University of the Algarve
Center of Marine Sciences

THE USE OF LIVE GRASS SHRIMP (*Palaemonetes varians*) AS THE ONLY SOURCE OF FOOD FOR THE CULTURE OF CUTTLEFISH, *Sepia officinalis* (Linnaeus, 1758).

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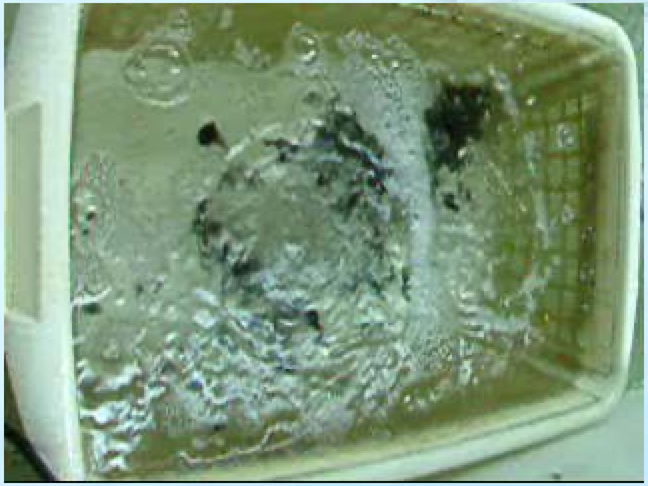
Overview and State of the Art

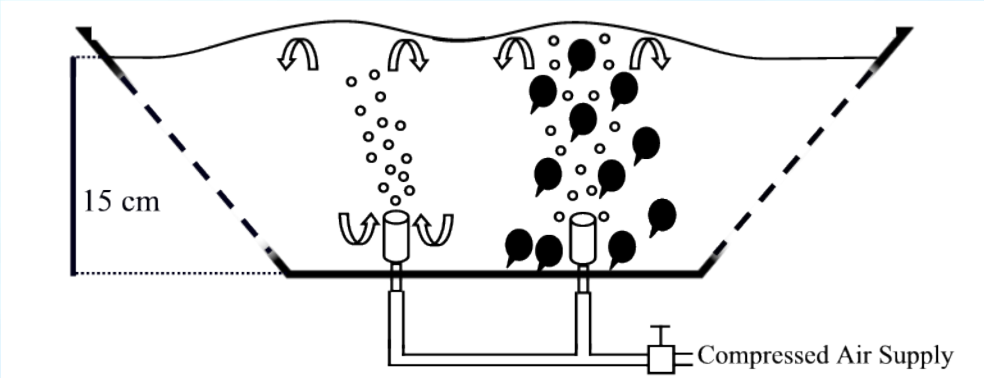
Culture Technology - Reproduction

Overview and State of the Art

Culture Technology – Hatchery

➡ Optimization of egg collection and incubation





Overview and State of the Art

Culture Technology - Hatchery Rearing and Density

Different phase culture densities

- hatchlings

500 hatchlings/m^2

Min. Area – 600 cm^2

- juveniles

120 juveniles/m^2

Min. Area – 1100 cm^2

Problems and Objectives

Problems:

- **Limited dietary alternatives for mass culture**
  - **live mysids – *Paramysis nouvelli* - first 15 DAH**
  - **live or frozen grass shrimp – *Palaemonetes varians* – onwards**
- **Inexistent overall nutrition knowledge about both predator and prey**
- **Labor and costs associated with live feeds, increased by the use of 2 prey species**

Problems and Objectives

Objectives:

- Culture cuttlefish through the life cycle exclusively on a diet of live grass shrimp and its consequences on:
  - growth
  - age at time of spawning
  - fertility
  - mortality
  - fecundity
- Determine grass shrimp nutritional profile:
  - total protein
  - amino acids
  - total lipids
  - fatty acids

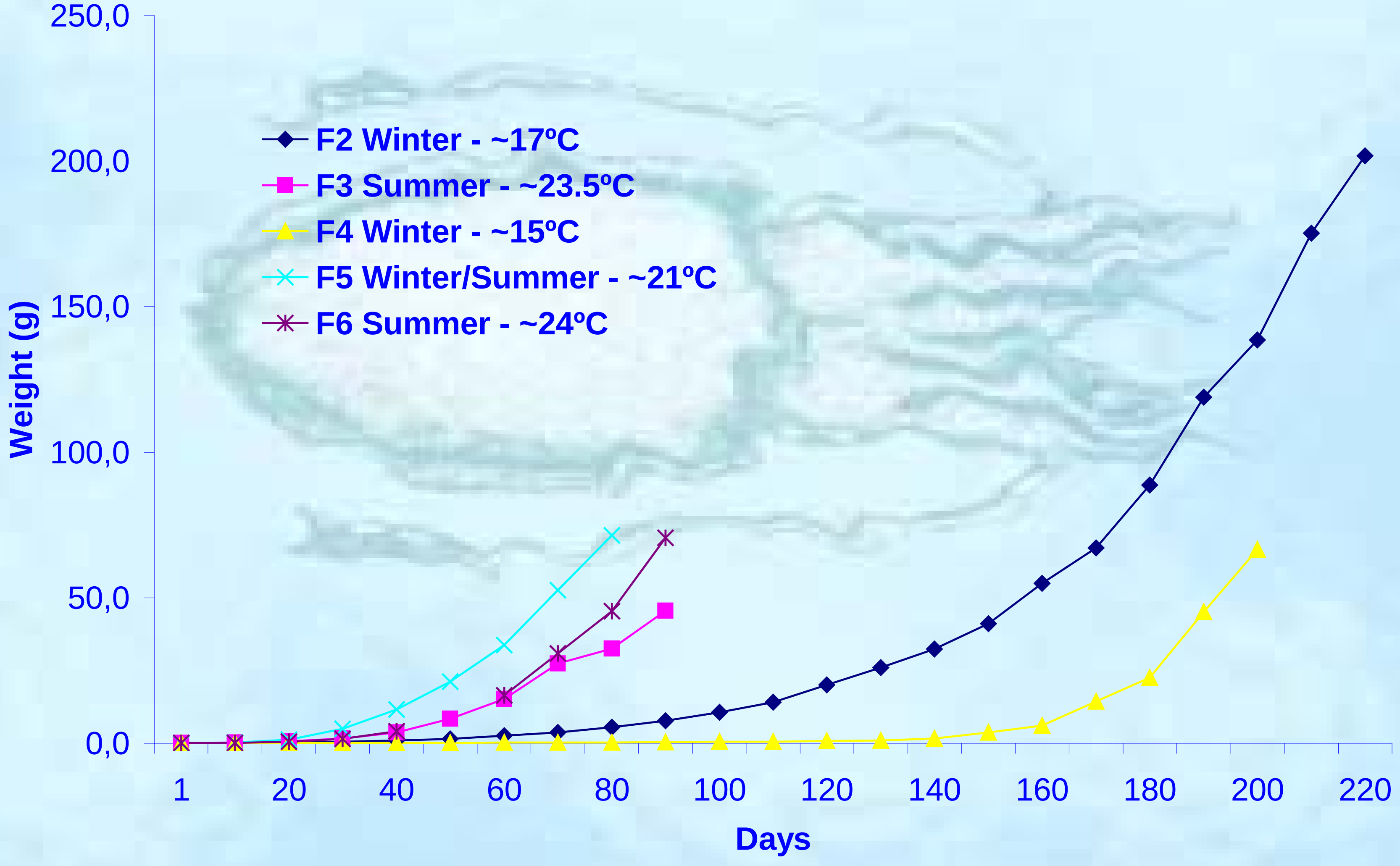
Material and Methods

Growth Experiments:

- Culture methodologies described earlier in State of the Art
- Food – Live Grass Shrimp *Palaemonetes varians* of increasing sizes captured from nature and supplied *ad libitum*
- Determination of:
  - Mean Weight
  - Mean IGR
  - Total Mortality
  - Cumulative Mortality
  - Total Egg Number and Weight
  - Egg laying period
  - Fertility
  - Fecundity
  - Breeders Weight and Sex

Results and Discussion

Cuttlefish Life Cycles:



Results and Discussion

Cuttlefish Life Cycles:

Table I – Weight, Growth Models, Mean Cumulative Mortality and Total Biomass of the life cycles for *S. officinalis* cultured in the laboratory exclusively fed on live grass shrimp (*P. varians*).

Generation	***F2***	***F3***	***F4***	***F5***	***F6***
Season	Winter	Summer	Winter	Winter/Summer	Summer
Growth Model	$Y=-4.8836+2.1145*e^{0.021x}$	$Y=-5.1797+3.3155*e^{0.031x}$	$Y=-0.2662+0.0263*e^{0.037x}$	$Y=-6.811+4.462*e^{0.025x}$	$Y=-3.019+1.592*e^{0.043x}$
Statistical R^2 of model	0.996	0.985	0.994	0.995	0,997
Mean IGR (%BW/day)	3.56±1.655	13.79±5.954	3.10±1.377	6.05±3.277	8.20±3.545
Mean Cumulative Mortality (%)	18.52	50.00	0.00	8.00	80.00
Mean Temperature (ºC)	17.11±1.69	23.43±1.35	15.17±2.95	21.06±2.58	23.63±1.84
Maximum Weight at birth (g)	0.113	0.124	0.106	0.145	0.142
Minimum Weight at birth (g)	0.060	0.067	0.054	0.024	0.078
Maximum Weight at spawning (g)	263.30	56.28	89.14	97.64	91.60
Minimum Weight at spawning (g)	140.10	25.07	46.10	40.59	39.90
Hatchlings used	27	30	35	50	60
Total Biomass Produced (g)	4438.80	637.15	2329.17	3288.09	937.00

Results and Discussion

Cuttlefish Life Cycles:

Table II – Biological parameters of the life cycles for *S. officinalis* cultured in the laboratory exclusively fed on live grass shrimp (*P. varians*).

Generation	*F2*	*F3*	*F4*	*F5*	*F6*
Duration of life cycle (days)	262	126	274	254	104
Duration of spawning period (days)	42	36	62	138	14
Eggs laid (n)	5916	1808	3952	4780	586
Total egg biomass (g)	3448.5	236.8	1261	2103	150.6
Eggs (n) / Female	370	301	247	478	293
Eggs sampled (n)	2939	848	1100	1613	270
Mean egg weight (g)	0.56 ± 0.17	0.25 ± 0.08	0.32 ± 0.10	0.44 ± 0.13	0.26 ± 0.09
Largest egg weighed (g)	2.464	0.622	0.834	1.004	0.519
Smallest egg weighed (g)	0.114	0.142	0.113	0.148	0.098
Hatchlings sampled (n)	255	204	400	217	No hatchlings
Mean hatchling weight (g)	0.076 ± 0.013	0.081 ± 0.016	0.055 ± 0.019	0.100 ± 0.012	-
Mean female weight (g); (n)	193.3 ± 30.8 (16)	64.7 ± 12.7 (6)	101.7 ± 25.9 (21)	104.9 ± 21.8 (10)	101.8 ± 15.9 (2)
Mean male weight (g); (n)	310.0 ± 89.6 (7)	77.6 ± 22.3 (18)	200.6 ± 37.9 (11)	110.8 ± 13.3 (9)	125.7 ± 19.4 (5)
Mean temperature; Time to hatch	25ºC ; 25 days	20ºC ; 28days	22.6 ºC ; 26 days	15ºC ; 60 days	-
Hatching percentage (%)	-	16.0	47.7	67.5	0.0

Discussion and Conclusions

- **It is possible to culture *S. officinalis* exclusively on a live grass shrimp diet supplied *ad libitum***
- **Temperature is still the most important factor explaining differences between generations**
- **Winter generations have always at least 50% longer cycles and consequently grow larger**
- **Shorter life cycles than those reported by NRCC and Caen Researcher are probably due to smaller culture bottom areas**

Discussion and Conclusions

- Short life cycles, high temperatures and increased growth and generations seems to promote overall mortality, fecundity and fertility
- Temperature seems to affect sex ratio (♀/♂)
  - Winter – 2.3 and 1.9
  - Hybrid – 0.9
  - Summer – 0.3 and 0.4

Discussion and Conclusions

- Fertility did not displayed a clear pattern, increasing or decreasing. However, like in Forsythe *et al.* (1994), it dropped completely after 6 generations
- Faster embryonic development of eggs, induced by higher temperatures, seems to promoted higher mortality
- Total protein, lipid and water content of grass shrimp seems to be similar to those reported for cuttlefish

Discussion and Conclusions

- **Fatty acid of both cuttlefish and grass shrimp are similar, being 16:0, 20:5n-3 and 22:6n-3 the most important and abundant**
- **Results show that lipid metabolism has been neglected**
- **PUFA rich food is needed for hatchling and juvenile phase**

Discussion and Conclusions

- **Grass shrimp is good enough for replacing mysids and culture cuttlefish throughout the life cycle**

Future Research

- Cuttlefish growth during Summer
- Amount of food supply per day based on culture temperature
- Nutritional content of both cuttlefish and grass shrimp
- Production of grass shrimp

Development of artificial diets and intensive culture

Fundings

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