Federal Rural University of Pernambuco
Department of Fisheries and Aquaculture
Post Graduate Program in Fisheries and Aquaculture

Recent Developments on Broodstock Maturation and Reproduction of Indigenous Penaeid Species in Brazil

Dr. Sílvio Peixoto

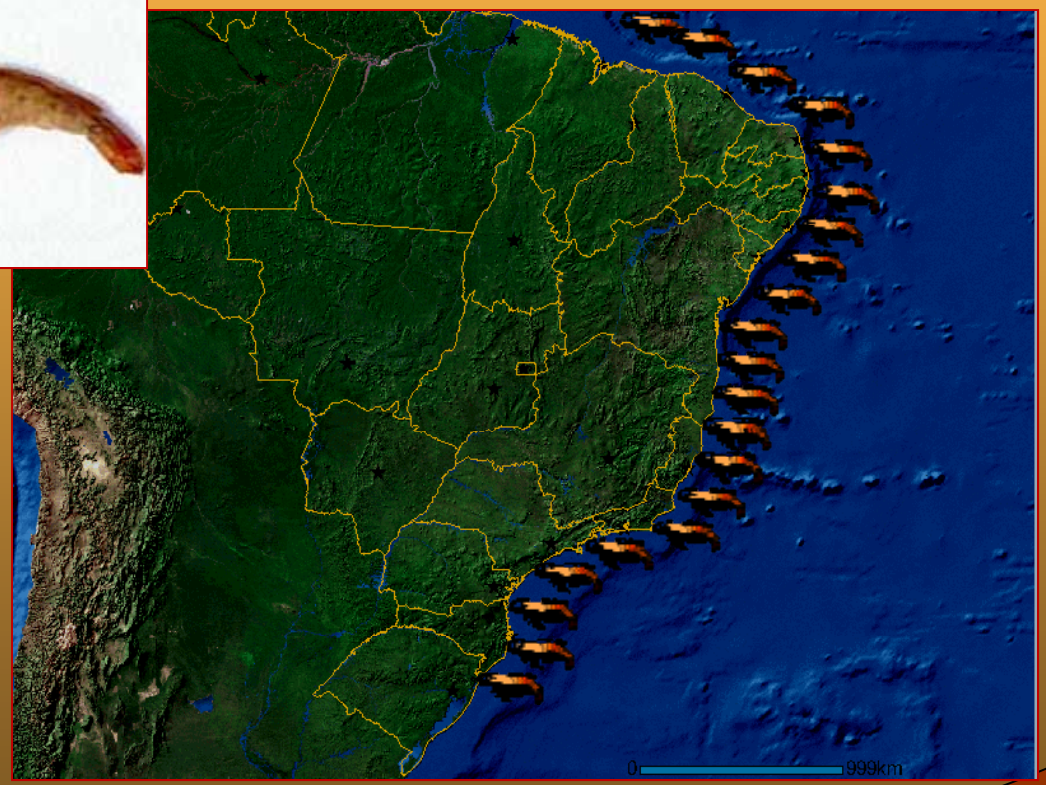
Larvi 2009
5th Fish & Shellfish Larviculture Symposium

Introduction

- ✓ **Genus *Farfantepenaeus***
  - ✓ *3 species with potential to aquaculture*
  - ✓ *Distribution of **F. paulensis** in the Brazilian coast*

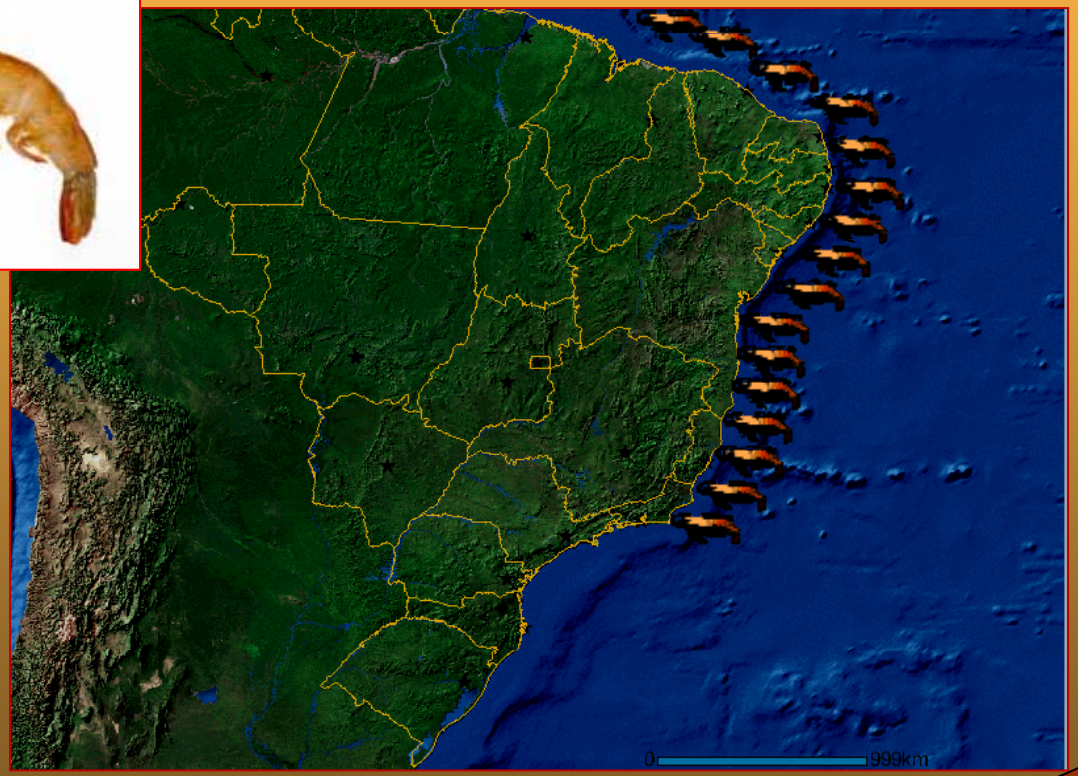
Introduction

- ✓ **Genus *Farfantepenaeus***
  - ✓ *3 species with potential to aquaculture*
  - ✓ *Distribution of* ***F. brasiliensis*** *in the Brazilian coast*



Introduction

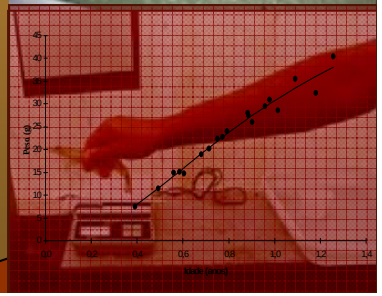
- ✓ **Genus *Farfantepenaeus***
  - ✓ *3 species with potential to aquaculture*
  - ✓ *Distribution of **F. subtilis** in the Brazilian coast*



Introduction

- ✓ **Advantages of indigenous species**
  - ✓ *Adapted to local conditions*
  - ✓ *Possibility of cage / pen culture*
  - ✓ *Broodstock in the adjacent coast*
  - ✓ *Higher price in the local market*

- ✓ **Research & development**
  - ✓ *Reproduction and growth performance in captivity*
  - ✓ *Different levels of technology*
  - ✓ *Increasing interest after L. vannamei disease outbreaks*

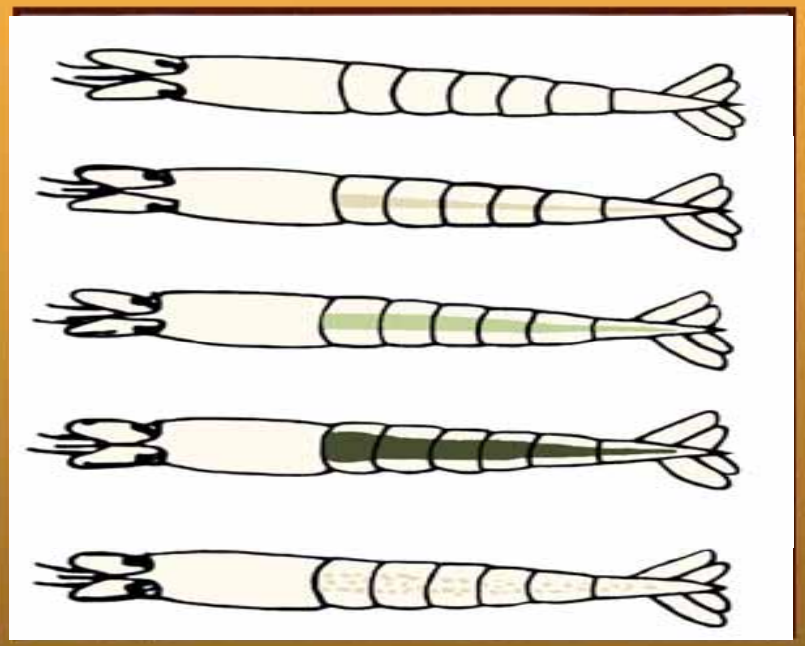


Reproductive biology

- ✓ Closed-thelycum species
- ✓ Mating behavior
  - ✓ *Intermolt males*
  - ✓ *Recently molted females*
- ✓ Sexual maturation
  - ✓ *males: > 16g*
  - ✓ *females: > 30g*
- ✓ Ovarian development
  - ✓ *morphology and color (5-6 stages)*
  - ✓ *histology (4 stages)*

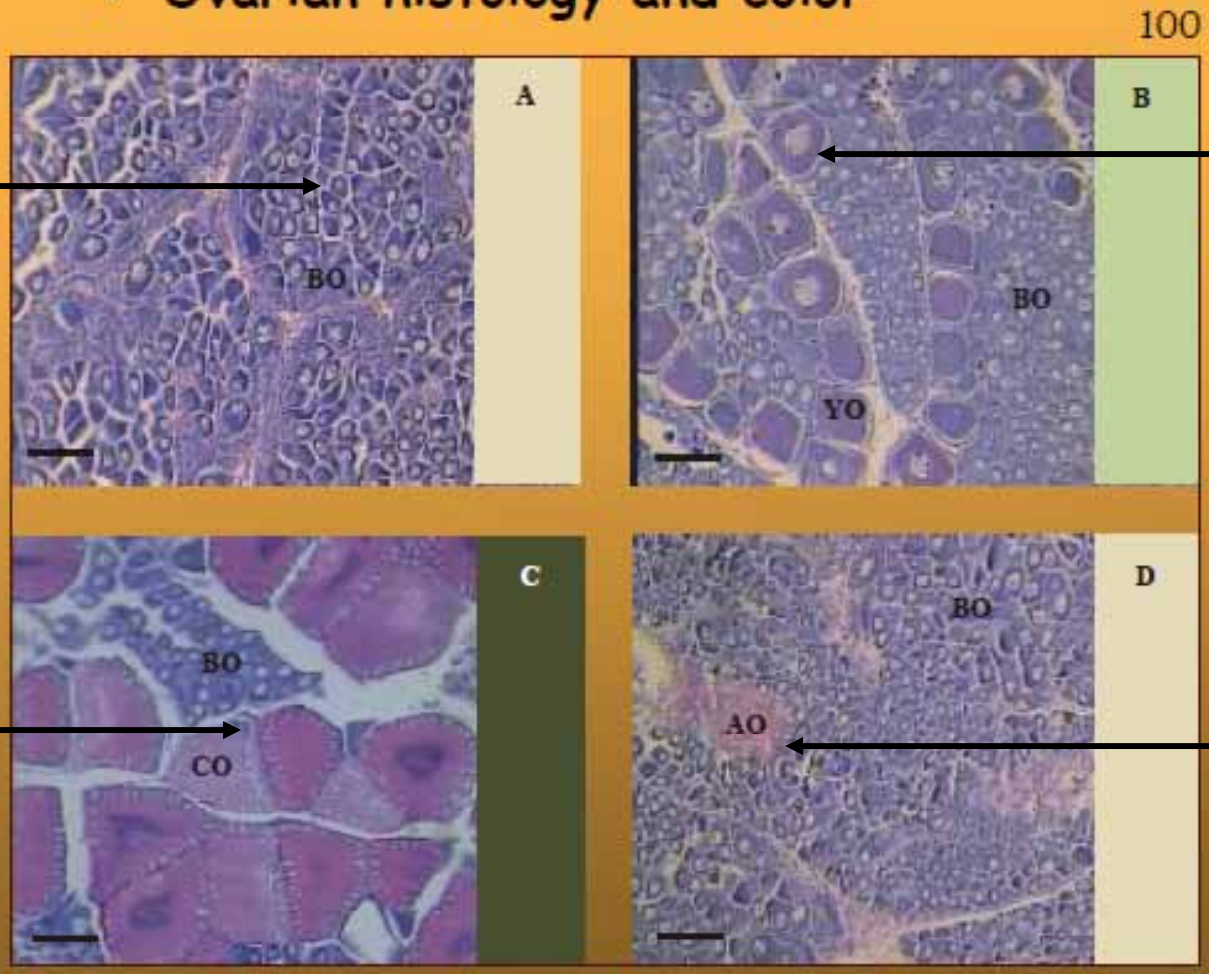
Reproductive biology

- ✓ Closed-thelycum species
- ✓ Mating behavior
  - ✓ *Intermolt males*
  - ✓ *Recently molted females*
- ✓ Sexual maturation
  - ✓ *males: > 16g*
  - ✓ *females: > 30g*
- ✓ Ovarian development
  - ✓ *morphology and color (5-6 stages)*
  - ✓ *histology (4 stages)*



Ovarian maturation

✓ Ovarian histology and color



Basophilic oocytes

I immature

Yolky oocytes

II developing

Cortical oocytes

III mature

Atretic oocytes

IV spent

Scale bar 100um

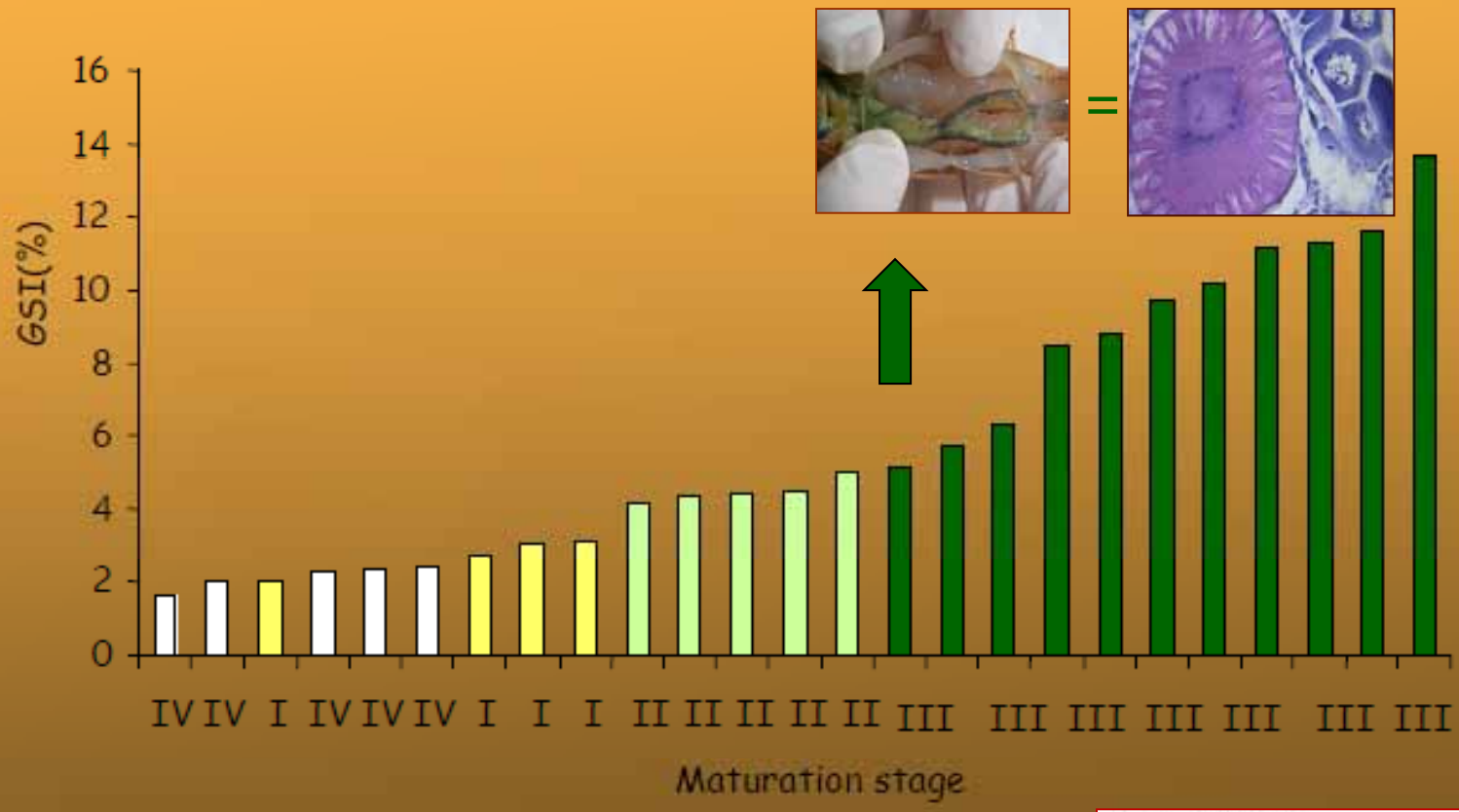
Aquaculture Research, 2003, 34, 1259–1260

Ovarian maturation of wild *Farfantepenaeus paulensis* in relation to histological and visual changes

S Peixoto, R O Cavalli, J D'Incao, Â M Milach & W Wasielesky

Ovarian maturation

- ✓ Relationship between gonadosomatic index (GSI) and maturation stage



Aquaculture Research, 2003, 34, 1259–1269

Ovarian maturation of wild *Farfantepenaeus paulensis* in relation to histological and visual changes

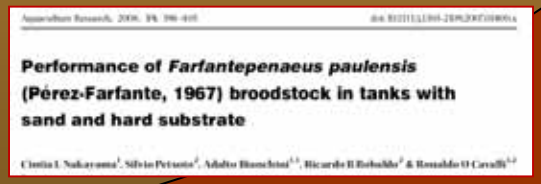
S Peixoto, R O Cavalli, J D'Incao, Â M Milach & W Wasielesky

Maturation system – sand substrate

- ✓ *Farfantepenaeus species* = burrowing behavior

X

- ✓ Positive aspects:
  - ✓ mating success
  - ✓ survival / physical condition of females
  - ✓ water quality
- ✓ Negative aspects:
  - ✓ intensive labour
  - ✓ sourcing mature females



Performance of *Farfantepenaeus paulensis* (Pérez-Farfante, 1967) broodstock in tanks with sand and hard substrate

Sources for Wild broodstock

- ✓ **Deep-sea broodstock** (40-60m)
  - ✓Nauplii production – since early 80's
  - ✓ *Large size (60 – 80g)*
  - ✓ *Superior performance*
  - ✓ *High cost*
  - ✓ *Unpredictable supply*

- ✓ **Shallow-water broodstock** (5-10m)
  - ✓ Lower cost / *unpredictable supply*
  - ✓ *Smaller size (40 – 60g)*
  - ✓Acceptable performance (eggs/female)
  - ✓ Poor offspring quality

Shallow-water broodstock

✓ *Ovarian histology just before spawning*

⇩

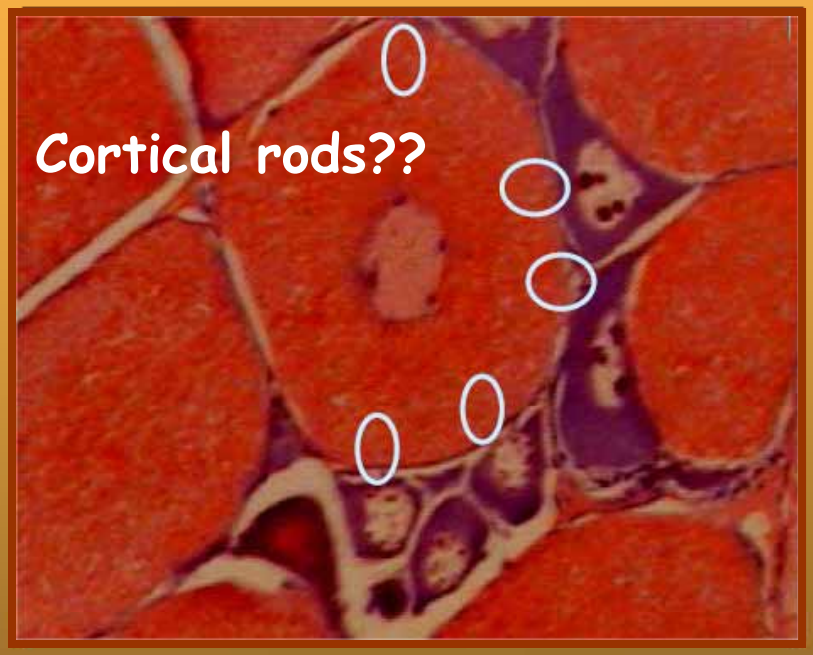
✓ *Mature cells without cortical rods*

⇩

✓ *Inability to reach full maturation*

⇩

✓ *Possible effects on offspring quality*



Description of reproductive performance and ovarian histology of wild *Farfantepenaeus paulensis* from shallow waters in southern Brazil.

Peixoto, S.; Cavalli, R. O.; D'Incao, F.; Wasielesky, W. and Agrado, N.

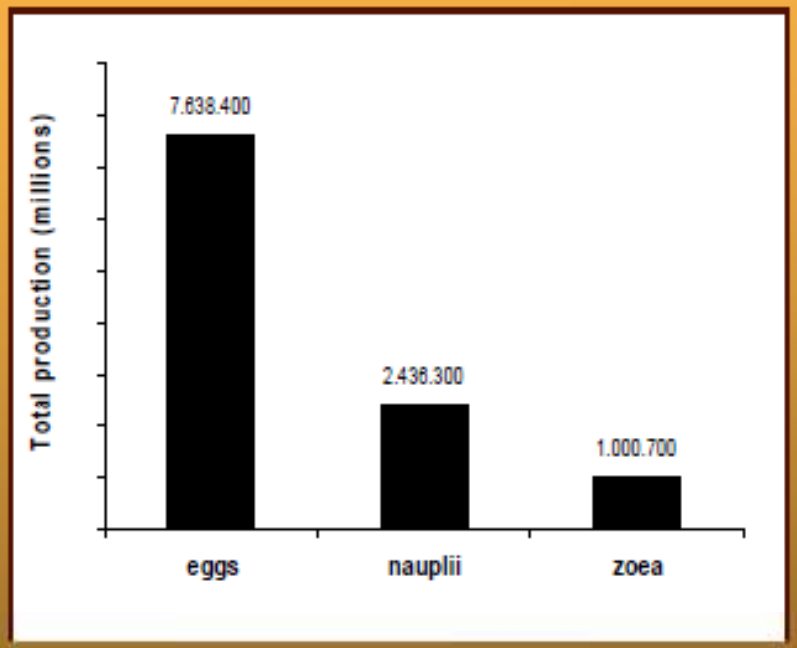
Shallow-water broodstock

✓ *Ovarian histology just before spawning*

✓ *Mature cells without cortical rods*

✓ *Inability to reach full maturation*

✓ *Possible effects on offspring quality*



Wild broodstock – Artificial insemination

✓Simple method to overcome the lack of mating

✓**Basic procedures**

- ✓Spermatophore extrusion
- ✓Selection of recently molted females
- ✓Implantation of the spermatophore

✓**Overall results**

- ✓One or two spermatophore / female
- ✓Unisex or mixed maturation systems
- ✓Spawning performance = naturally mated females

Aquaculture

Influence of artificial insemination on the reproductive performance of *Farfantepenaeus paulensis* in conventional and unisex maturation systems

Wild broodstock – Artificial insemination

- ✓Simple method to overcome the lack of mating

- ✓**Basic procedures**
  - ✓Spermatophore extrusion
  - ✓Selection of recently molted females
  - ✓Implantation of the spermatophore
- ✓**Overall results**
  - ✓One or two spermatophore / female
  - ✓Unisex or mixed maturation systems
  - ✓Spawning performance = naturally mated females

Wild broodstock – Artificial insemination

- ✓Simple method to overcome the lack of mating

- ✓**Basic procedures**
  - ✓Spermatophore extrusion
  - ✓Selection of recently molted females
  - ✓Implantation of the spermatophore
- ✓**Overall results**
  - ✓One or two spermatophore / female
  - ✓Unisex or mixed maturation systems
  - ✓Spawning performance = naturally mated females

Wild broodstock – Artificial insemination

✓Simple method to overcome the lack of mating

✓**Basic procedures**
- ✓Spermatophore extrusion
- ✓Selection of recently molted females
- ✓Implantation of the spermatophore

✓**Overall results**
- ✓One or two spermatophore / female
- ✓Unisex or mixed maturation systems
- ✓Spawning performance = naturally mated females

Domesticated broodstock

Some positive aspects:

- ✓ *Independence from wild stocks*
- ✓ *Year-round supply*
- ✓ *Uniform size and performance*
- ✓ *Selective breeding*

Broodstock management :

- ✓ *Pond or raceway tanks*
- ✓ *Spawner = 10-16 months*
- ✓ *Low densities (1-5 / m2)*
- ✓ *Intensive management practices*
  - ✓ *Temperature, water quality, feeding…*

Domesticated broodstock – effects of age and size

✓ **Male quality**

	S10	*L10*	*S16*	*L16*
Body weight (g)	10.3 [a]	15.1 [b]	24.5 [c]	30.2 [d]
Spermatophore weight (mg)	7.7 [a]	12.3 [b]	16.3 [c]	18.5 [c]
Sperm / spermatophore (x 10^6)	1.23 [a]	0.92 [a]	1.38 [a]	2.27 [b]

✓ Older males had heavier spermatophores, but not necessarily higher number of sperm cells

✓ *Number of sperm cells → effect of size* rather than age (S16 - L16)


Aquaculture

Effects of age and size on reproductive performance of captive *Farfantepenaeus paulensis* broodstock

Domesticated broodstock – effects of age and size

✓Female reproductive performance

	S10	*L10*	*S16*	*L16*
Body weight (g)	14.7 ^{a}	25.8 ^{b}	36.3 ^{c}	46.7 ^{d}
Spawns recorded	3	22	30	66
Ablation to 1st spawn (days)	17.0 ^{a}	11.4 ^{b}	10.6 ^{b}	9.2 ^{b}
Spawning rate (spawns/female)	0.2 ^{a}	1.4 ^{b}	1.8 ^{b}	2.9 ^{c}
Eggs / spawning (x 10^3)	35.8 ^{a}	86.4 ^{a}	101.5 ^{a}	147.4 ^{b}
Total eggs / female (x 10^3)	7.2 ^{a}	123.6 ^{b}	179.2 ^{b}	421.6 ^{c}
Fertilization rate (%)	-	72.2 ^{a}	69.7 ^{a}	69.8 ^{a}
Hatching rate (%)	-	41.5 ^{a}	53.1 ^{a}	64.1 ^{a}

- ✓ Domesticated females with 25g = minimal size for reproductive purposes
- ✓ Significant improvements on reproductive output = larger females (>45g)


Effects of age and size on reproductive performance of captive *Farfantepenaeus paulensis* broodstock

Domesticated X Wild broodstock – effect of source

✓Maturation trial (46g females, n=30)

✓Reproductive performance

	Domesticated	Wild
Spawns recorded	66	61
Spawning rate	2.91	2.82
Total eggs / female	421,587	529,065
Eggs / spawning	147,426	184,371
Total eggs produced	8,993,000	12,168,500

✓ Different sources / similar size = similar reproductive performance


Aquaculture

Comparison of reproductive output, offspring quality, ovarian histology and fatty acid composition between similarly-sized wild and domesticated *Forfolinepenaeus paulensis*

Domesticated X Wild broodstock – effect of source

✓ Ovaries of wild females contained higher levels of n-3 HUFA

	Domesticated	Wild
Total lipids	3.51 ± 1.82	2.30 ± 0.58
...	...	...
22:5n-3	0.24 ± 0.17	0.17 ± 0.27
22:6n-3	1.49 ± 0.91	3.50 ± 2.43
Σ Saturates	16.04 ± 3.46	19.74 ± 3.11
Σ (n-6) PUFA[1]	2.95 ± 0.74	4.09 ± 2.01
Σ (n-3) HUFA[2]	**6.33 ± 2.61 [b]**	**9.12 ± 2.13 [a]**
DHA/EPA ratio	0.38 ± 0.07	0.70 ± 0.77
(n-6)/(n-3) ratio	0.45 ± 0.08	0.44 ± 0.10


Aquaculture

Comparison of reproductive output, offspring quality, ovarian histology and fatty acid composition between similarly-sized wild and domesticated *Piaractus mesopotamicus*

Constraints and possibilities

✓ The future success of indigenous *Farfantepenaeus* culture would depend upon increasing supplies of high quality seed

✓ Current efforts to close the life cycle and improve the reproduction in captivity will contribute to design an efficient breeding program

Thank you

CSIRO
MARINE RESEARCH

CNPq
Conselho Nacional de Desenvolvimento Científico e Tecnológico

FACEPE

CAPES

Larvi 2009
5th Fish & Shellfish Larviculture Symposium