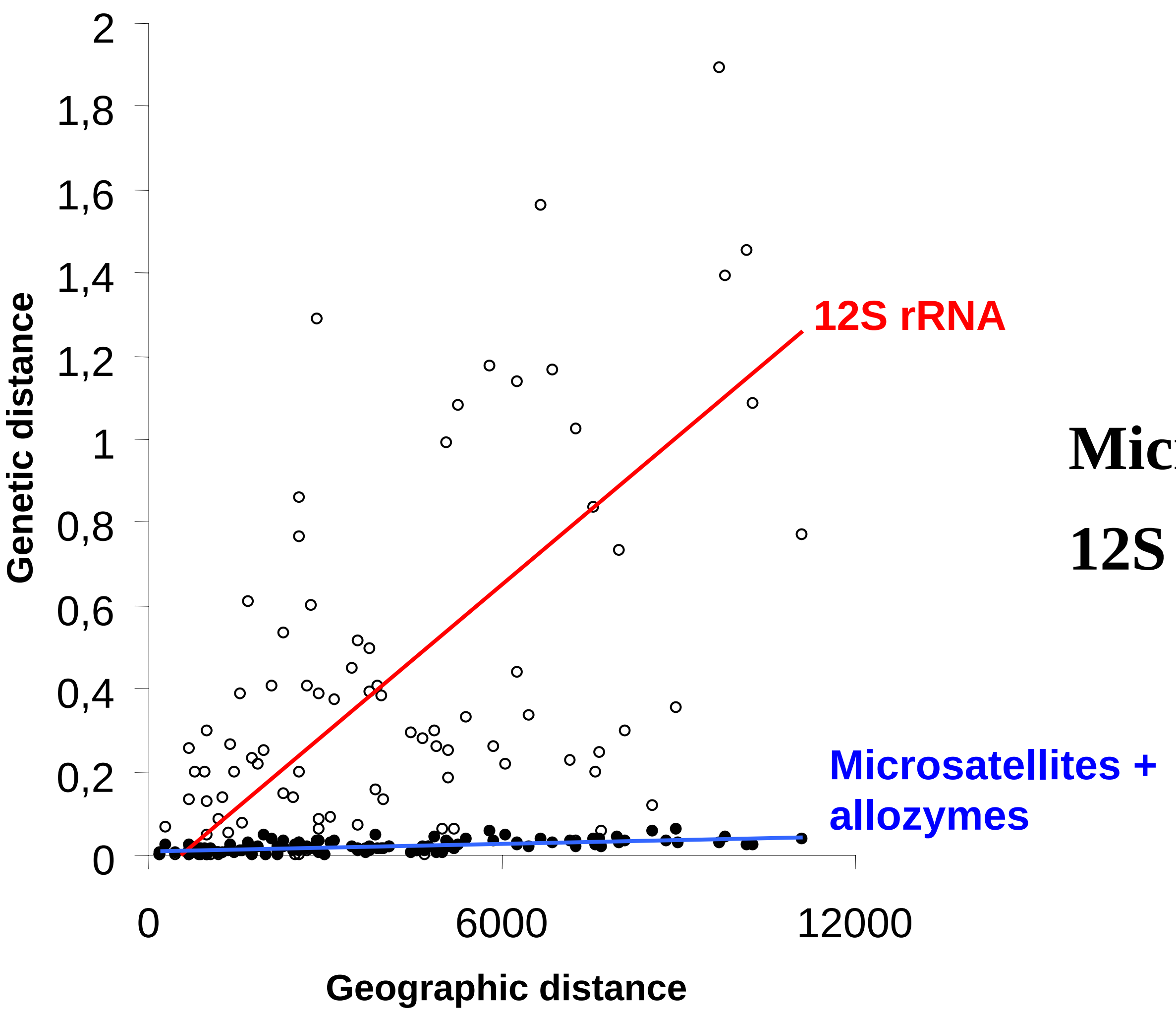


Microsatellite markers



12S rRNA

Isolation by distance :



Microsatellites : *Fst* = 0.019***

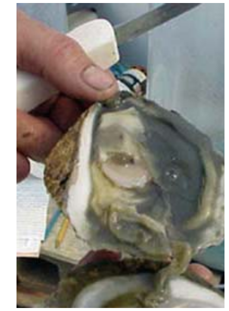
12S rRNA : *Fst* = 0.224***

10 X

Higher variance in reproductive success in females than in males ?

Parentage analyses in a natural population of *Ostrea edulis*

1- SAMPLING : 14 brooding females issued from a natural population (2001)

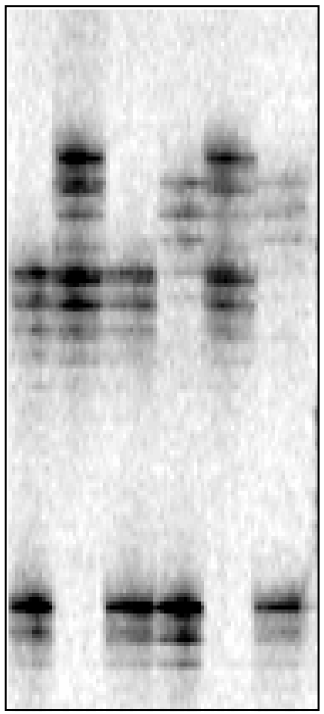


2- SCORING : 80 larvae per female

- 4 microsatellites markers : OeduJ12, U2, H15 and T5 (Launey *et al.*, 2002)

Locus OeduU2

Allele 188



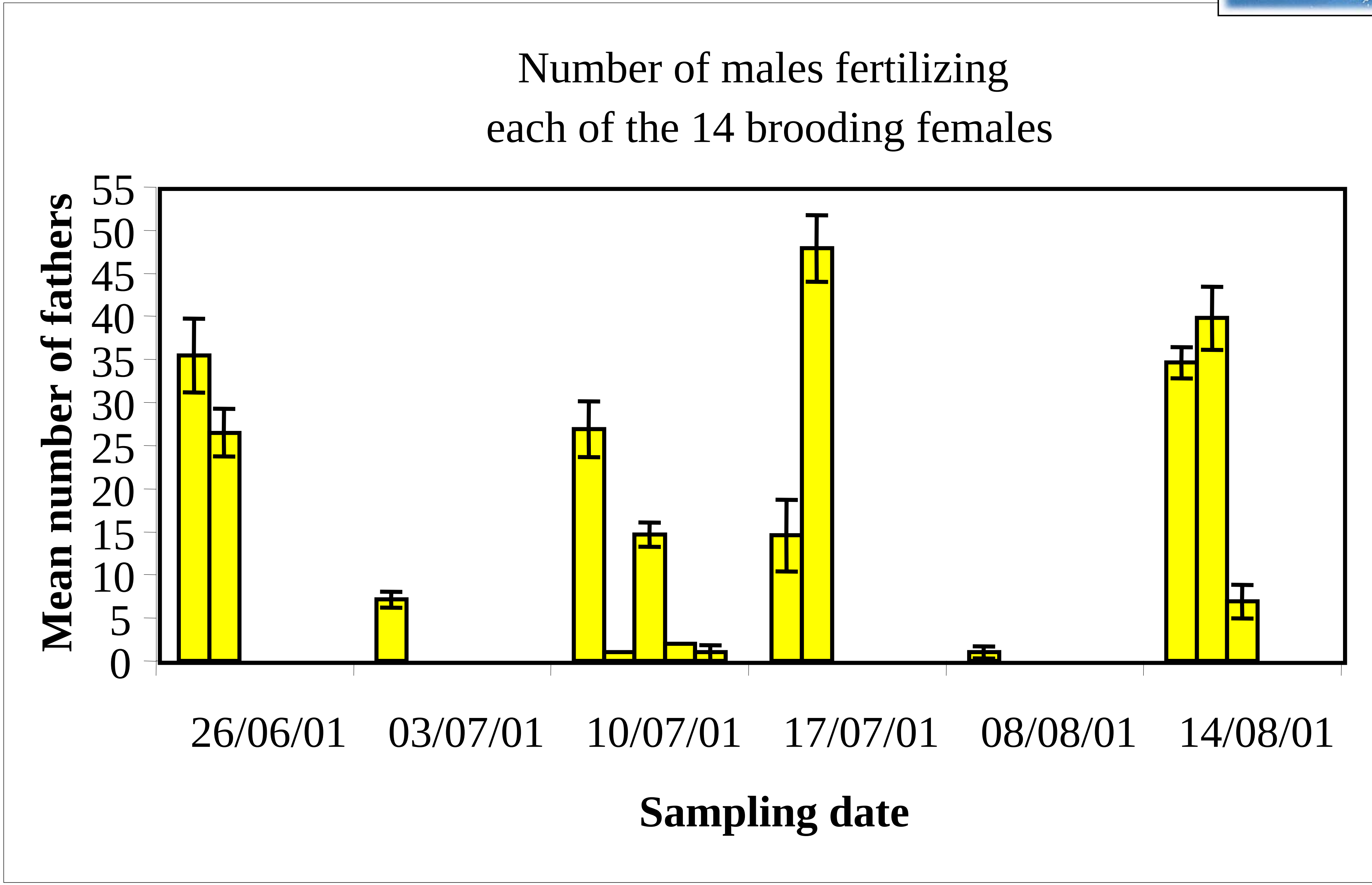
Allele 156

3- PATERNITY ANALYSIS :

Two parental reconstruction softwares:

- PARENTAGE (Emery *et al.*, 2001) : Bayesian
- GERUD1.0 (Jones, 2001) : combinatory

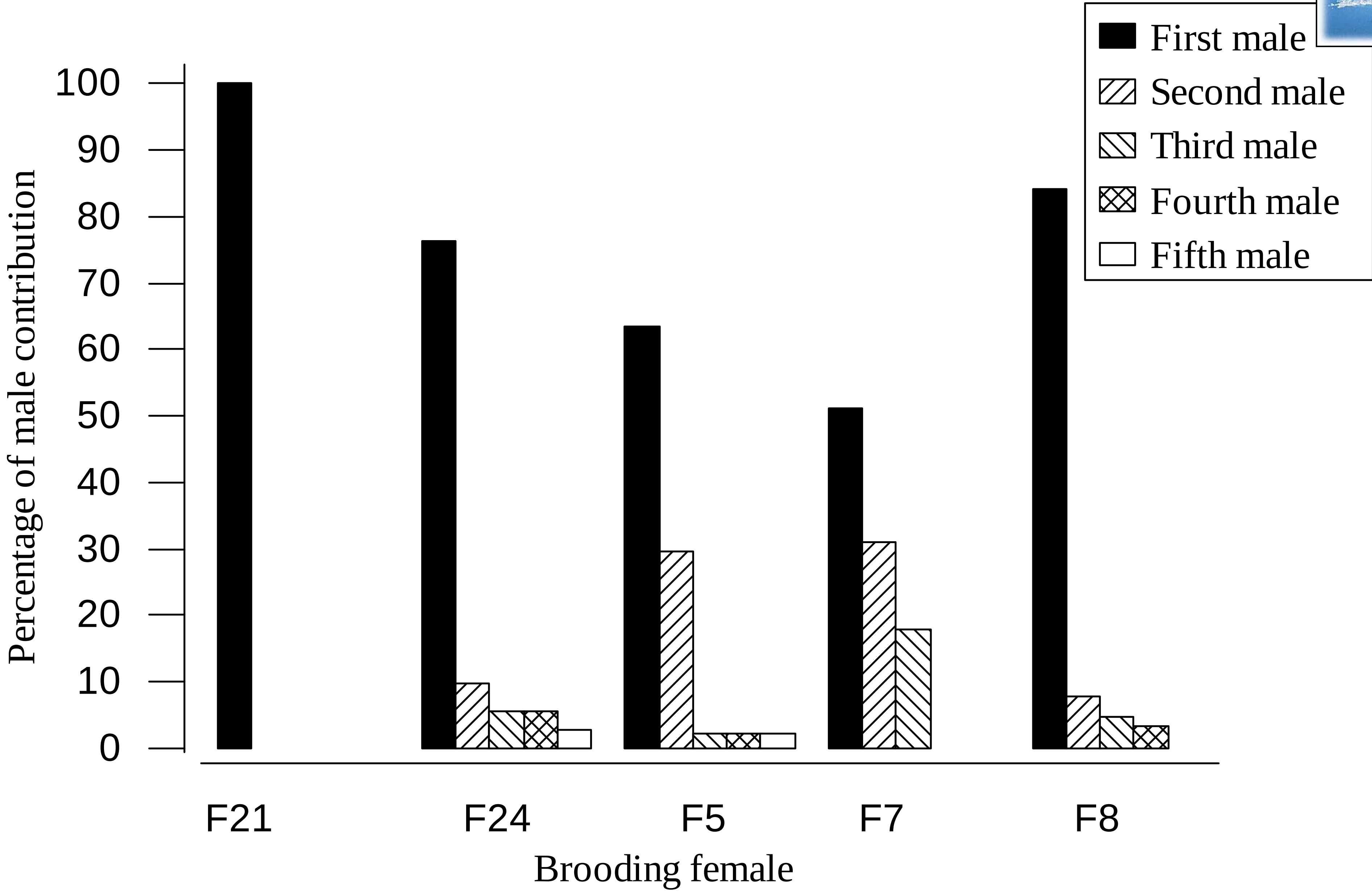
How many males fertilize a female ?



Very variable number of males per female (1 to > 40)

(PARENTAGE)

Male contributions within each female



Variance in individual male contribution : male with the highest contribution fathered from 51 to 100% of larvae

(GERUD1.0)

Parentage analyses in a natural population of *Ostrea edulis*

Paternal analyses of brooding females of *Ostrea edulis* in a wild population

These results are of limited value to answer our inital question because :

- The population size is poorly known
- The effective population size is difficult to estimate
- The spatial distribution of males and females is unknown
- The ffective sex ratio unknown
- …

What about experimental (hatchery) populations ?

1- COLLECTION OF LARVAE :

Six successive spawning events over 2 weeks (14/03 to 30/03)

2- GENOTYPING : 63 oysters, 80 larvae per spawning

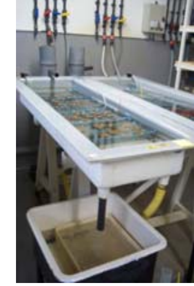
- 3 microsatellites loci: OeduJ12, U2, T5 (Launey *et al*., 2002)

3- GENETIC ANALYSES :

- Genetic differentiation adult/mass spawning θ
- Effective population size (NeEstimator 1.3. Software)

4- PARENTAGE ANALYSES :

- Combined exclusion probability 98.3%
- PAPA software (Duchesne *et al*., 2002) : max. likelihood



• **Effective population size**

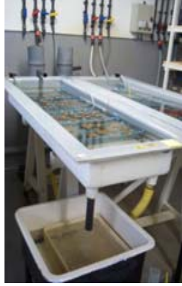
	Ne (temporal method)
14/03/03	21.0 [12.4 36.2]
17/03/03	12.5 [7.8 19.6]
20/03/03	21.0 [12.3 36.5]
22/03/03	22.3 [12.9 39.6]
28/03/03	33.2 [17.8 70.1]
30/03/03	29.6 [16.3 58.9]

➡ Relatively small Ne (12-33)

Genetic variability of a cohort : Ne<20 (Hedgecock *et al*., submitted)

➡ Large 95% CI : small number of markers

Genetic analyses



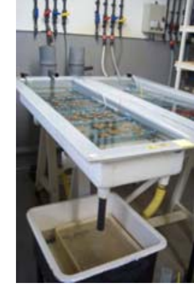
- **Genetic differentiation (Fst x 100)**

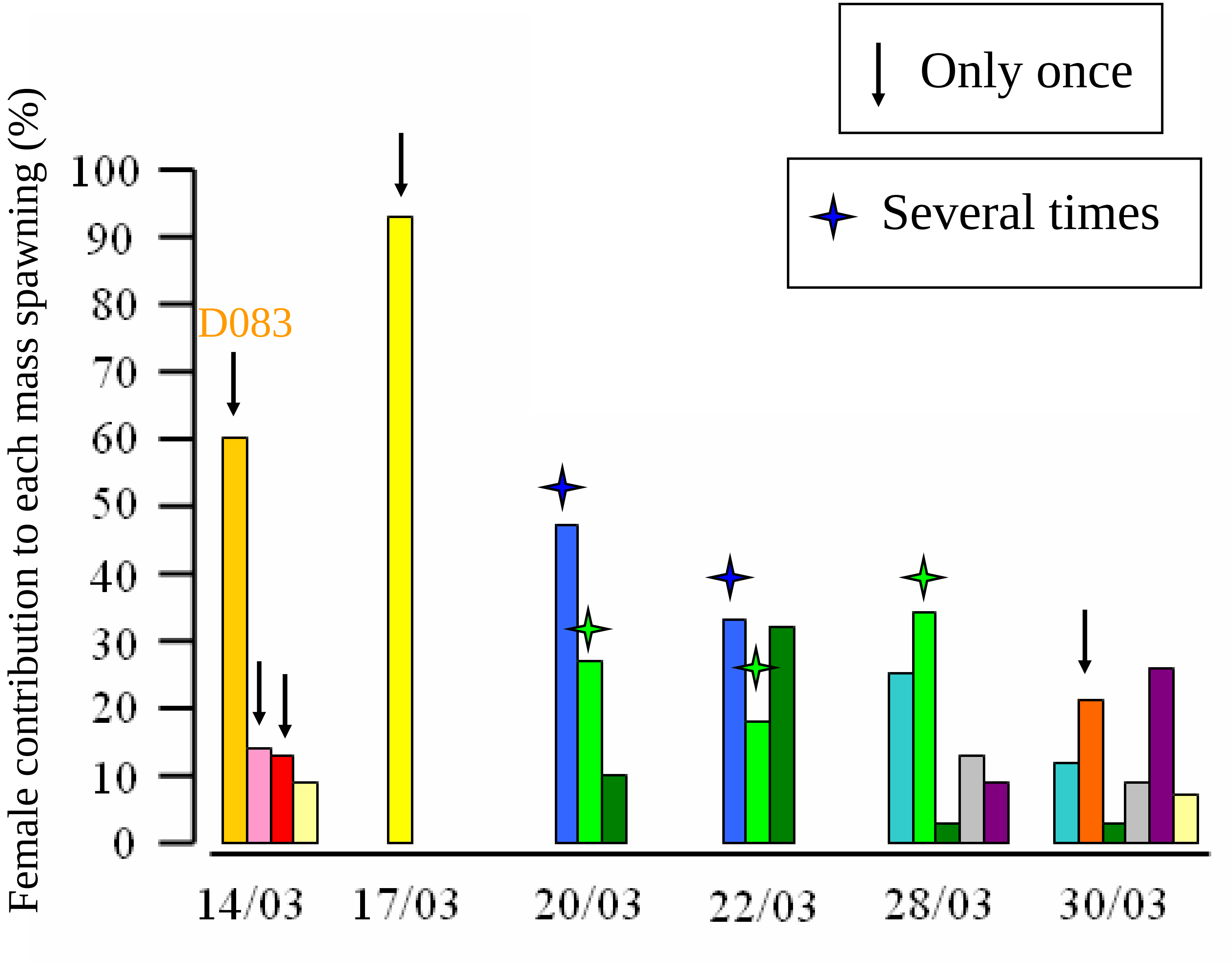
	14/03/03	17/03/03	20/03/03	22/03/03	28/03/03	30/03/03
Adults	3***	5.5***	3.1***	1.5***	1.3***	1.2***
14/03/03	-	11.9***	7.1***	5.9***	5***	5.1***
17/03/03	-	-	9.8***	6.8***	7.9***	7.8***
20/03/03	-	-	-	0.7**	4.2***	4.5***
22/03/03	-	-	-	-	3***	3***
28/03/03	-	-	-	-	-	1.8***

	14	14+17	14+17+20	14+17+20+22	14+17+20+22+28	14+17+20+22+28+30
Adult	3***	1.1***	0.6**	0.6**	0.3*	0.2NS

While pooling the succesive spawning cohorts, genetic differentiation becomes blurred

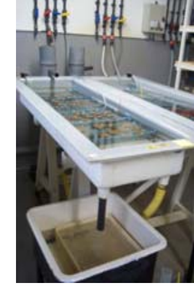
Parentage analyses : Female contributions

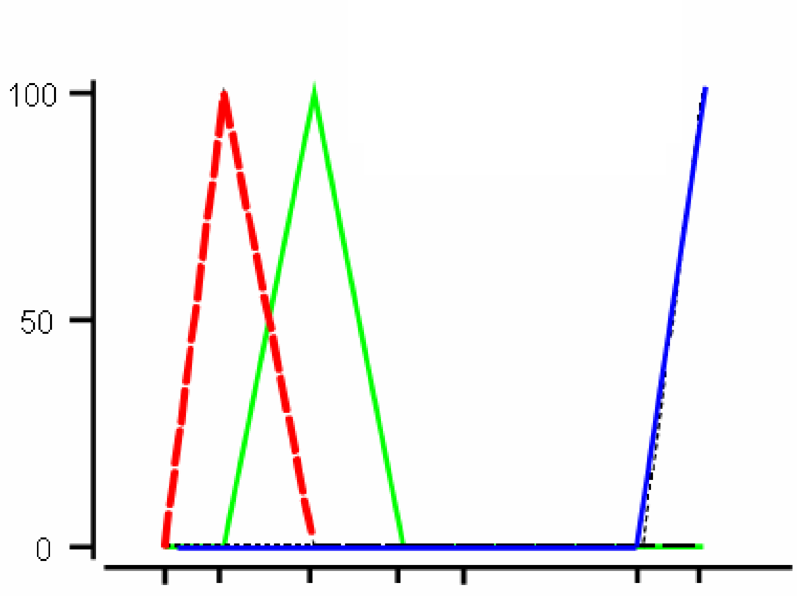




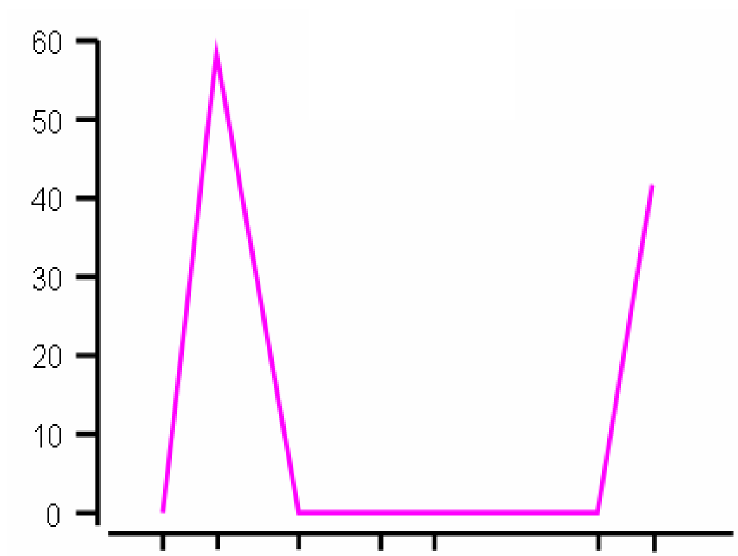
(PAPA)

Parentage analyses : Dynamics of female larval release

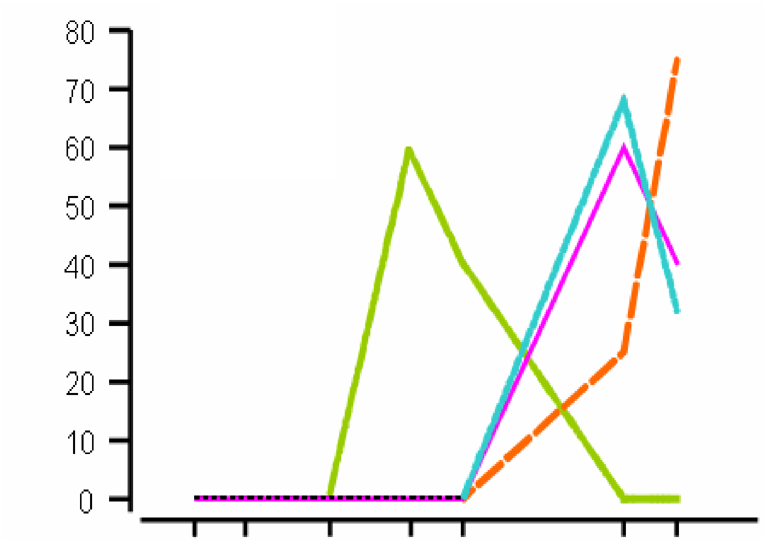




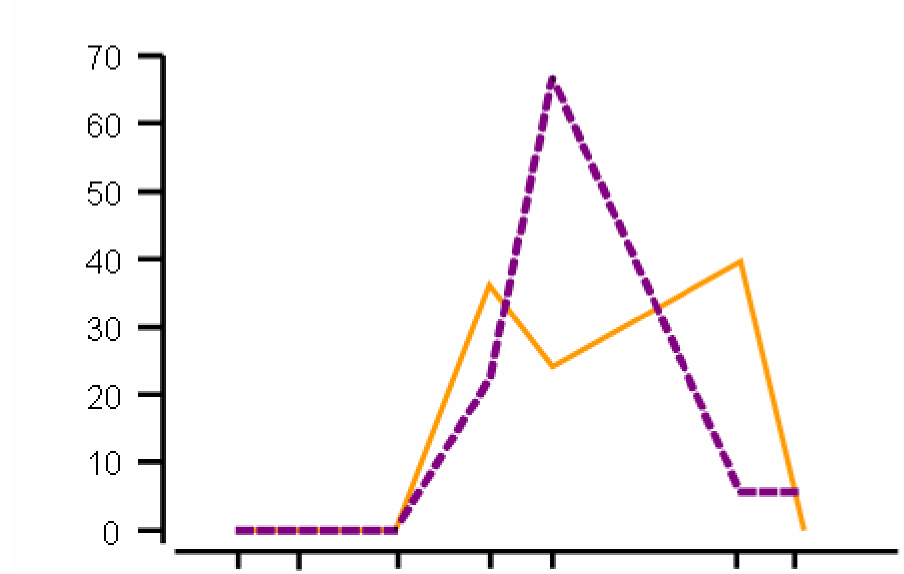
In 1 mass spawning



In 2 spaced mass spawning



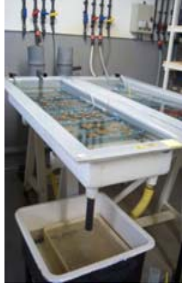
In 2 successive mass spawning

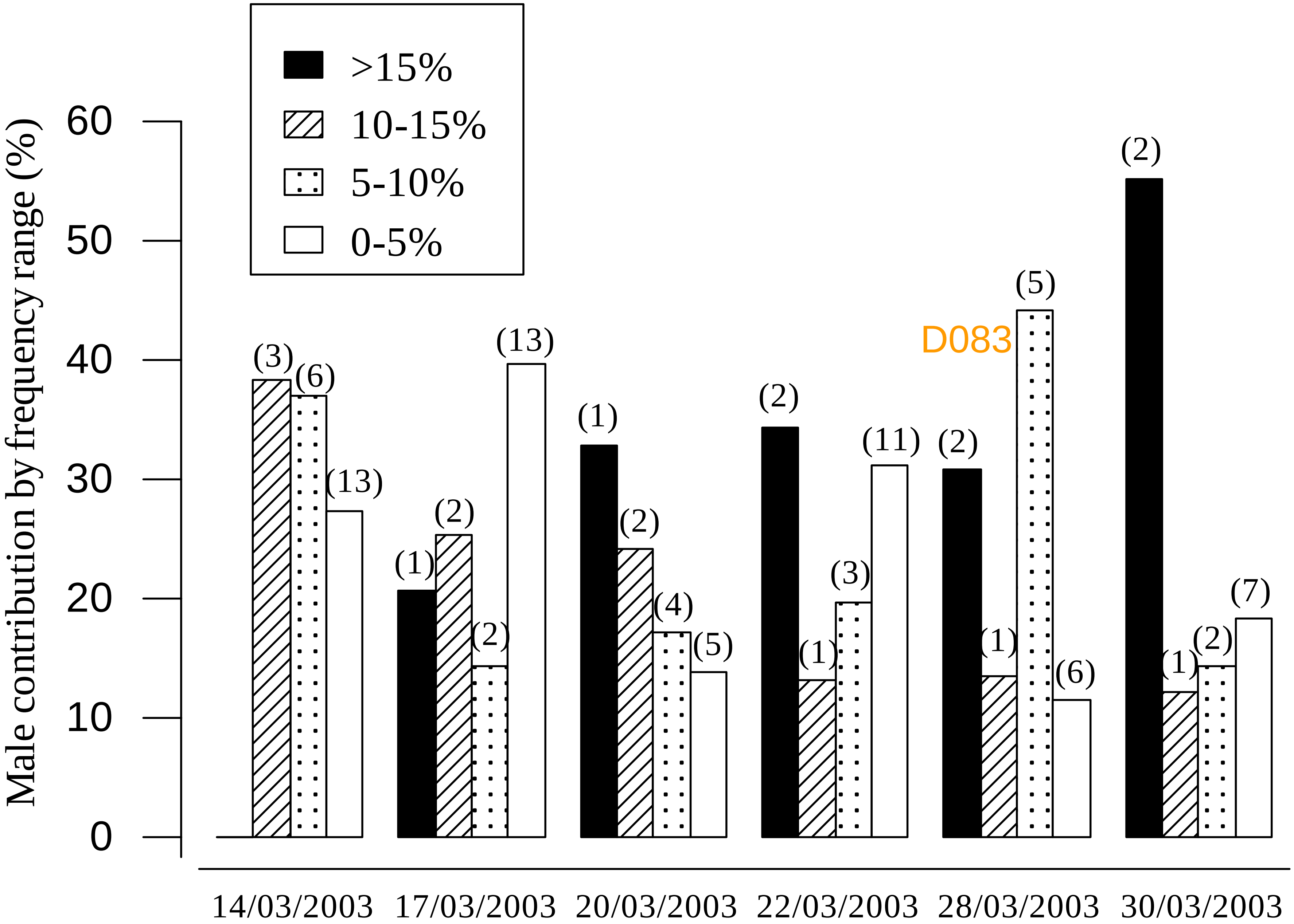


In 3 or 4 mass spawning

Variable extension in time of larval release and its dynamics

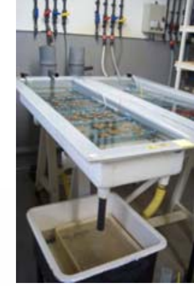
Parentage analyses : Male contributions

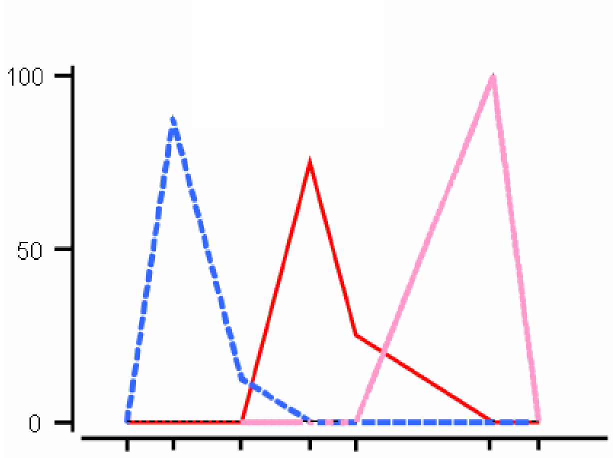




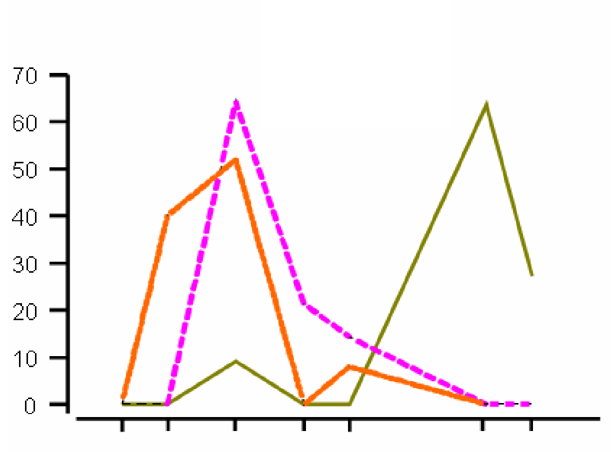
(PAPA)

Parentage analyses : dynamics of male contributions

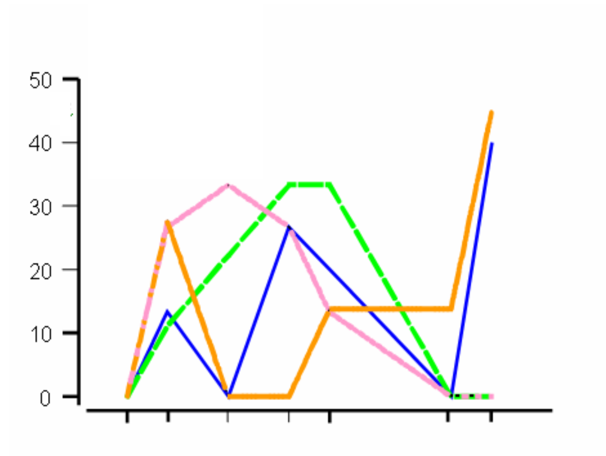




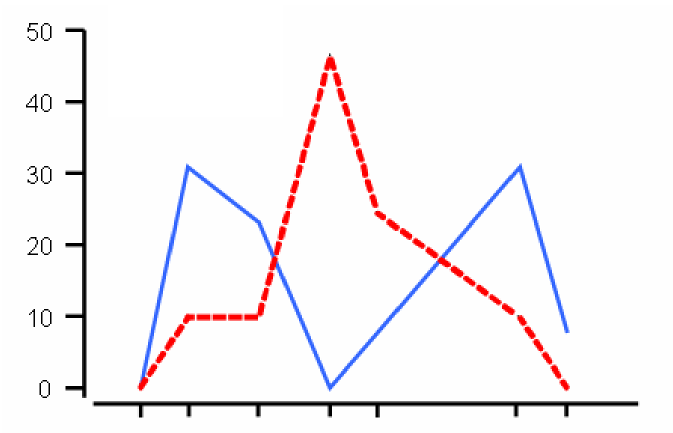
In 1 or 2 mass spawning



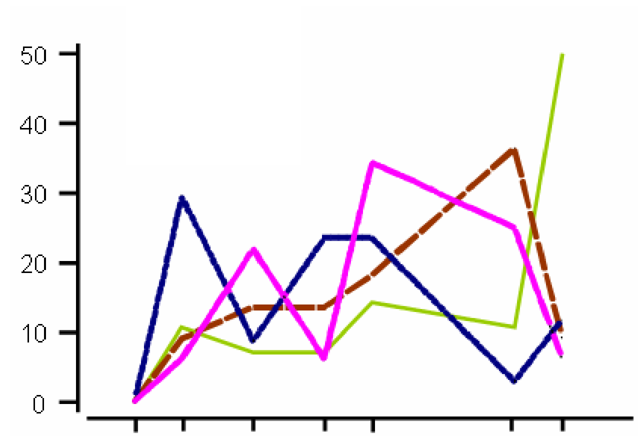
In 3 mass spawning



In 4 mass spawning



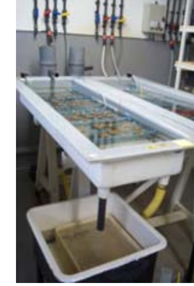
In 5 mass spawning



In 6 mass spawning

→ More complex patterns

Implications / Conclusions



- Better knowledge of reproductive biology of *O. edulis*
  - Ability to change of sex very quickly (maturation of 2 types of gametes simultaneous)
  - Spawning of an individual does not stimulate all the others
  - High variability in the temporal dynamics of emission of gametes and larvae

- Relative variance in reproductive success in males and females:
  - For most females, spawing events are constituted by the progeny of several males (especially in our hatchery experiment)
  - Most males fertilize several females (hatchery experiment)
  - Effective reproductive period is longer for males that for females (hatchery experiment)

→ **Higher variance in reproductive success in females than in males**