# EFFECT OF HIGH STOCKING DENSITY ON GROWTH AND SURVIVAL IN DIFFERENT LIFE STAGES OF *Litopenaeus vannamei* IN BFT CULTURE SYSTEM

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# Shrimp culture in 80´s

**Low stocking densities – 3, 7, or 10/m²**

Productivities about 0.3-1.0 ton/ha/year

# Shrimp culture in 90´s

**Higher stocking densities – 10 to 30/m²**

Productivities about 1.0 to 6.0 ton/ha/year

# Waddell Mariculture Center –SC - USA
## Sustainable Intensive Shrimp Culture Research

During 90: s

- Hopkins et al.,1995:

- Productivity around 5000/ha/crop - *Litopenaeus vannamei*

-Zero or reduced water exchange.

Stocking densities – 50 70/m²

Browdy, 2001:

- Higher production - up to 10 ton /ha/crop
- Superintensive shrimp culture system biofloc based
- Stocking densities higher than 100/m²

Belize Aquaculture Ltda

# Looking to the Future
# Next Generation Systems (Browdy, 2001)

- Sistemas Fechados e Bioseguros com avançada engenharia
- Higher production per area unit
- e multiplas safras por año. Menor custo de produccion
- Uso de post-larvae libre de patogenos y selecionados para crescimiento rapido
- Sistema automaticos para reduzir uso de agua.
- Baja salinidad y reuso da agua.

# WMC Raceway Harvest Data

| | Nov. 00 | | Jan. 02 | | | Mar. 03 | Nov. 04 |
|---|---|---|---|---|---|---|---|
| Days | 140 | 140 | 132 | 132 | 140 | 76* | 113 |
| Density | 200 | 200 | 300 | 300 | 300 | 300 | 420 |
| Mean Wt (g) | 19.3 | 18.9 | 14.6 | 15.4 | 17.1 | 16.6 | 21.0 |
| Survival (%) | 60.1 | 63.9 | 70.5 | 71.7 | 55.2 | 91 | 79.5 |
| Production (kg/m) | 2.3 | 2.4 | 3.1 | 3.3 | 2.8 | 4.5 | 6.8 |
| FCR | 2.8 | 2.8 | 1.8 | 2.0 | 1.9 | 1.5 | 1.9 |

*** Stocked nursed juveniles**

Browdy, 2005

# Highest production in raceways (USA)

2008 - In Oceanic Institute (Hawaii, EUA), Otoshi *et al*. reported 10.3 kg/ $m^2$ (103 ton/ha) . Initial stocking density of 828 Shrimp/$m^2$ (Final stocking density of 562 shrimp/$m^2$ .

2009 – Recently Samocha, et al reported production up to 9.75 kg/m3 in Corpus Christi (Texas) with initial stockig density of 530/m3

Is it possible to improve productivities in raceways????

# PARTIAL HARVEST WITH BFT, A PROMISING SYSTEM FOR PACIFIC WHITE SHRIMP

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Global Group, Indonesia

Partial Harvesting with Cast Nets

**Table 1. Partial harvest performance with biofloc technology (February-July).**

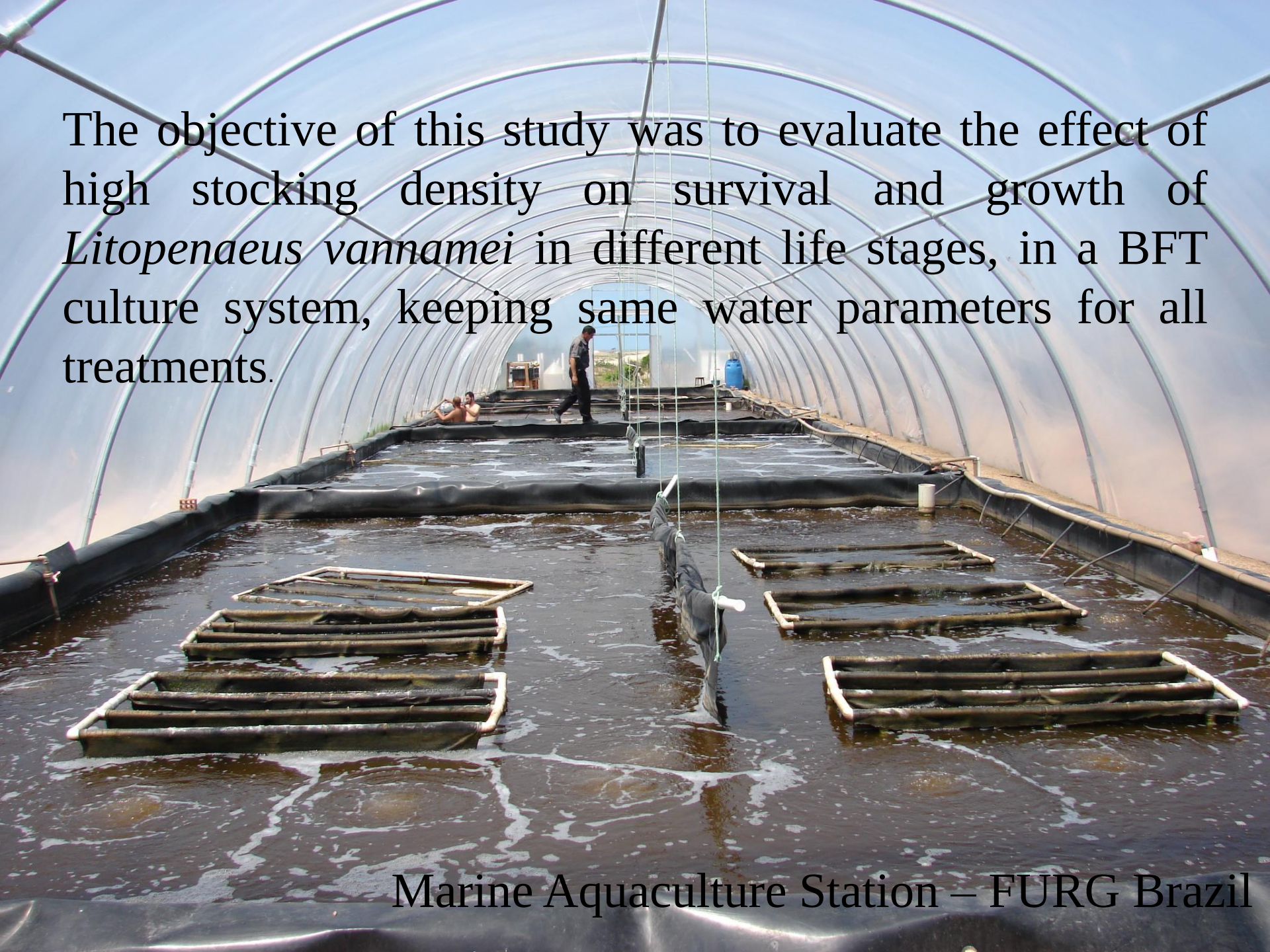
| Pond Size | System | Power Input (hp/ha) | Density ($m^2$) | Partial | Harvest | | | Production (kg/ha) | FCR | | Power Efficiency (kg/hp) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Days of Culture | Biomass (kg) | Mean Body Weight (g) | | G.P. | Feed | Capacity | Efficiency |
| 1<br>5,896 $m^2$ | Phyto-plankton | 27 (PW) | 100 | 1 | 118 | 434 | 21.28 | 19,439 | 0 | 1.60 | 560 | 720 |
| | | | | Final | 127 | 11,027 | 23.26 | | | | | |
| 2<br>5,896 $m^2$ | Biofloc | 31 (PW) | 145 | 1 | 108 | 2,092 | 16.95 | 22,910 | 0.59 | 1.20 | 680 | 739 |
| | | | | 2 | 121 | 1,016 | 18.18 | | | | | |
| | | | | Final | 131 | 10,400 | 19.23 | | | | | |
| 3<br>5,940 $m^2$ | Biofloc | 30 (PW) | 146 | 1 | 109 | 2, 108 | 17.86 | 24, 219 | 0.56 | 1.14 | 680 | 807 |
| | | | | 2 | 122 | 999 | 20.00 | | | | | |
| | | | | Final | 130 | 11,279 | 21.28 | | | | | |
| 4<br>4,704 $m^2$ | Biofloc | 34 (PW) | 257 | 1 | 85 | 1,962 | 10.75 | 38,229 | 0.58 | 1.12 | 680 | 1,124 |
| | | | | 2 | 99 | 1,896 | 13.33 | | | | | |
| | | | | 3 | 113 | 1,871 | 16.13 | | | | | |
| | | | | 4 | 127 | 2,587 | 17.86 | | | | | |
| | | | | 5 | 134 | 2,475 | 18.87 | | | | | |
| | | | | Final | 155 | 7,192 | 21.28 | | | | | |
| 5<br>2,500 $m^2$ | Biofloc | 36 (PW)<br>12 (BL) | 280 | 1 | 84 | 924 | 11.63 | 49,484 | 0.48 | 1.11 | 680 | 1,031 |
| | | | | 2 | 99 | 1,455 | 13.51 | | | | | |
| | | | | 3 | 113 | 1,324 | 16.39 | | | | | |
| | | | | 4 | 127 | 1,448 | 17.54 | | | | | |
| | | | | 5 | 134 | 1,043 | 18.52 | | | | | |
| | | | | Final | 155 | 6,177 | 20.00 | | | | | |
| 6<br>2,500 $m^2$ | Biofloc | 26 (PW)<br>12 (BL) | 145 | 1 | 110 | 1,666 | 19.61 | 26,180 | 0.50 | 1.10 | 680 | 655 |
| | | | | 2 | 124 | 367 | 20.41 | | | | | |
| | | | | Final | 127 | 5,012 | 21.28 | | | | | |
| 7<br>2,500 $m^2$ | Biofloc | 36 (PW)<br>12 (BL) | 145 | 1 | 110 | 892 | 16.39 | 26,460 | 0.50 | 1.10 | 680 | 551 |
| | | | | 2 | 124 | 323 | 17.54 | | | | | |
| | | | | Final | 130 | 5,400 | 18.52 | | | | | |

PW = Paddlewheel aerators, BL = Air blowers

# Otoshi et al 2007:

## Shrimp Behavior May Affect Culture Performance At Super-Intensive Stocking Densities

*… the results showed that crowding behavior associated with high density may have negatively impacted shrimp growth, irrespective of water quality.*



The objective of this study was to evaluate the effect of high stocking density on survival and growth of *Litopenaeus vannamei* in different life stages, in a BFT culture system, keeping same water parameters for all treatments.

Marine Aquaculture Station – FURG Brazil

**Southern Brazil**


Rio Grande do Sul State - 32 S: Equivalent to South Carolina

# UNIVERSITY OF RIO GRANDE
# INSTITUTE OF OCEANOGRAPHY


Laboratories:

Crustacean Biology, Ecology of Benthic Communities, Marine Mammals, Coastal Management and Ecology, Ictiology, Fisheries Resources and Technology, Phytonkton and Zooplankton, Hydrochemistry, Marine Biochemistry…MARINE AQUACULTURE (50 researchers)

# MARINE AQUACULTURE LABORATORY

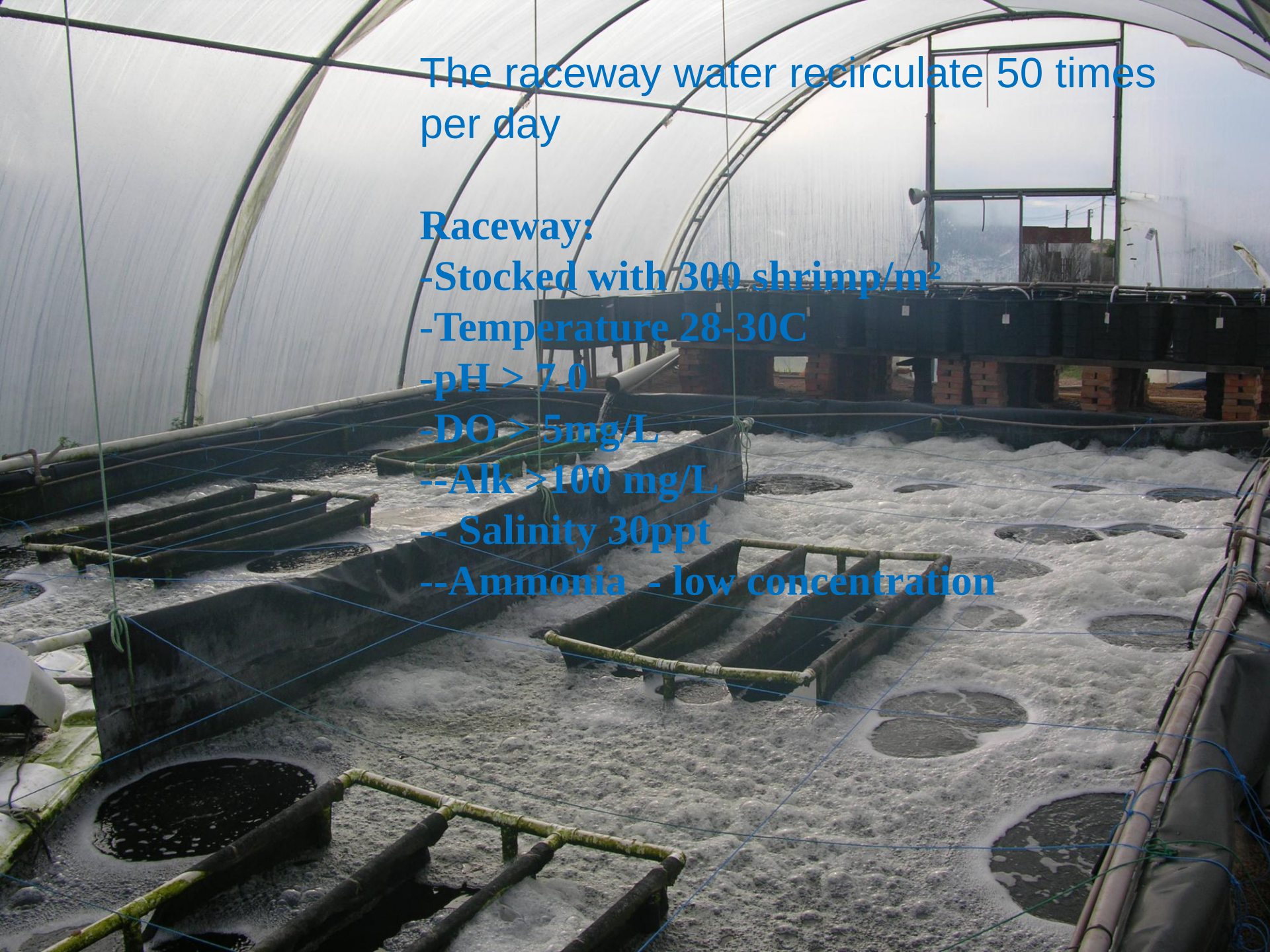
Maturation, larviculture, growout, research


Post-larvae (0.003 g)

# Heterotrophic Culture Systems

Estação Marinha de Aquacultura – FURG - Brazil


Microcosm system connected to a
100 m3 raceway



The raceway water recirculate 50 times per day

**Raceway:**

**-Stocked with 300 shrimp/$m^2$**

**-Temperature 28-30C**

**-pH > 7.0**

**-DO > 5mg/L**

**--Alk >100 mg/L**

**-- Salinity 30ppt**

**--Ammonia - low concentration**

# Experiment 1 – Effect of stocking density in Nursery

Materials and Method

Post-larvae (0.003 g)

Density: 4,400, 8,800, 13,200 and 17,600/m3

Microcosms;  170L Tank

Feeding: 3 X day, in feeding tray (40 CP)

The experiment lasted 30 days

# Results Experiment - 1

**Nursery** - Initial weight 0,003 ( 0,001)

| PLs/ m3 | Final Weight (g) | | Survival (%) | | Final Biomass (kg $m^{-3}$) | | Final density |
|---|---|---|---|---|---|---|---|
| 4,400 | 0.45 | 0.12[a] | 96.26 | 2.26 [a] | 1.90 | 0,09 [a] | 4,224 |
| 8,800 | 0.33 | 0.13[b] | 95.55 | 6.13 [a] | 2.75 | 0.12 [b] | 8,360 |
| 13,200 | 0.30 | 0.09[b] | 95.49 | 2.23 [a] | 3.60 | 0.21 [c] | 12,540 |
| 17,600 | 0.23 | 0.09[c] | 87.60 | 5.16[b] | 3.51 | 0.27 [c] | 15,312 |

# Experiment 2 – Effect of stocking density in Grow-out (1g – 6g shrimp)

## Experiment 2: *Grow-out*

*L. vannamei* juveniles with 1.23g (± 0,09) were reared in different stocking densities: 880, 1,320, 1,760, 2,200 and 2,650 shrimp/$m^3$, during 40 days.

## Experiment 2 – Grow-out -

| Shrimp/ $m^3$ | Final weight (g) | | Survival (%) | | Final biomass (kg/ m3) | Final density Shrimp/$m^3$ |
|---|---|---|---|---|---|---|
| 880 | 7.53 | 0.83[a] | 89.33 | 4.71 [a] | 5.91 [a] | 785 |
| 1,320 | 7.23 | 0.91[b] | 91.11 | 14.73 [a] | 8.67 [b] | 1,203 |
| 1,760 | 6.74 | 0.97[c] | 89.89 | 13.81 [a] | 10.63 [c] | 1,570 |
| 2,200 | 6.12 | 1.05[d] | 68.60 | 10.58[b] | 9.23 [bc] | 1,499 |
| 2,650 | 6.06 | 1.12 [d] | 62.96 | 1.11 [b] | 10.04 [c] | 1,641 |

# Experiment 3 – Effect of stocking density in Grow-out (6g – 12g shrimp)

## Experiment 3: *Grow-out*

*L. vannamei* juveniles with **6.32g** (± 0.7), were reared in different stocking densities: 590, 880, 1,180, 1,470 and 1,760 shrimp/$m^3$, during 40 days.

## Experiment 3 – Grow out

| Stocking density Shrimp/$m^3$ | Final weight (g) | | Survival (%) | | Final biomass (kg /$m^3$) | Final density Shrimp/m3 |
|---|---|---|---|---|---|---|
| 590 | 11.42 | 0.98[a] | 90.63 | 3,23[a] | 6.06[a] | 529 |
| 880 | 10.52 | 0.87[b] | 95.11 | 4,22[a] | 8.79[b] | 838 |
| 1180 | 10.64 | 1.07[b] | 91.33 | 3,78[a] | 11.19[c] | 1070 |
| 1470 | 10.9 | 1.23[b] | 63.06 | 5,43[b] | 10.04[c] | 926 |
| 1760 | 10.01 | 1.67[b] | 54.06 | 3,42[c] | 9.49[b] | 952 |

# Experiment 4 – Effect of stocking density in Grow-out (12 – 18g shrimp)

## Experiment 4: *Grow-out*

*L. vannamei* juveniles with **11.96g** (±1.14), were reared in different stocking densities: 440, 880, 1,320 and 1,760 shrimp/$m^3$, during 40 days.

**Fase Engorda 3** - peso inicial 11,23 ( 1,14) nas densidades: 150, 300, 450 e 600 camarões/$m^2$

Tabela 4. Médias e desvio padrão do peso final, sobrevivência, biomassa final e densidade final dos camarões *L. vannamei* com peso médio inicial de 11,96 g ( 1,14) cultivados por 45 dias em diferentes densidades no sistema heterotrófico

| Initial stocking density/ $m^3$ | Fianl weight (g) | | Survival (%) | | Final biomass (kg $m^{-3}$) | Final density Shrimp/$m^3$ |
|---|---|---|---|---|---|---|
| 440 | 17.58 | 1.88[a] | 99.1 | 1.15 [a] | 7.62 [a] | 436 |
| 880 | 15.65 | 1.89[b] | 97.55 | 4.04 [a] | 13.18 [b] | 855 |
| 1320 | 15.45 | 1.91[b] | 75.1 | 15.70 [b] | 14.94 [c] | 992 |
| 1760 | 15.35 | 1.97[b] | 49.33 | 21.0[c] | 13.26 [b] | 864 |

According to results, if excluded water quality factors,is possible to culture *L. vannamei* in following stocking densities

Nurseries – 4,400/m3 (until 1 g) – 1.90 kg/m3

Grow-out – 1,760/m3 (until 6 g) – 10.63 kg/m3

Grow-out – 1,180/m3 (until 12 g) – 11.19 kg/m3

Grow-out – 880/m3 (until 16-18 g) – 13.18 kg/m3

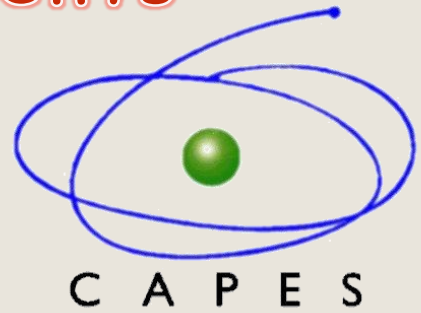
# Conclusion

The results confirmed the negative effect of stocking density for different life stages of *Litopenaeus vannamei*;

It is also confirmed that is possible to culture *L. vannamei* with biomass higher than 14 Kg/m3

# Acknowledgements







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# Thanks for your attention!

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