# CRIAÇÃO DE BIJUPIRÁ EM SISTEMA DE RECIRCULAÇÃO DE ÁGUA

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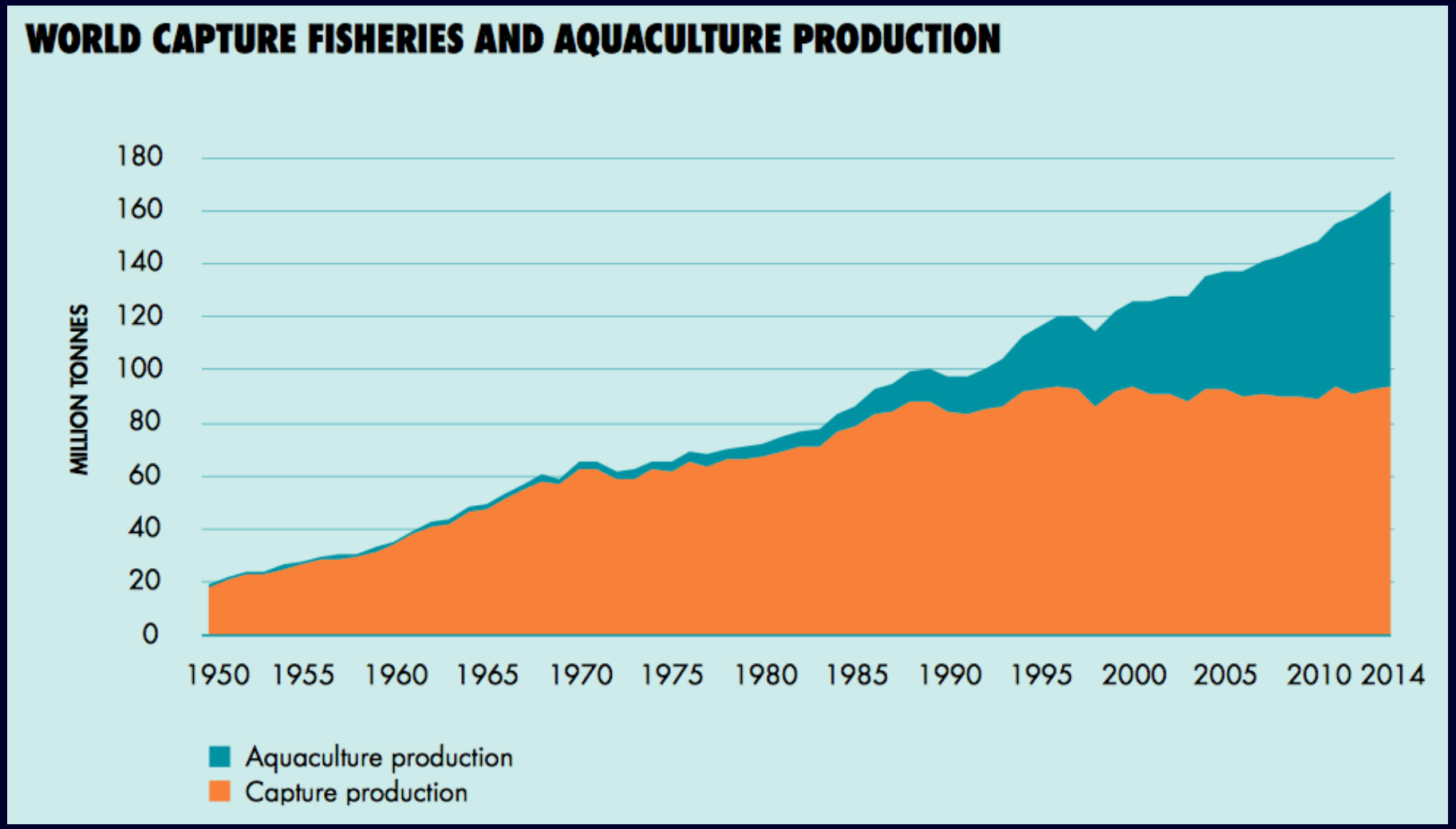
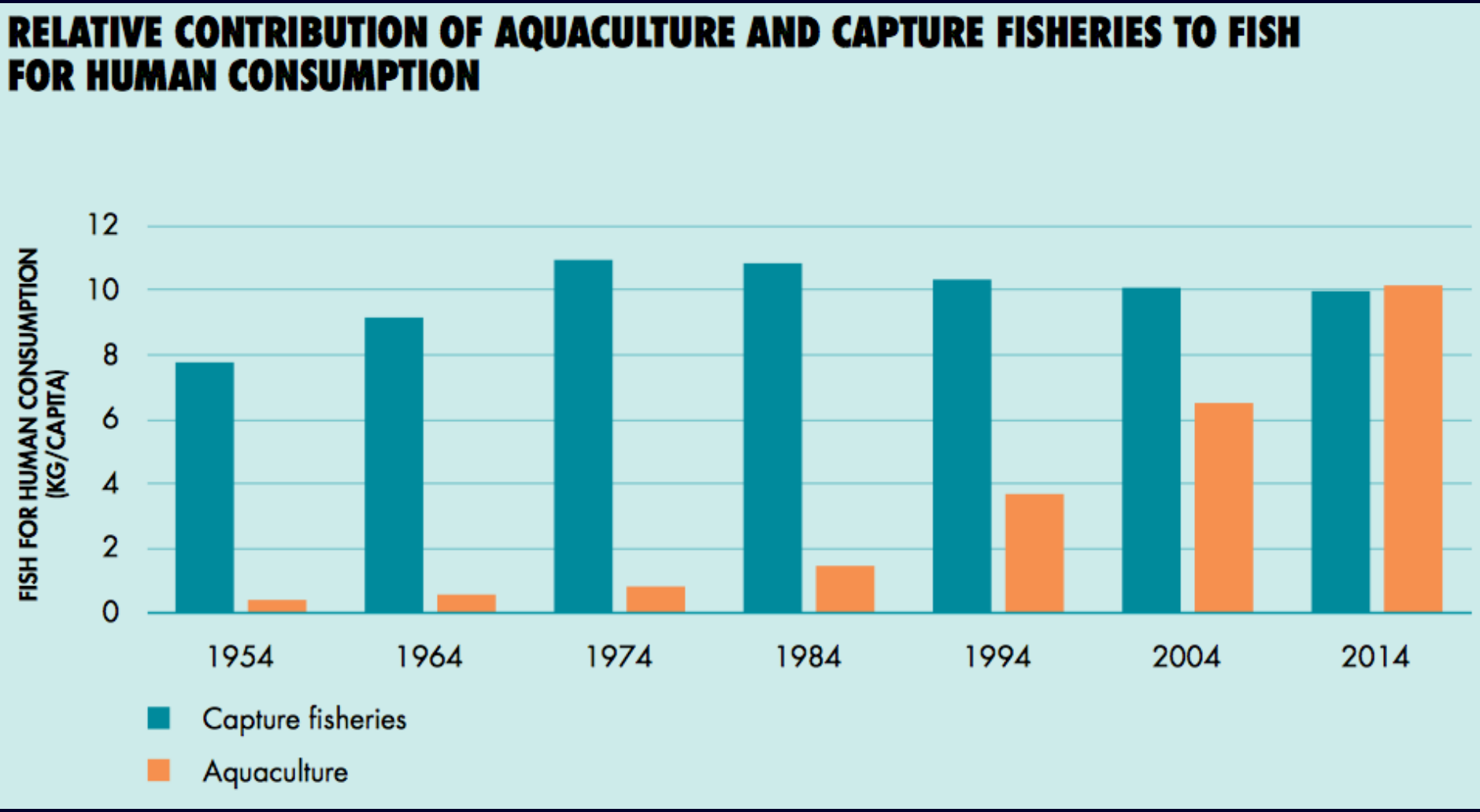
• Fortaleza Fenacam 2016
BRASIL
• FURG, Rio Grande

# PRODUÇÃO MUNDIAL DE PESCADO



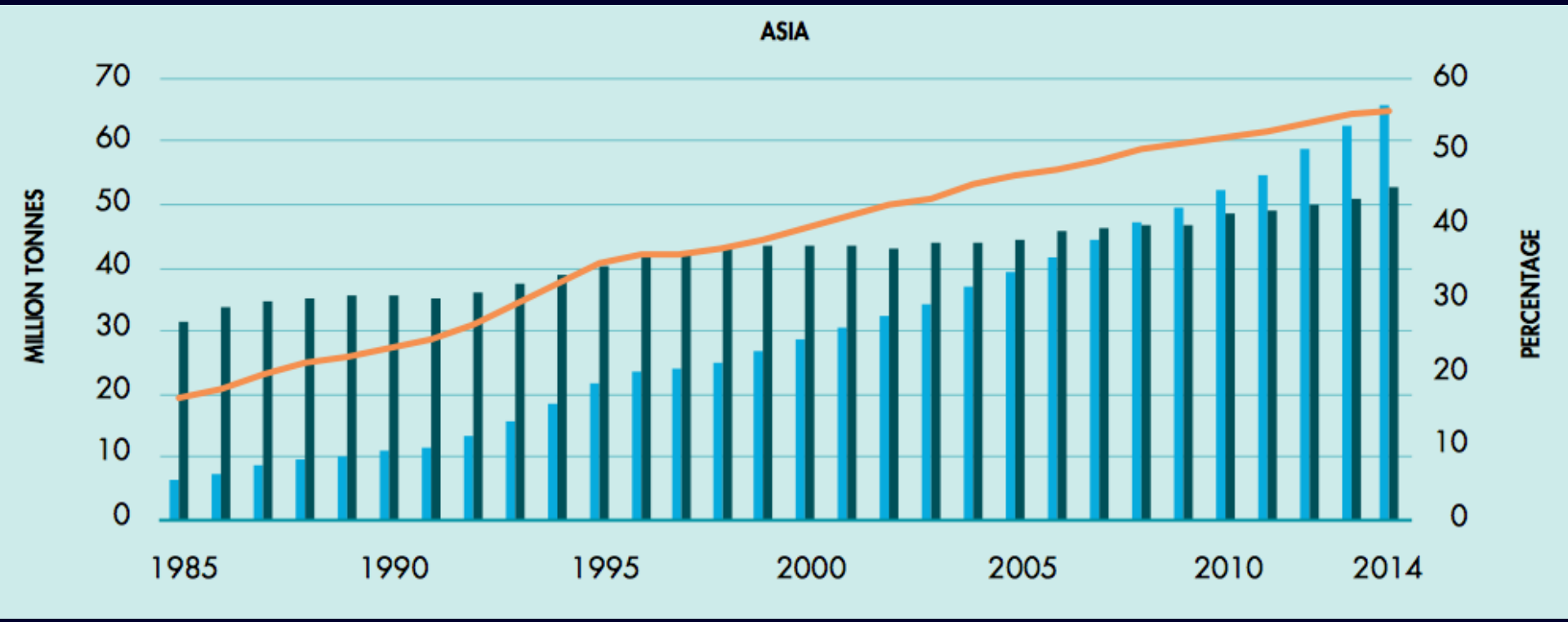

FAO 2016

# PRODUÇÃO MUNDIAL DE PESCADO: consumo direto



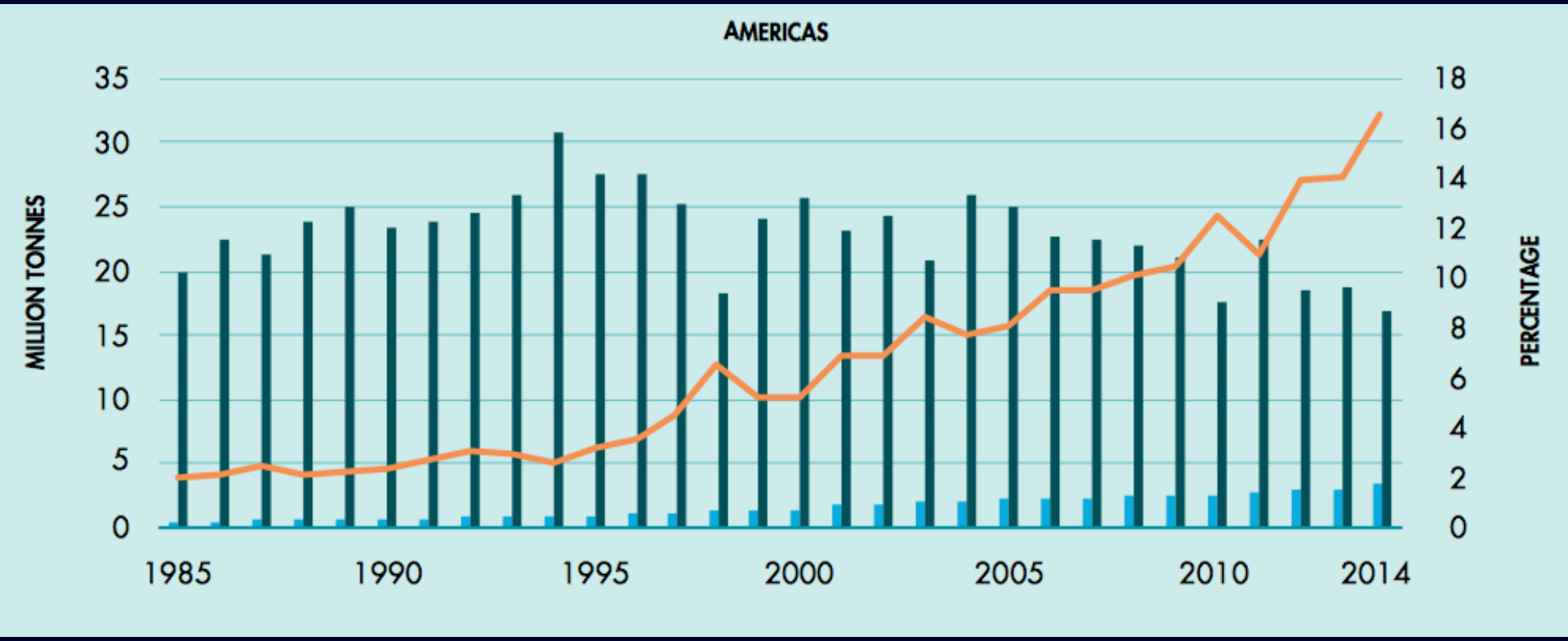

FAO 2016

# Aquacultura x Pesca: Ásia




FAO 2016

# Aquacultura x Pesca: América




FAO 2016

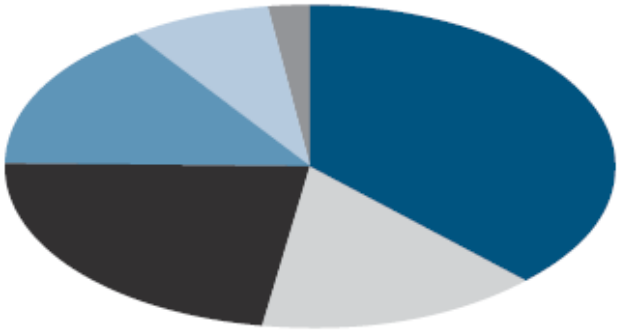
# PRINCIPAIS GRUPOS DE ESPÉCIES CULTIVADAS

World acquaculture production:

QUANTITY

| | |
|---|---|
| 54% | Freshwater fishes |
| 27% | Molluscs |
| 9% | Crustaceans |
| 6% | Diadromous fishes |
| 3% | Marine fishes |
| 1% | Aquatic animals NEI |

VALUE

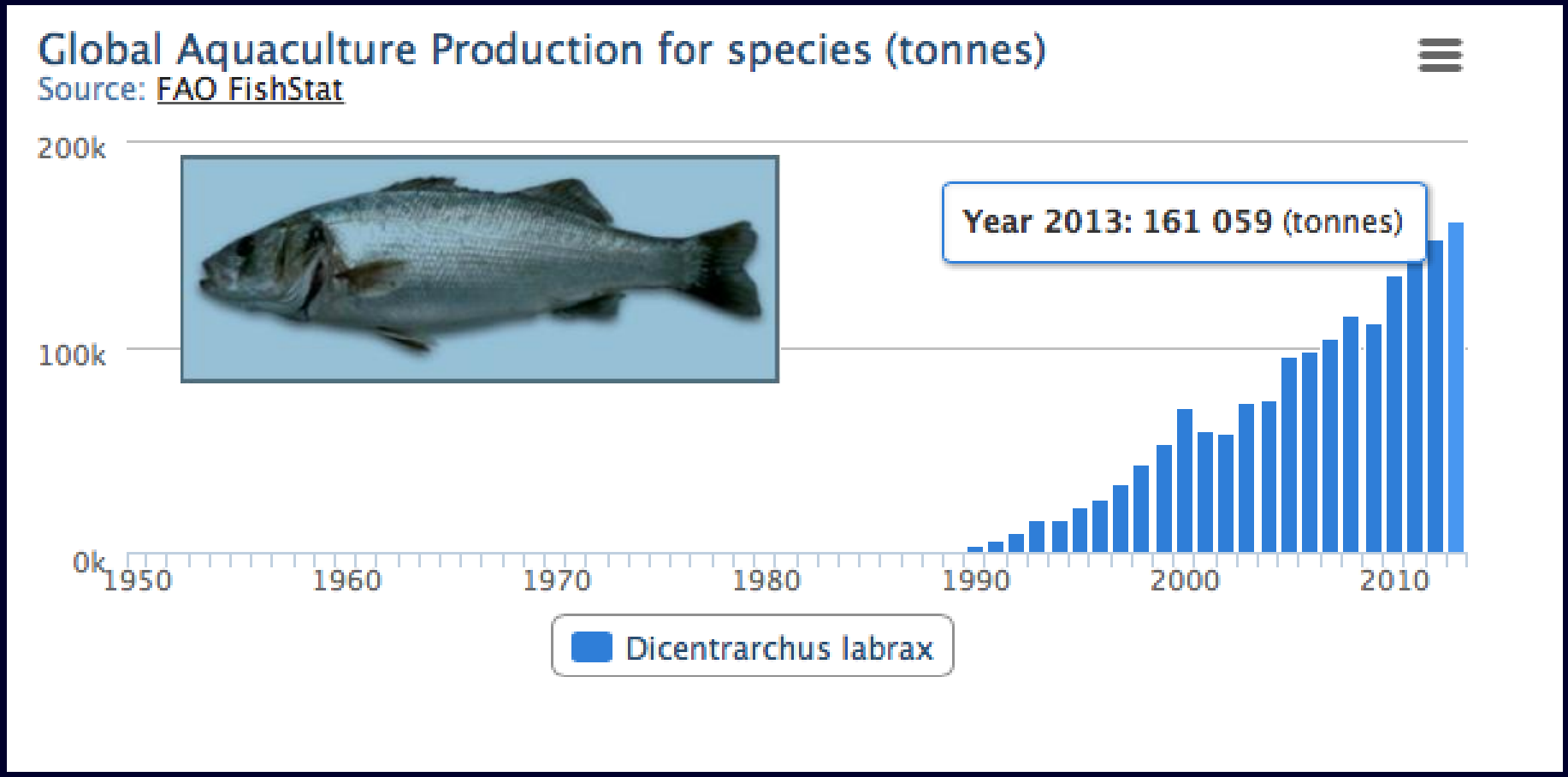


| | |
|---|---|
| 37% | Freshwater fishes |
| 15% | Molluscs |
| 23% | Crustaceans |
| 15% | Diadromous fishes |
| 8% | Marine fishes |
| 2% | Aquatic animals NEI |

*Note:* NEI = not elsewhere included.

FAO 2012

# PISCICULTURA MARINHA NO MUNDO




FAO 2016

# Crescimento de bijupirá x pargo (45 dae)


Foto: Benetti

RSMAS

Para produzir 100.000 ton:

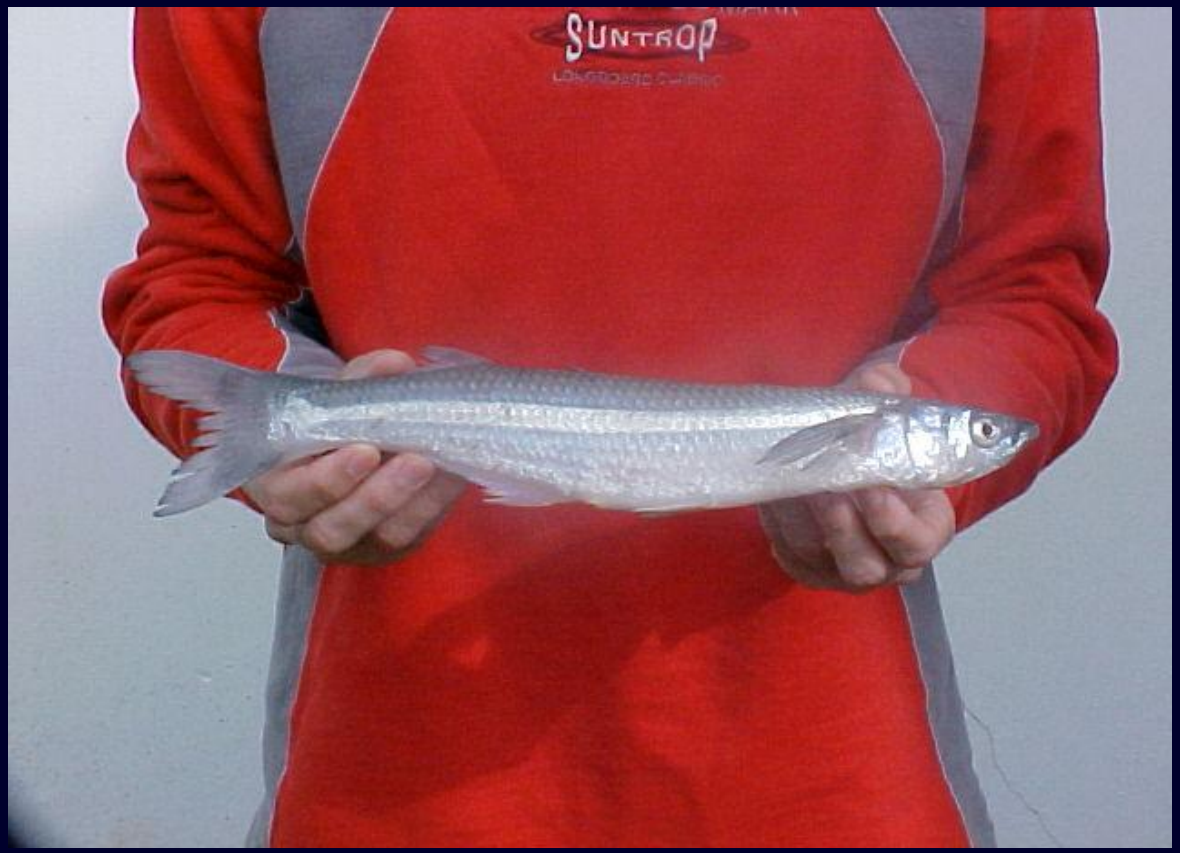
20 milhões de alevinos de bijupirá (5 kg)

200 milhões de alevinos de pargo (0,5 kg)

# PISCICULTURA MARINHA NO BRASIL

AINDA ESTAMOS SELECIONANDO ESPÉCIES ...

# A experiência com PEIXE-REI



# PEIXE-REI: incubação e larvicultura

Diâmetro do ovo: 2mm

Comprimento larva: 7mm

Primeira alimentação *Artemia*

Sampaio (2006)

# A experiência com LINGUADO

Aquaculture Research

Aquaculture Research, 2008, **39**, 712–717 doi: 10.1111/j.1365-2109.2008.01923.x

# Hormone-induced ovulation, natural spawning and larviculture of Brazilian flounder *Paralichthys orbignyanus* (Valenciennes, 1839)

**Luís A Sampaio[1], Ricardo B Robaldo[2,*] & Adalto Bianchini[2]**

[1]Departamento de Oceanografia, Laboratório de Maricultura, Fundação Universidade Federal do Rio Grande – FURG, Rio Grande – RS, Brazil

# Produção de linguado em RAS no Brasil

# Produção de linguado em RAS no Brasil

# A experiência com CORVINA

PANAMJAS
Pan-American Journal of Aquatic Sciences

**Early developmental aspects and validation of daily growth increments in otoliths of *Micropogonias furnieri* (Pisces, Sciaenidae) larvae reared in laboratory**

CRISTIANO QUEIROZ DE ALBUQUERQUE[1], JOSÉ HENRIQUE MUELBERT[2] & LUIS ANDRÉ N. SAMPAIO[3]

# PRODUÇÃO DE ALEVINOS DE CORVINA

Desova induzida: HCG 500 UI/Kg

Temperatura: 23 °C

Salinidade: 30 ‰

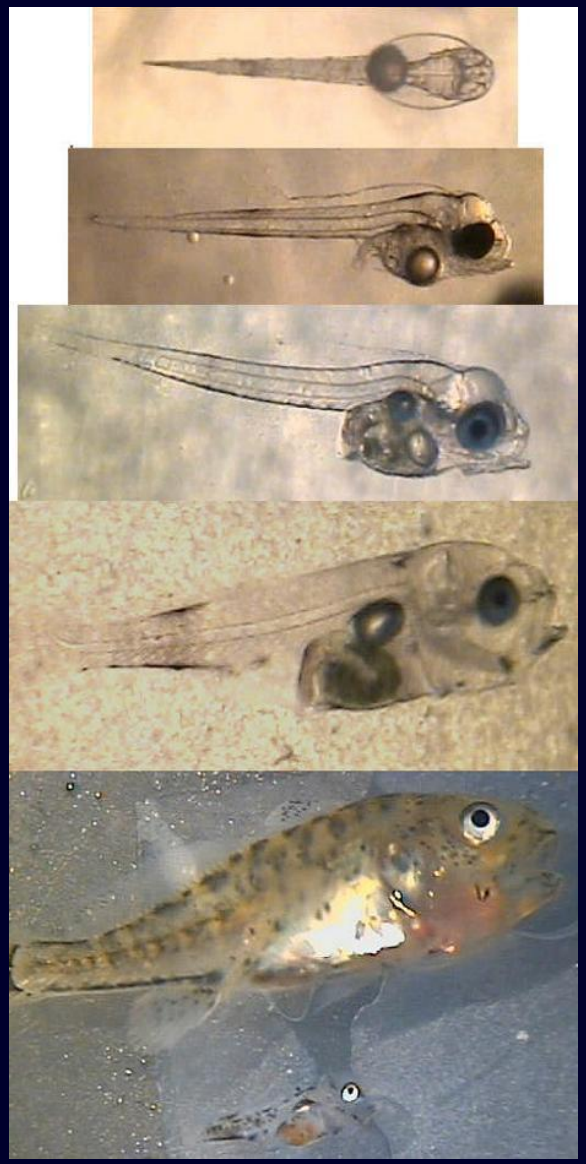
Comprimento ao eclodir: 1,9 mm

Alimentação

green water (*Tetraselmis tetrathele*)

Rotíferos

*Artemia*



Albuquerque et al (2009)

# *Experiência com bijupirá no Brasil*

Bijupirá - *Rachycentron canadum*

# *Experiência com bijupirá no Brasil*

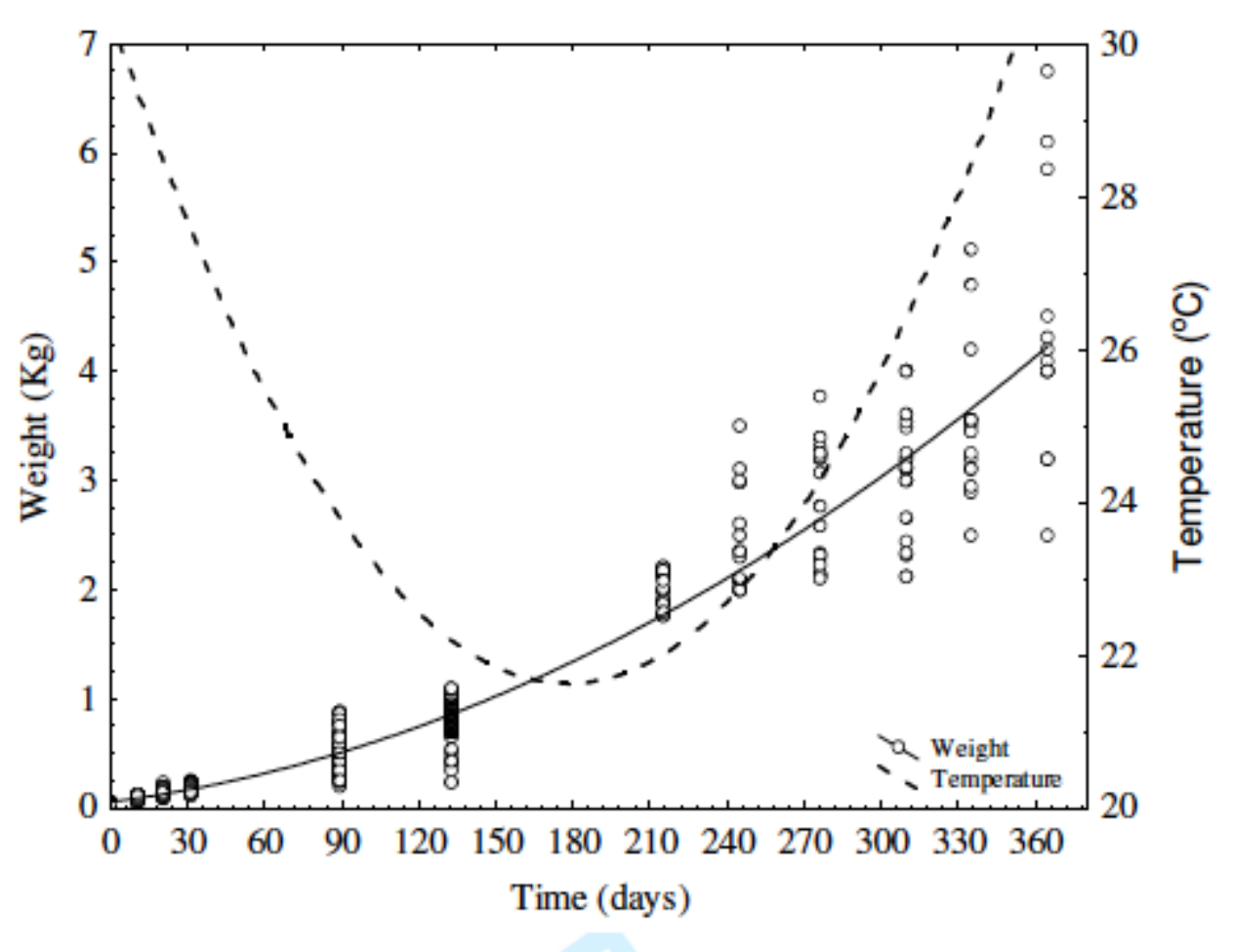
*Tanque-rede Recife*

# Produção de bijupirá em Ilha **Grande - Brasil**

# Produção de bijupirá em Ilha **Grande - Brasil**

* Pousada Nautilus

# Crescimento de bijupirá em tanque-rede costeiro




0 → 4Kg

12 meses

≈ 11g/dia

Sampaio et al (2011) Aquaculture Research 42:832-834

# Experiência com bijupirá no Brasil

Tanque-rede Rio de Janeiro

* Pousada Nautilus

# FURG

*Courtesy:Paulo Iribarrem*

# Criação de bijupirá em sistema de recirculação de água (RAS)

Reprodução de bijupirá criados em RAS

Larvicultura de bijupirá em RAS

Berçário de bijupirá em RAS

Engorda de bijupirá durante um ano em RAS

# Produção de cobia em RAS no Brasil

# SISTEMAS DE RECIRCULAÇÃO DE ÁGUA

Filtros: mecânico, biológico
Aquecedor/Resfriador
Skimmer
Esterilização: UV, ozônio
Sump: decantação
Bombas
Controle de luz: intensidade e fotoperíodo - cor

# LAPEM – FURG: tanques para engorda

## Sistema de filtração

# AQUICULTURA INTENSIVA

## QUALIDADE DE ÁGUA: tudo é importante, especialmente em sistemas de recirculação de água

OXIGÊNIO

TEMPERATURA

COMPOSTOS NITROGENADOS

(amônia, nitrito e nitrato)

pH

ALCALINIDADE

DUREZA

SALINIDADE

.....

# LAPEM – FURG: Laboratório experimental

## 8 RAS com 3 tanques (300 L) em cada

# LAPEM – FURG: Laboratório experimental

## 8 RAS com 3 tanques (300 L) em cada

# LAPEM – FURG: laboratório experimental

## 3 RAS com 5 tanques (1.000 L) em cada


# LAPEM – FURG: tanques para engorda

## RAS com 2 tanques (15.000 L)

*Alevinos adquiridos de um produtor no litoral de SP e transportados por via terrestre até a FURG (duração 24h)*

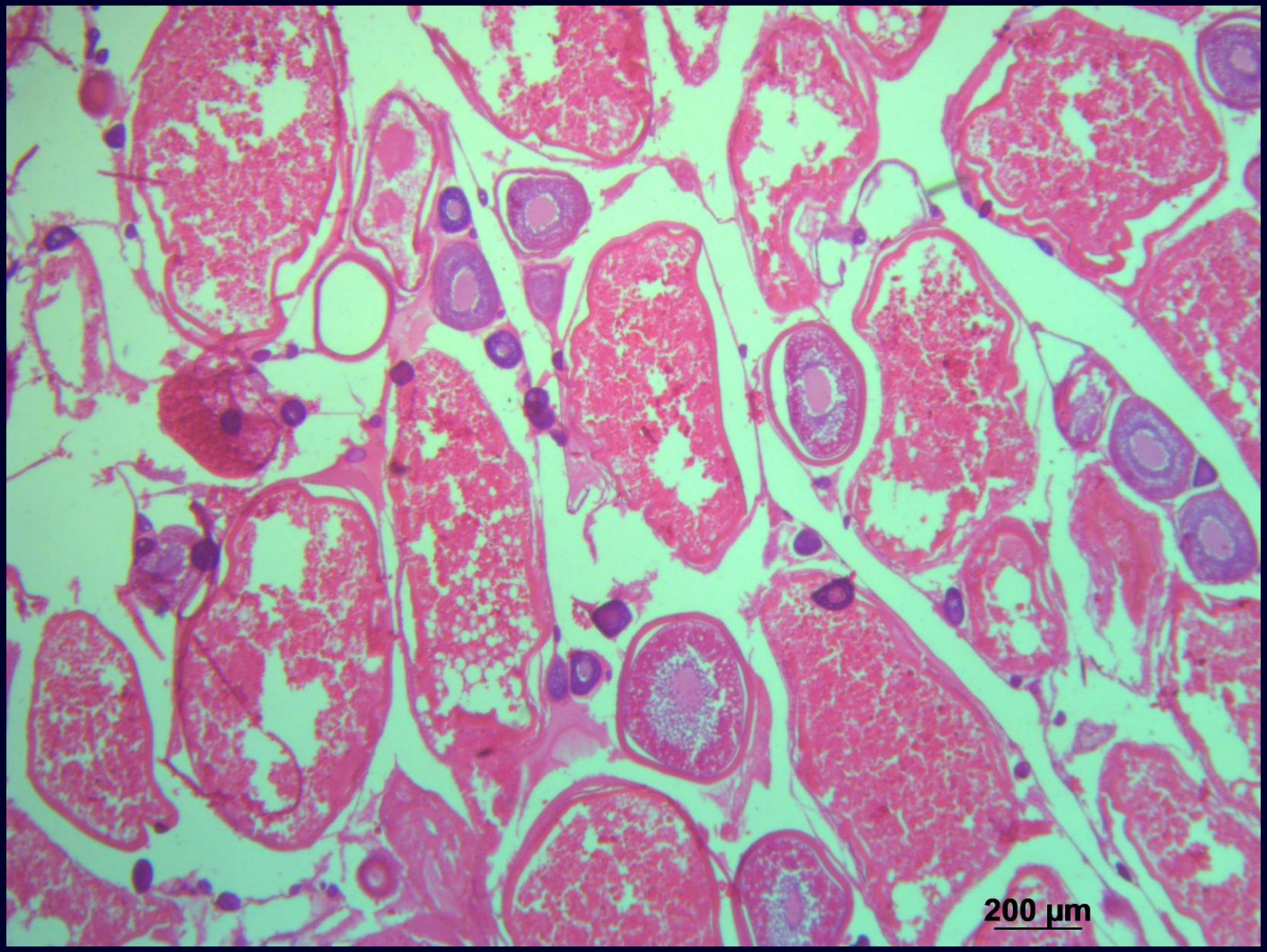
# Tanques de reprodutores (2 tanques, 15 ton cada)


*REPRODUÇÃO*

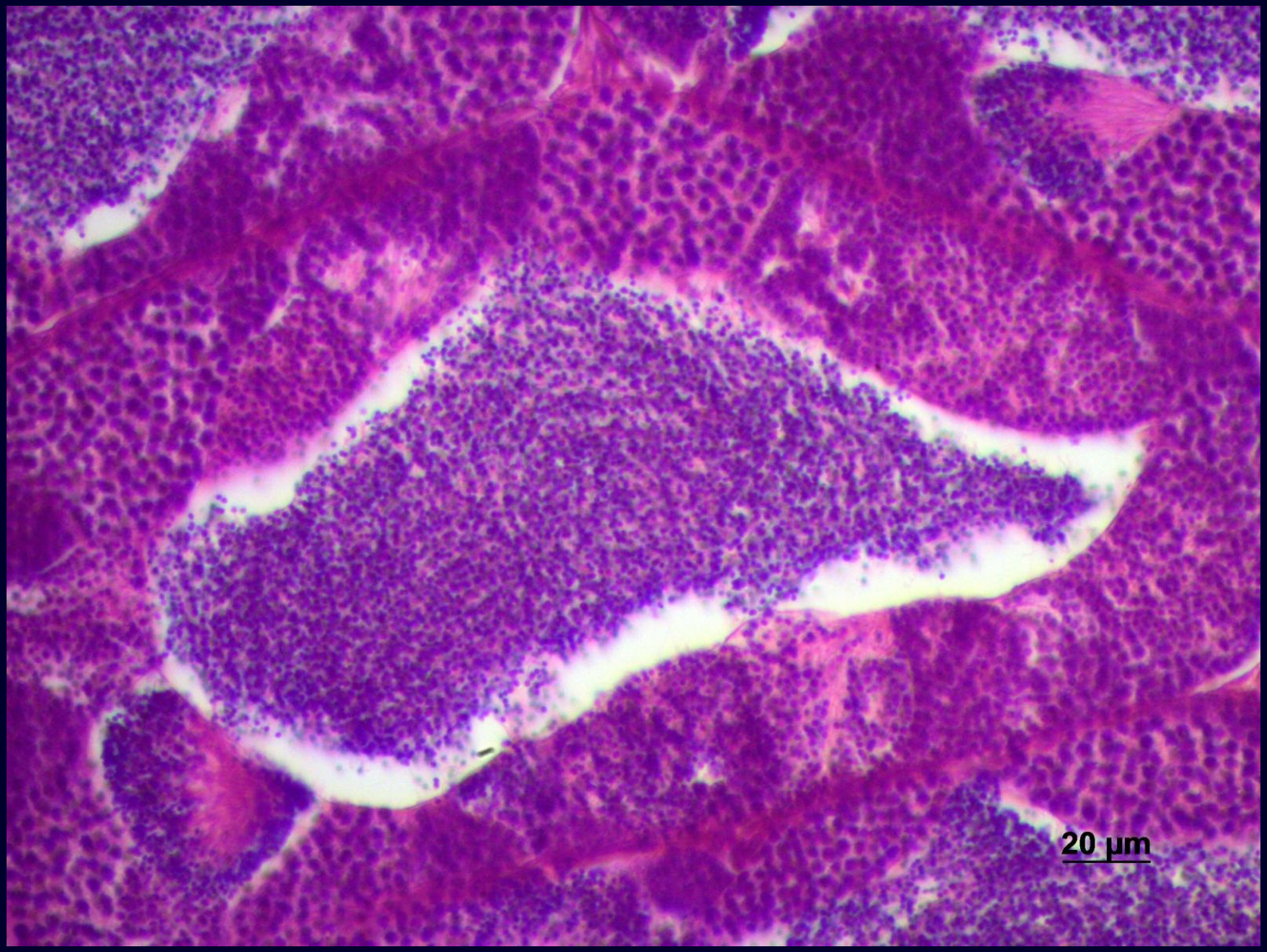
*Bijupirás criados em RAS durante 3 anos*

*Desova natural nos tanques de 15 ton*

# Ovário maturo

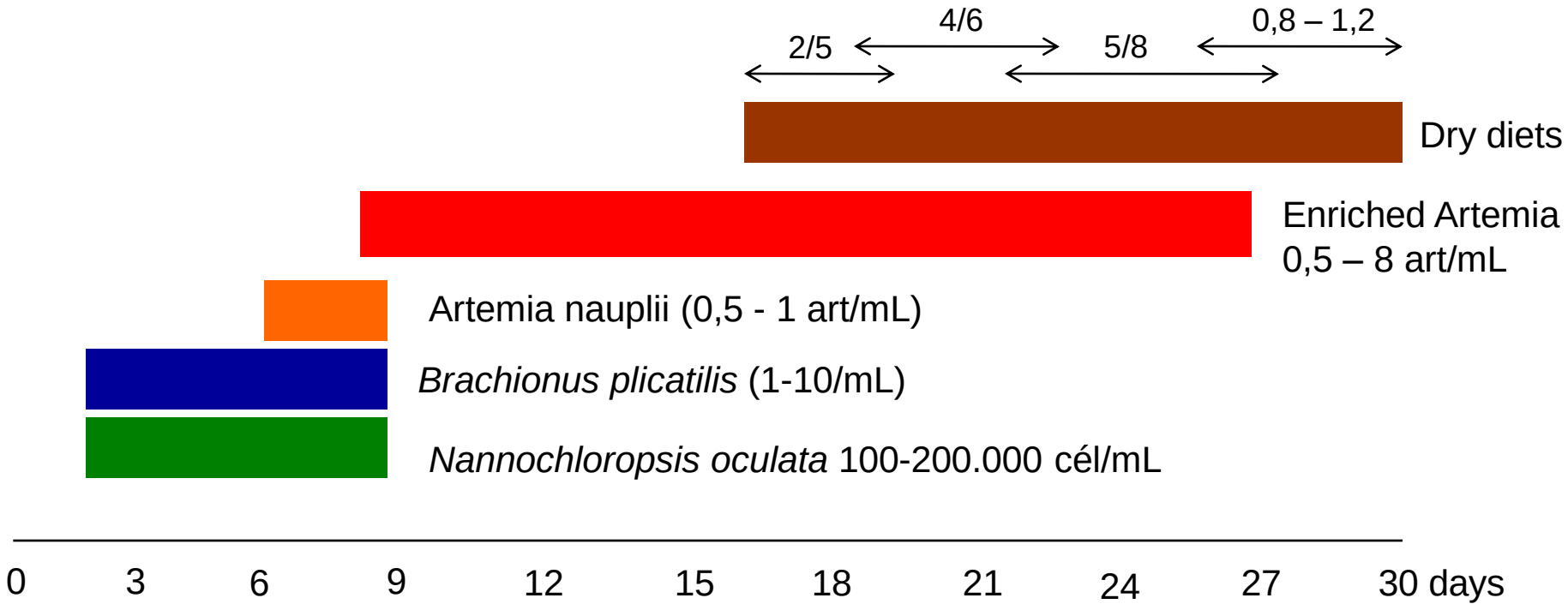


# Testículo maturo

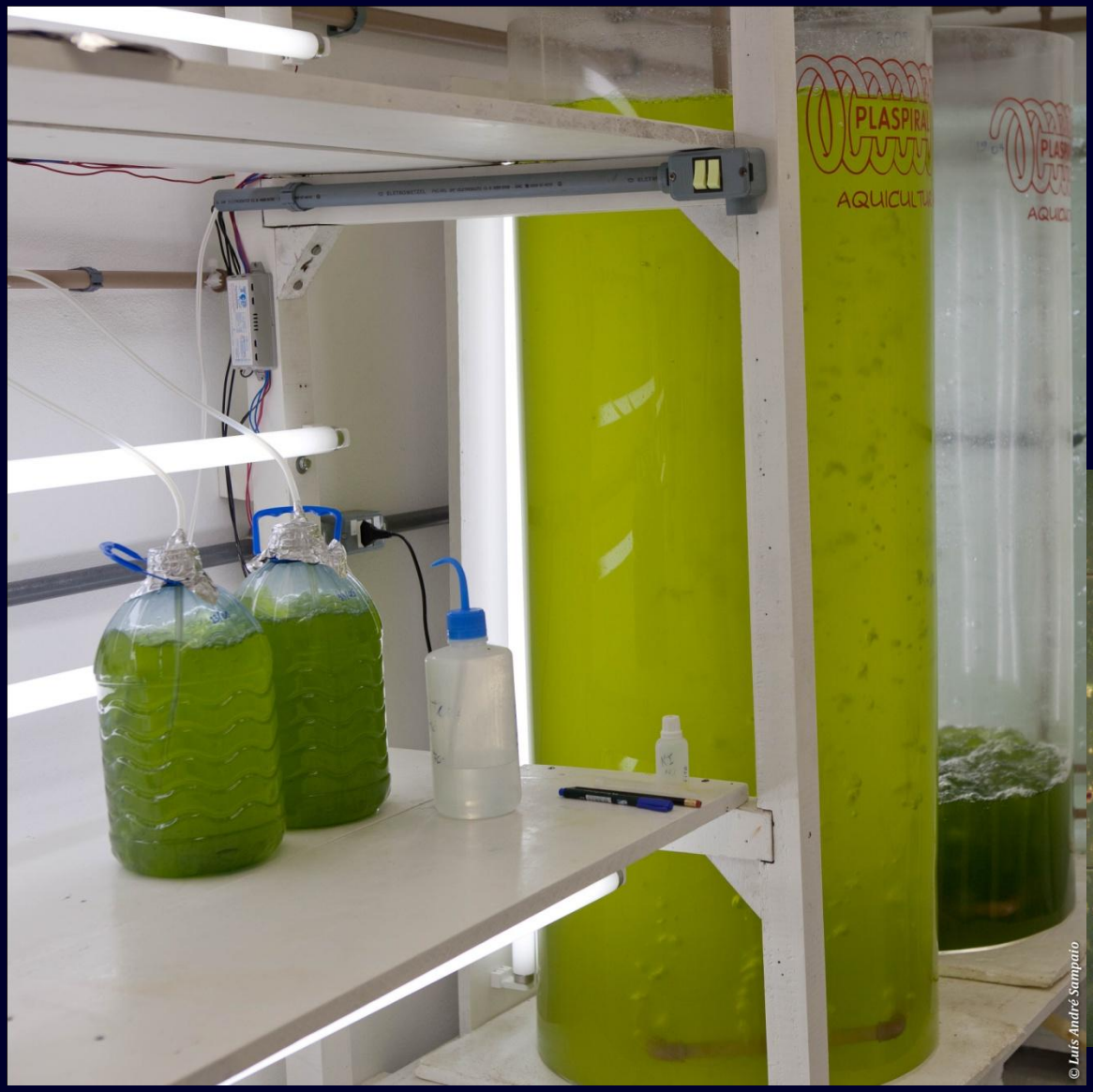


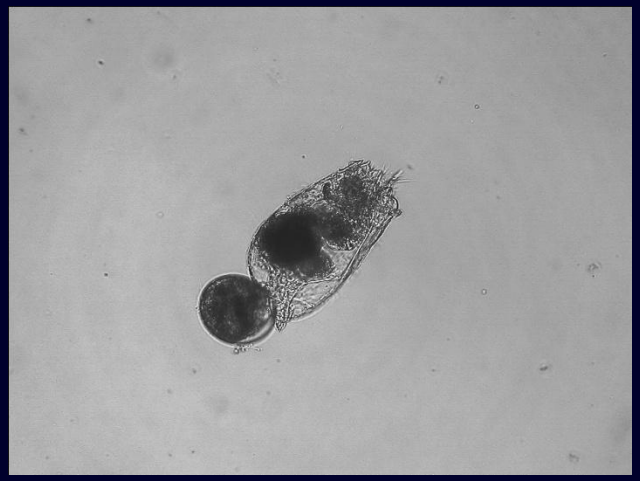
# Embrião em desenvolvimento

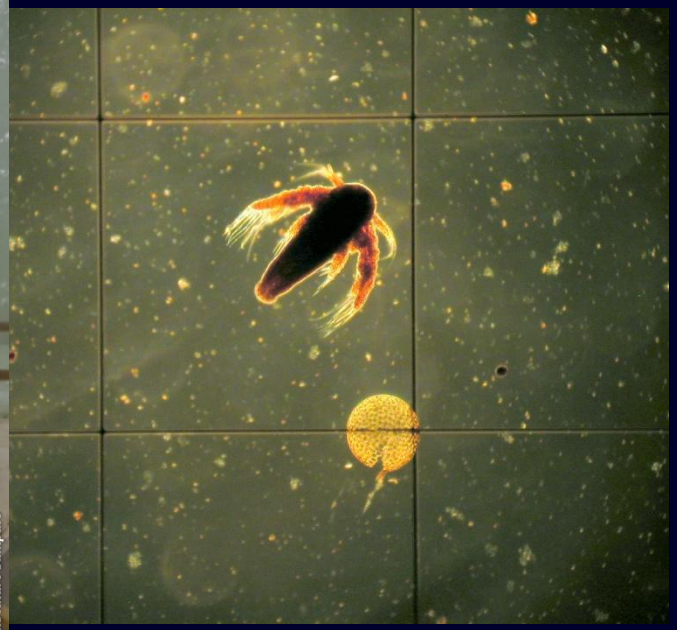
# LARVICULTURA: protocolo de alimentação



# Alimento vivo

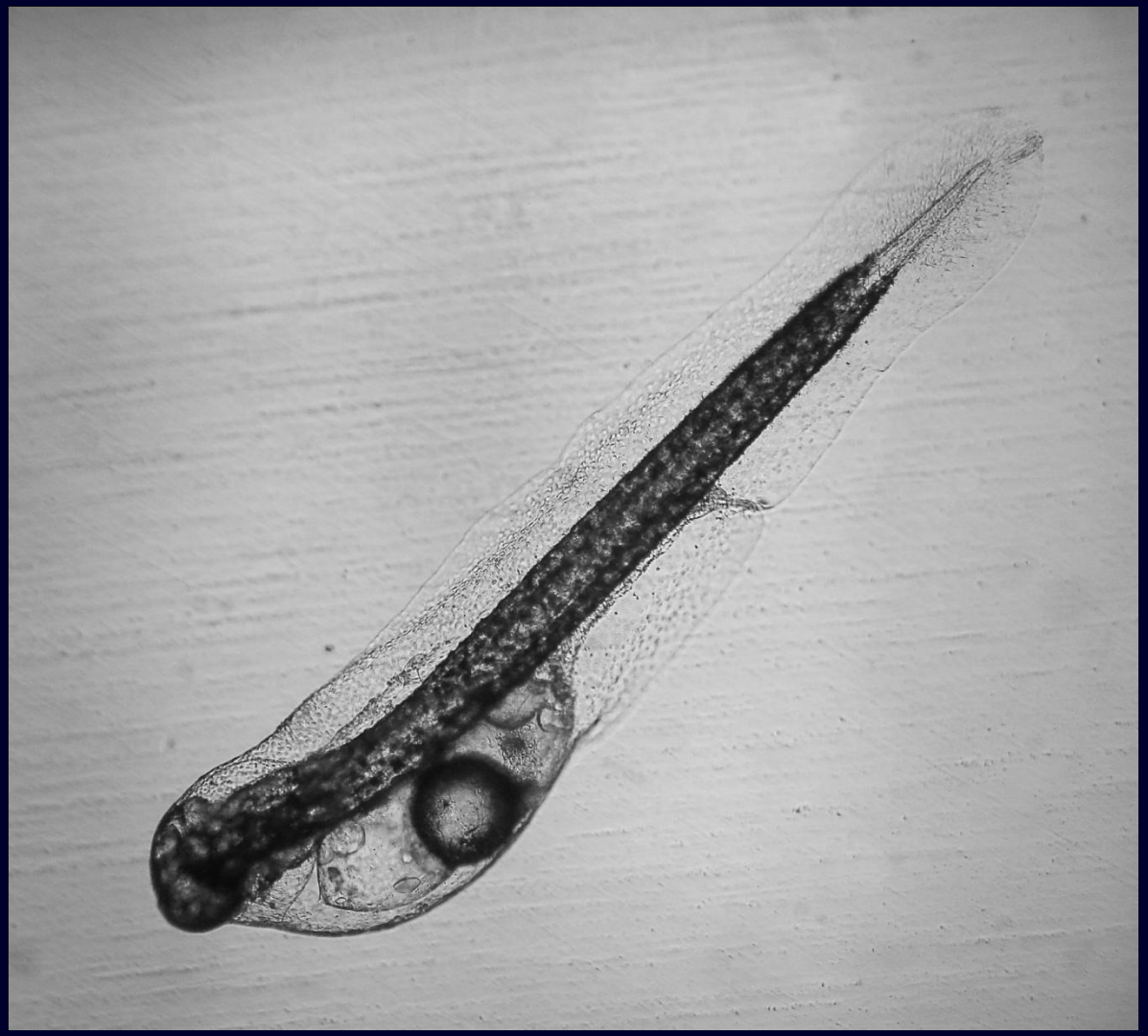




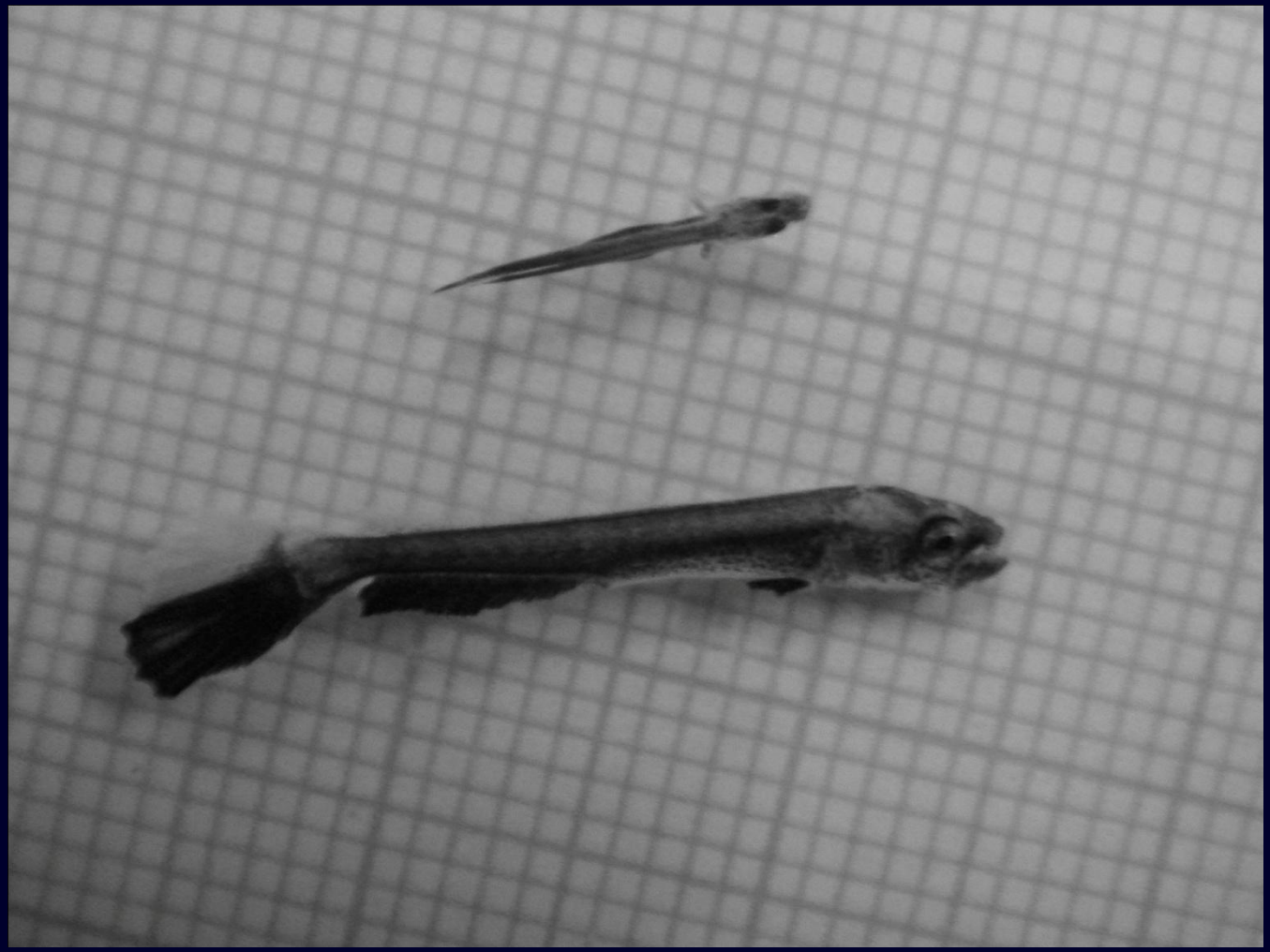
# Green water larviculture

# Larva recém eclodida



# Larva 5 dae

# Larva 15 dae – crescimento heterogêneo



# LAPEM – FURG: crescimento bijupirá

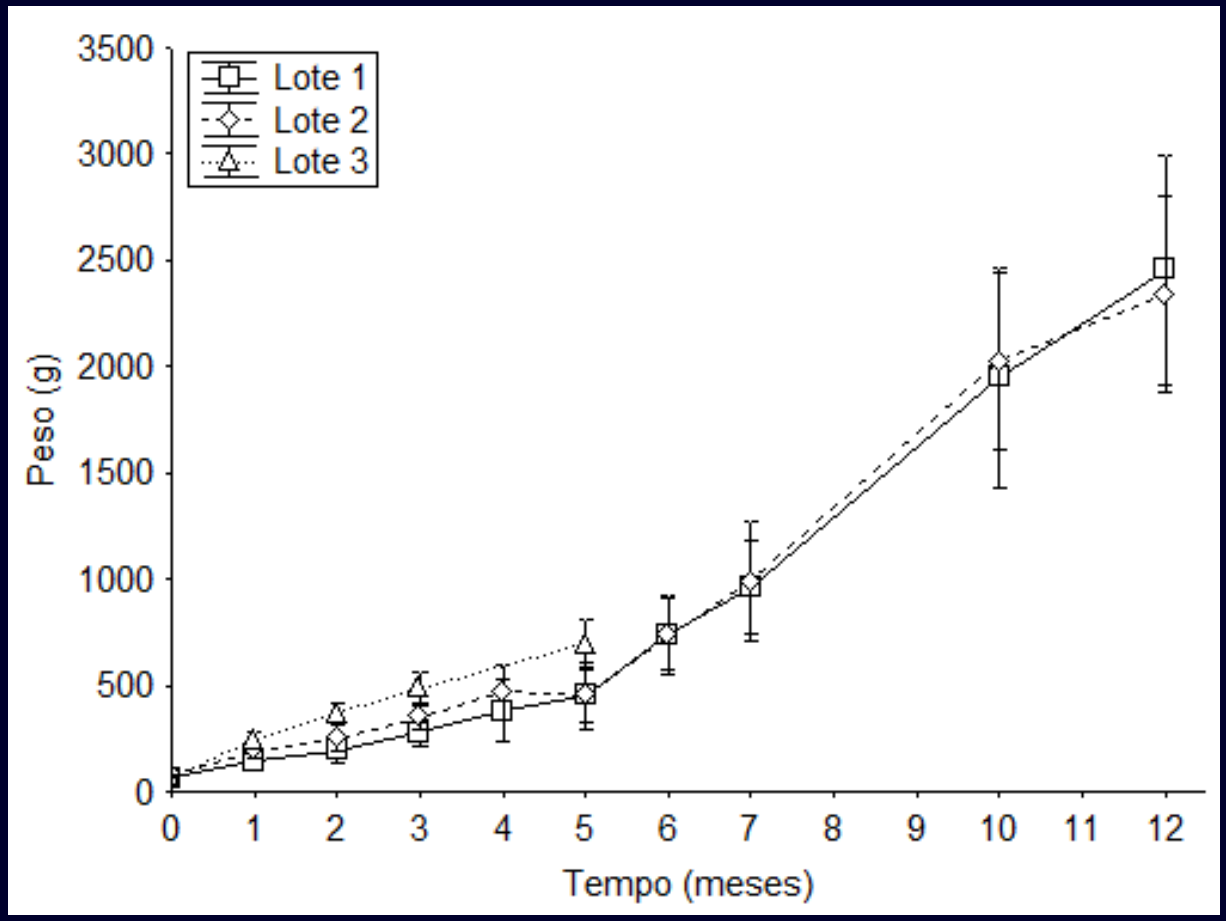

442 g

# LAPEM – FURG: crescimento bijupirá


1,25 kg

# Cobia growth

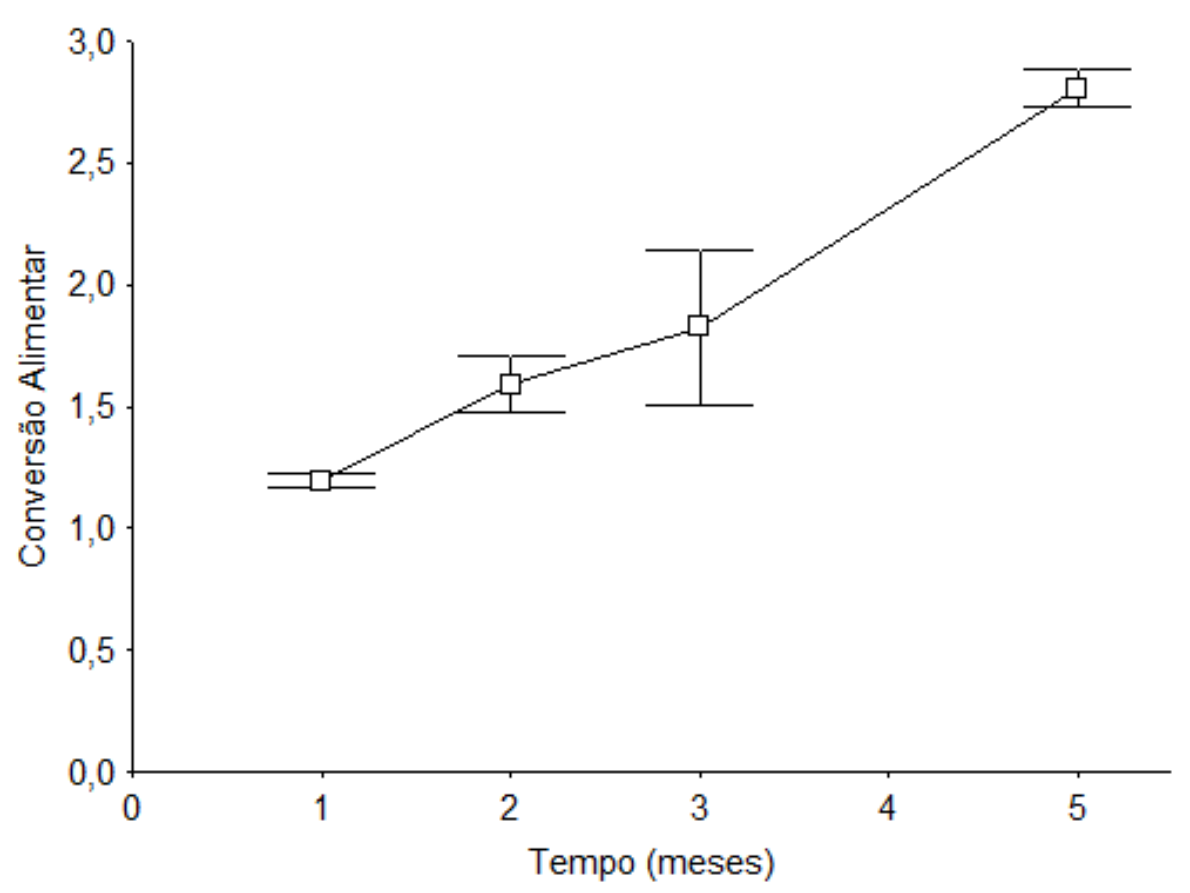
# LAPEM – FURG: crescimento bijupirá




2,5 kg

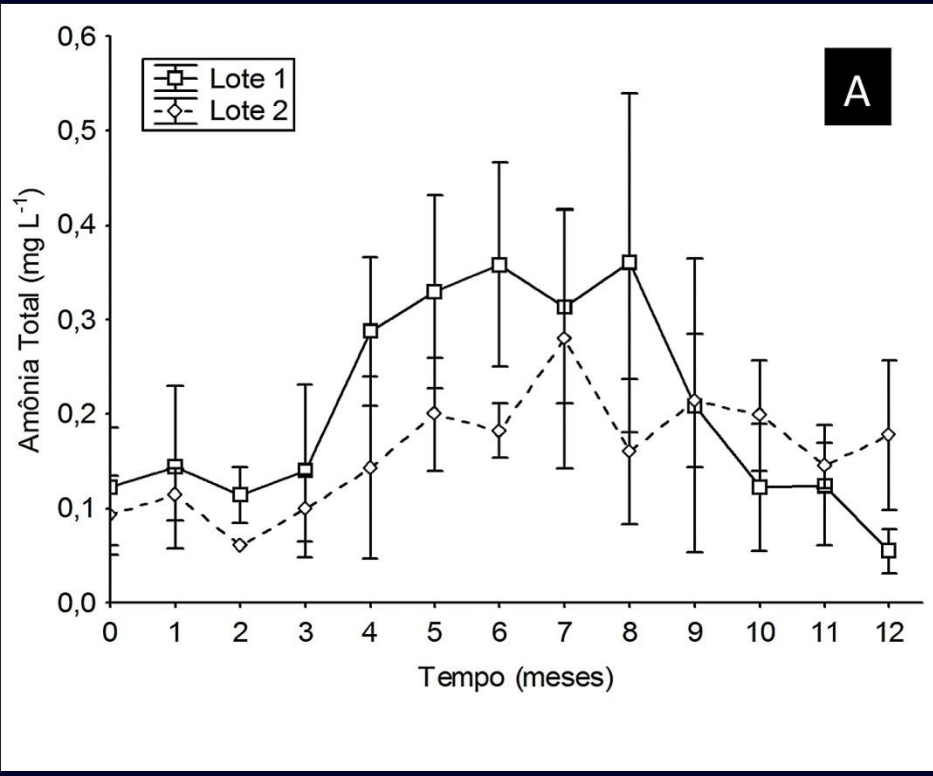
Crescimento de 3 lotes de bijupirá em RAS.

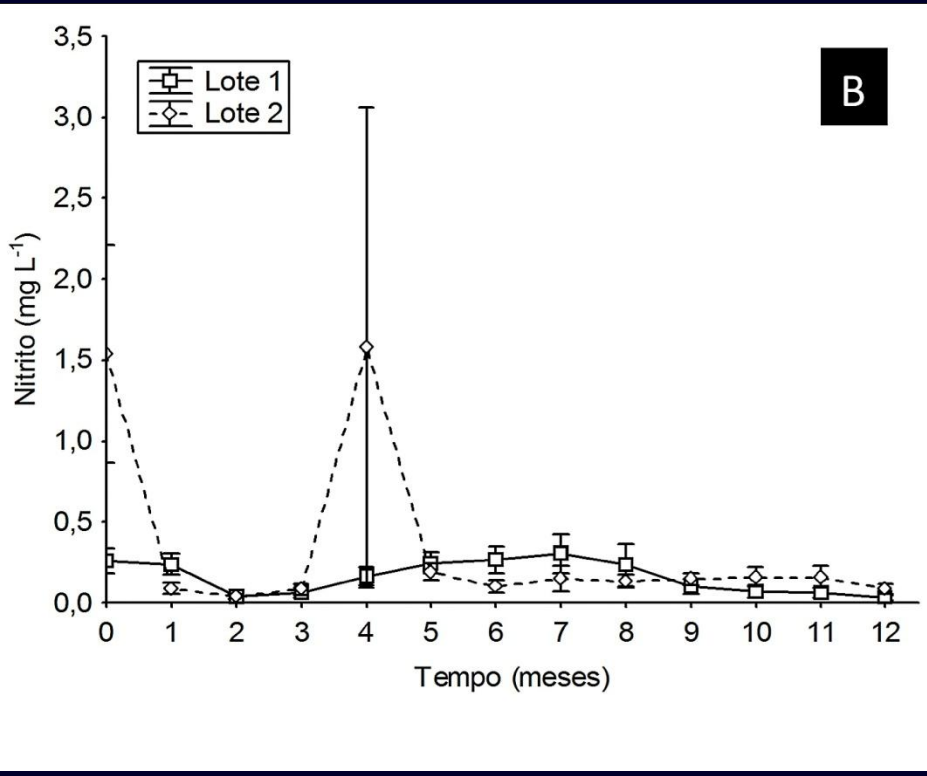
# LAPEM – FURG: crescimento bijupirá




Conversão alimentar lote 3 em RAS.

# Concentrações de amônia (A) e nitrito (B) ao longo do ano.




Nitrato máximo 52 ppm.

# LAPEM – FURG: eficiência no uso de água

Considerando o volume de água utilizada para encher o sistema e as limpezas diárias dos filtros :

Lotes 1 e 2: 1.400 L água marinha/kg peixe (biomassa 3 kg/$m^3$)

Lote 3: 166 L água marinha/kg peixe (biomassa 12 kg/$m^3$)

Para aumentar a eficiência:

Maior densidade de estocagem e REUSO DA ÁGUA:

- no mesmo ciclo de produção
- para outros ciclos de produção

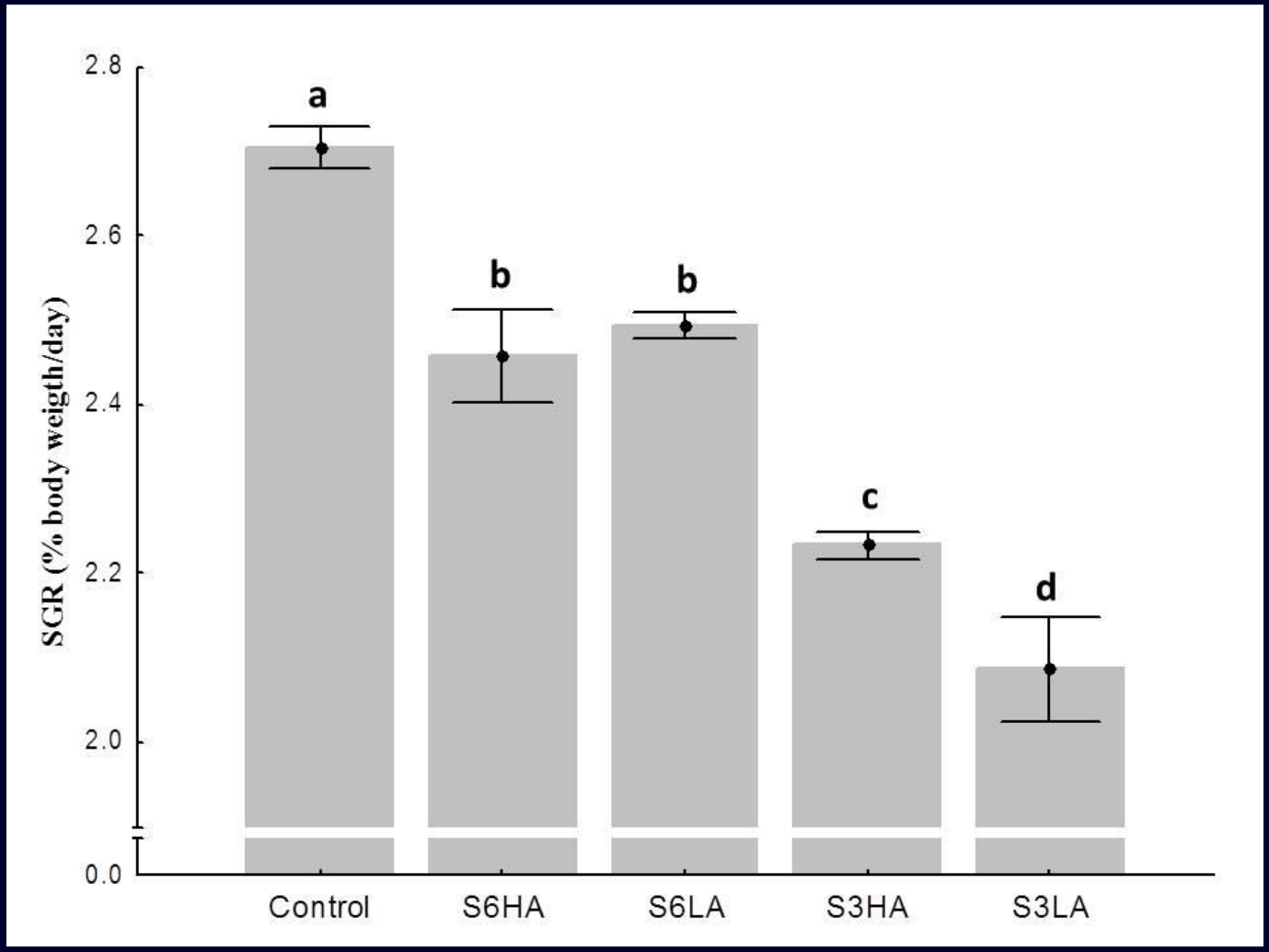
# LAPEM – FURG: salinidade

Lote 3: 166 L água marinha/kg peixe (biomassa 12 kg/$m^3$)

Salinidade 35: 5,8 ton sal/ton peixe

Salinidade 5: 0,85 ton sal/ton peixe

# *Crescimento de bijupirá em baixa salinidade*



# ESTRESSE E BEM ESTAR

Aquaculture 307 (2010) 173–177

Contents lists available at ScienceDirect

Aquaculture

journal homepage: www.elsevier.com/locate/aqua-online

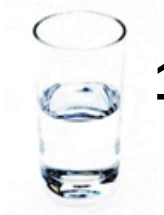
Short communication

## Physiological responses of cobia *Rachycentron canadum* following exposure to low water and air exposure stress challenges

J. Trushenski [a,*], M. Schwarz [b], R. Takeuchi [c], B. Delbos [b], L.A. Sampaio [d]

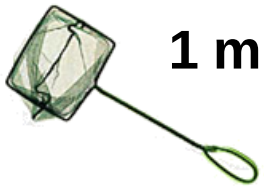
**CONTROL**

**LOW WATER**



**15 mins**

**AIR EXPOSURE**



**1 min**

Coleta de sangue:
0, 0.5, 1, 2, 6, 12, 24, 48, 72 h após os estressores

Aquaculture 307 (2010) 173–177

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Short communication

# Physiological responses of cobia *Rachycentron canadum* following exposure to low water and air exposure stress challenges

J. Trushenski [a,*], M. Schwarz [b], R. Takeuchi [c], B. Delbos [b], L.A. Sampaio [d]

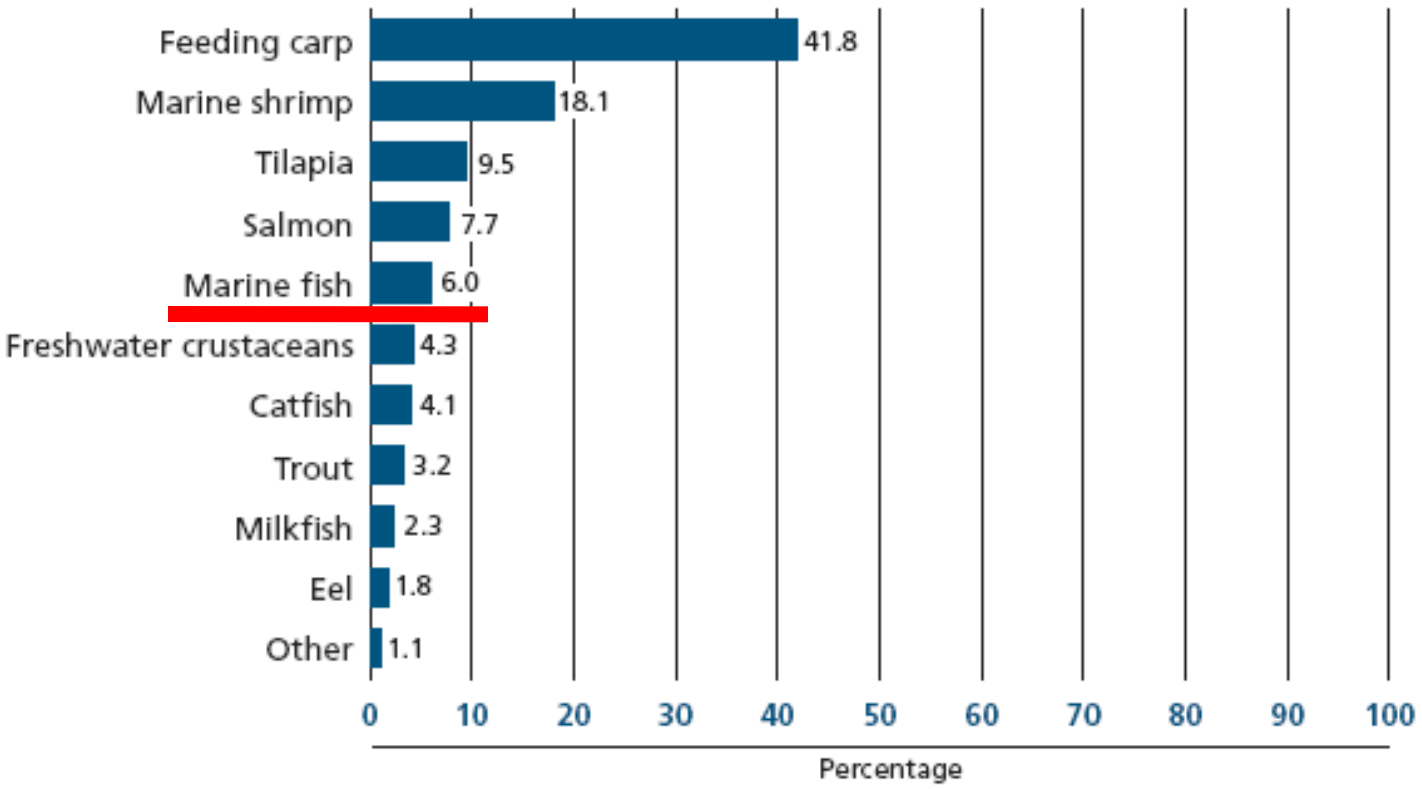
**Table 1**
Haematological responses of juvenile cobia by stress challenge protocol (means ± SE). p-values resulting from the repeated measures ANOVA are provided. For response parameters exhibiting a significant interactive effect of challenge protocol and time, results of one-way ANOVA and pairwise comparison test within a time point are also provided. Means with common letters are not significantly different at the stated time point; absence of letters indicates lack of a significant challenge protocol effect at a given time point ($P<0.05$).

| Parameter | Stress challenge protocol | Hours post-stressor exposure | | | | | | | | | Repeated measures ANOVA *P*-values | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 0.5 | 1 | 2 | 6 | 12 | 24 | 48 | 72 | Stress | Time | Stress × time |
| Cortisol (ng/mL) | CONTROL | 16 ± 15 | 58 ± 45 | 34 ± 18 b | 49 ± 18 | 15 ± 19 | 47 ± 15 | 50 ± 17 | 49 ± 17 | 41 ± 15 | 0.08 | <0.01 | <0.01 |
| | AIR EXPOSURE | 32 ± 15 | 230 ± 45 | 179 ± 18 a | 14 ± 18 | 24 ± 19 | 14 ± 15 | 35 ± 17 | 1 ± 17 | 31 ± 15 | | | |
| | LOW WATER | 50 ± 15 | 132. ± 45 | 41 ± 18 b | 33 ± 19 | 51 ± 19 | 47 ± 15 | 34 ± 17 | 60 ± 17 | 24 ± 15 | | | |
| Glucose (mg/dL) | CONTROL | 62 ± 4 | 56 ± 8 c | 58 ± 8 c | 65 ± 13 b | 57 ± 6 b | 44 ± 2 | 56 ± 5 | 45 ± 2 | 38 ± 2 | <0.01 | <0.01 | <0.01 |
| | AIR EXPOSURE | 57 ± 4 | 184 ± 8 a | 189 ± 8 a | 157 ± 13 a | 89 ± 6 a | 55 ± 2 | 46 ± 5 | 42 ± 2 | 42 ± 2 | | | |
| | LOW WATER | 56 ± 4 | 127 ± 8 b | 107 ± 8 b | 99 ± 13 b | 67 ± 6 ab | 53 ± 2 | 55 ± 5 | 46 ± 2 | 50 ± 2 | | | |
| Lactate (mmol/L) | CONTROL | 0.4 ± 0.2 | 0.1 ± 0.7 b | 0.0 ± 0.5 b | 0.0 ± 0.5 b | 0.0 ± 0.2 | 0.5 ± 0.1 | 0.4 ± 0.2 | 0.5 ± 0.2 | 0.1 ± 0.3 | <0.01 | <0.01 | <0.01 |
| | AIR EXPOSURE | 0.0 ± 0.2 | 5.5 ± 0.7 a | 8.6 ± 0.5 a | 3.4 ± 0.5 a | 0.6 ± 0.2 | 0.4 ± 0.1 | 0.4 ± 0.2 | 0.4 ± 0.2 | 0.8 ± 0.3 | | | |
| | LOW WATER | 0.0 ± 0.2 | 0.7 ± 0.7 b | 1.1 ± 0.5 b | 0.1 ± 0.5 b | 0.1 ± 0.2 | 0.1 ± 0.1 | 0.2 ± 0.2 | 0.5 ± 0.2 | 0.6 ± 0.3 | | | |
| Osmolality (mOsm/kg) | CONTROL | 368 ± 13 | 372 ± 9 b | 373 ± 13 | 375 ± 8 | 396 ± 3 a | 358 ± 7 | 396 ± 5 | 376 ± 3 | 372 ± 3 | <0.01 | <0.01 | <0.01 |
| | AIR EXPOSURE | 394 ± 14 | 439 ± 9 a | 413 ± 13 | 381 ± 9 | 380 ± 3 b | 379 ± 7 | 387 ± 5 | 374 ± 3 | 374 ± 3 | | | |
| | LOW WATER | 371 ± 15 | 391 ± 9 b | 385 ± 13 | 403 ± 8 | 386 ± 3 ab | 370 ± 7 | 388 ± 5 | 370 ± 3 | 385 ± 5 | | | |

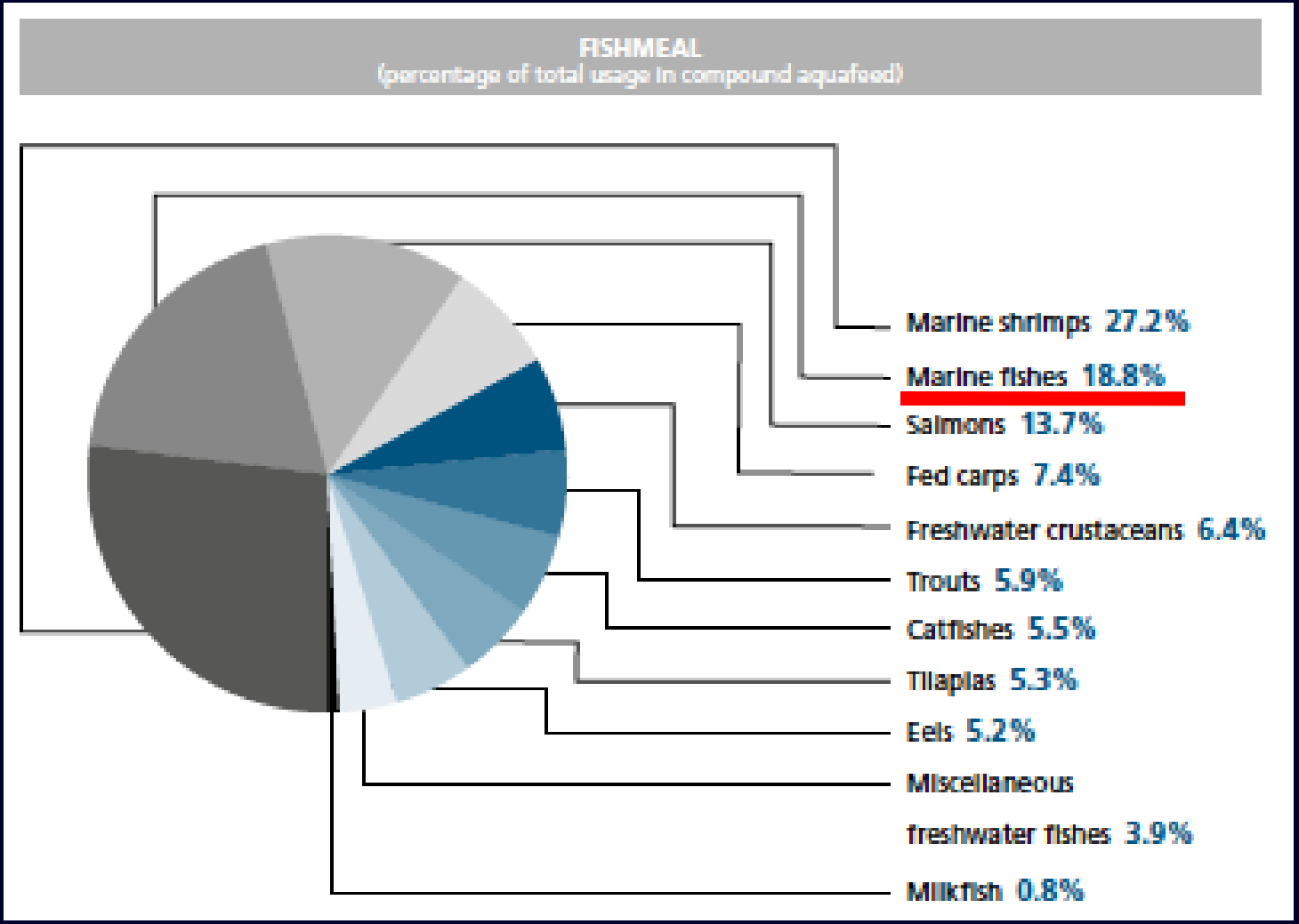
Trushenski et al (2010)

# SUBSTITUIÇÃO DE FARINHA E ÓLEO DE PEIXE POR OUTRAS FONTES DE PROTEÍNA E LIPÍDIO

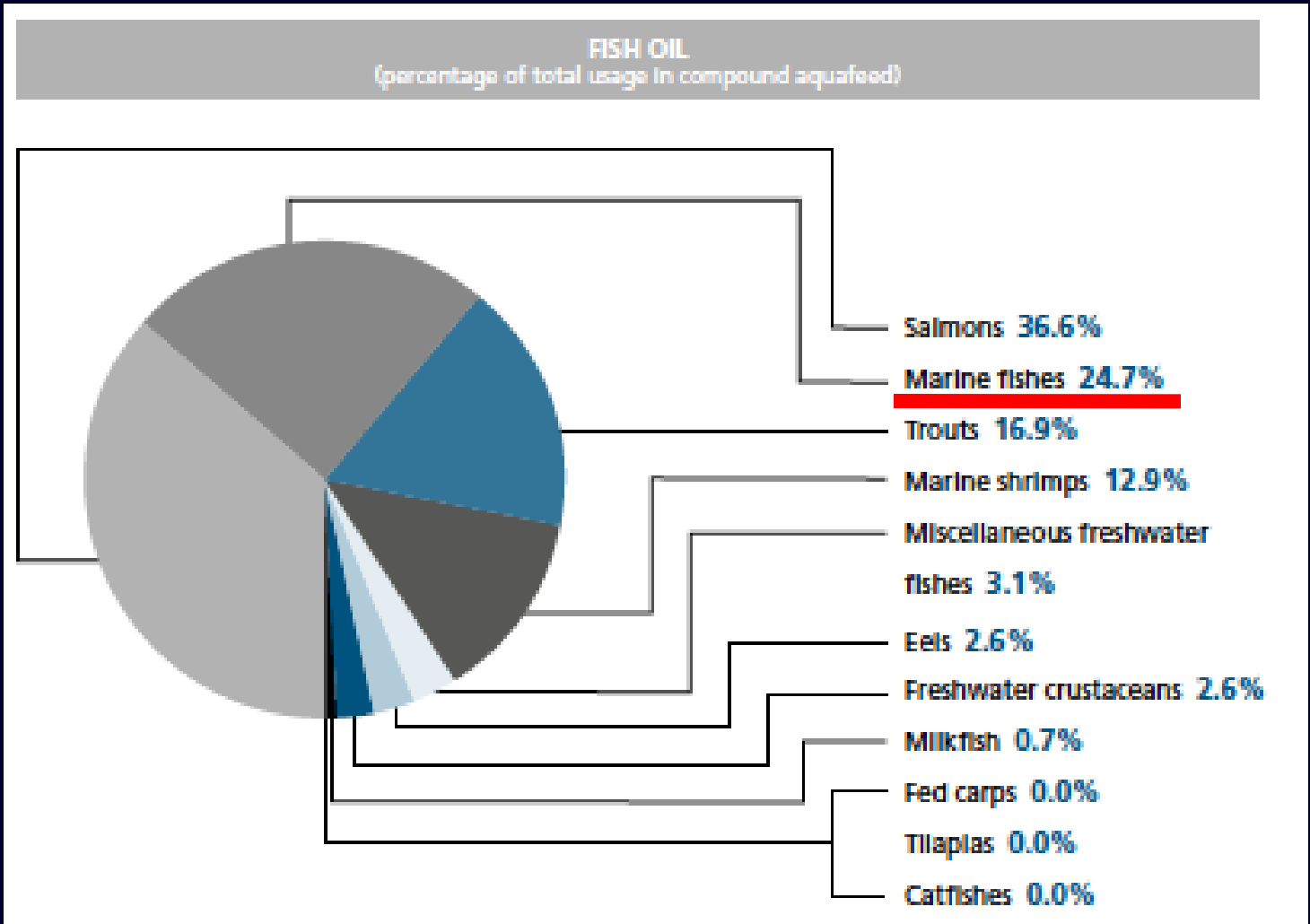
# USO DE RAÇÃO NA AQUACULTURA



# USO DA FARINHA DE PEIXE NA AQUACULTURA



# USO DO ÓLEO DE PEIXE NA AQUACULTURA



Aquaculture Nutrition

*Aquaculture Nutrition* **2011 17;** e437–e447 doi: 10.1111/j.1365-2095.2010.00779.x

# Effect of replacing dietary fish oil with soybean oil on production performance and fillet lipid and fatty acid composition of juvenile cobia *Rachycentron canadum*

J. TRUSHENSKI[1], M. SCHWARZ[2], H. LEWIS[1], J. LAPORTE[1], B. DELBOS[2], R. TAKEUCHI[3] & L.A. SAMPAIO[4]

Table 2. Production performance by dietary treatment. Values represent LS-means ± SE of triplicate tanks (tank-based calculations) or multiple fish within triplicate tanks (individual fish-based calculations); in all cases, tanks were used as experimental units (n = 3). Means with common letters are not significantly different.

| Parameter | 100% FO | 67% FO | 33% FO | 0% FO | *P*-value |
|---|---|---|---|---|---|
| Survival (%) | 100 | 100 | 100 | 100 | --- |
| Initial Individual Weight (g) | 61.5 ± 1.4 | 62.5 ± 1.4 | 61.8 ± 1.4 | 63.5 ± 1.4 | 0.74 |
| Final Individual Weight (g) | 167.5 ± 3.8 a | 163.5 ± 3.8 ab | 157.3 ± 3.8 ab | 146.8 ± 3.8 b | 0.02 |

# Substituição do óleo de peixe por óleo de soja em bijupirá: efeito na composição de ácidos graxos do filé

**Table 3** Fillet total lipid content and fatty acid composition. Values represent LS-means ± SE of multiple fish within triplicate tanks ($n = 3$); SE <0.1 are reported as "0.0". Means with common letters are not significantly different. All fatty acid abbreviations are as defined in Table 1

| Fatty acid(s) | 100% FO | 67% FO | 33% FO | 0% FO | *P*-value |
|---|---|---|---|---|---|
| 14:0 | 5.9 ± 0.1 a | 5.2 ± 0.1 b | 4.6 ± 0.1 c | 4.1 ± 0.1 d | <0.01 |
| 16:0 | 21.9 ± 0.1 a | 20.9 ± 0.1 b | 20.4 ± 0.2 bc | 19.9 ± 0.1 c | <0.01 |
| 18:0 | 5.9 ± 0.1 | 5.8 ± 0.1 | 5.8 ± 0.1 | 5.8 ± 0.1 | 0.82 |
| Total SFA[1] | 35.2 ± 0.2 a | 33.2 ± 0.2 b | 32.1 ± 0.2 c | 30.9 ± 0.2 d | <0.01 |
| 16:1*n*-7 | 8.8 ± 0.1 a | 7.6 ± 0.1 b | 6.7 ± 0.1 c | 5.8 ± 0.1 d | <0.01 |
| 18:1*n*-7 | 3.4 ± 0.0 a | 3.1 ± 0.0 b | 2.9 ± 0.0 c | 2.7 ± 0.0 d | <0.01 |
| 18:1*n*-9 | 11.4 ± 0.1 d | 12.5 ± 0.1 c | 13.8 ± 0.1 b | 15.0 ± 0.1 a | <0.01 |
| Total MUFA[2] | 25.1 ± 0.1 | 24.6 ± 0.1 | 24.6 ± 0.2 | 24.7 ± 0.1 | 0.08 |
| 18:2*n*-6 (Ac. Linonêico) | 10.0 ± 0.2 d | 14.8 ± 0.2 c | 19.2 ± 0.3 b | 23.1 ± 0.2 a | <0.01 |
| 20:4*n*-6 | 1.3 ± 0.0 a | 1.2 ± 0.0 a | 1.0 ± 0.0 b | 1.0 ± 0.0 b | <0.01 |
| *n*-6[3] | 11.9 ± 0.2 d | 16.5 ± 0.2 c | 20.8 ± 0.2 b | 24.6 ± 0.2 a | <0.01 |
| 18:3*n*-3 | 1.3 ± 0.0 d | 1.8 ± 0.0 c | 2.2 ± 0.0 b | 2.6 ± 0.0 a | <0.01 |
| 18:4*n*-3 | 1.7 ± 0.0 a | 1.4 ± 0.0 b | 1.2 ± 0.0 c | 0.9 ± 0.0 d | <0.01 |
| 20:5*n*-3 (EPA) | 8.2 ± 0.1 a | 7.3 ± 0.1 b | 6.3 ± 0.1 c | 5.4 ± 0.1 d | <0.01 |
| 22:5*n*-3 | 2.4 ± 0.0 a | 2.2 ± 0.0 b | 1.9 ± 0.0 c | 1.6 ± 0.0 d | <0.01 |
| 22:6*n*-3 (DHA) | 10.6 ± 0.3 a | 9.8 ± 0.3 a | 8.2 ± 0.4 b | 7.1 ± 0.3 b | <0.01 |
| *n*-3[4] | 25.4 ± 0.3 a | 23.6 ± 0.3 b | 20.7 ± 0.4 c | 18.3 ± 0.3 d | <0.01 |
| Total PUFA[5] | 39.7 ± 0.3 c | 42.2 ± 0.3 b | 43.3 ± 0.4 ab | 44.4 ± 0.3 a | <0.01 |
| Total LC-PUFA[6] | 23.8 ± 0.4 a | 21.7 ± 0.4 b | 18.5 ± 0.5 c | 15.8 ± 0.4 d | <0.01 |
| Total MC-PUFA[7] | 13.8 ± 0.2 d | 18.7 ± 0.2 c | 23.1 ± 0.3 b | 27.1 ± 0.2 a | <0.01 |
| *n*-3:*n*-6 | 2.1 ± 0.0 a | 1.4 ± 0.0 b | 1.0 ± 0.0 c | 0.7 ± 0.0 d | <0.01 |
| Crude lipid (g kg$^{-1}$, DM basis) | 11.8 ± 0.8 | 10.8 ± 0.8 | 10.2 ± 0.8 | 11.5 ± 0.8 | 0.55 |

FO, fish oil.

Trushenski et al (2011a)

# Substituição de farinha de peixe por soja em bijupirá

TABLE 2. *Final production performance and fillet composition by dietary treatment.*[1]

| Parameter | Dietary treatment | | | | |
|---|---|---|---|---|---|
| | 100% FM control | 50% FM | 50% FM + attractant | 0% FM | 0% FM + attractant |
| Production performance | | | | | |
| Survival (%) | 100.0 ± 1.5 | 96.7 ± 1.5 | 100.0 ± 1.5 | 100.0 ± 1.5 | 100.0 ± 1.5 |
| Final individual weight (g) | 167.5 ± 2.6[a] | 157.3 ± 2.6[a] | 163.3 ± 2.6[a] | 93.2 ± 2.6[b] | 101.3 ± 1.6[b] |
| Weight gain (%) | 172.0 ± 4.1[a] | 154.7 ± 4.1[a] | 158.3 ± 4.1[a] | 47.7 ± 4.1[b] | 65.7 ± 4.1[b] |
| SGR (% BW/day) | 2.39 ± 0.04[a] | 2.23 ± 0.04[a] | 2.26 ± 0.04[a] | 0.93 ± 0.04[b] | 1.20 ± 0.04[b] |
| Total consumption (g/fish) | 147.3 ± 3.2[a] | 134.3 ± 3.2[a] | 138.3 ± 3.2[a] | 99.3 ± 3.2[b] | 105.1 ± 3.2[b] |
| Feed intake (% BW/day) | 3.45 ± 0.07 | 3.25 ± 0.07 | 3.24 ± 0.07 | 3.08 ± 0.07 | 3.18 ± 0.07 |
| FCR | 1.39 ± 0.07[c] | 1.40 ± 0.07[c] | 1.38 ± 0.07[c] | 3.30 ± 0.07[a] | 2.64 ± 0.07[b] |
| Dress-out (%) | 34.5 ± 0.8 | 34.4 ± 0.8 | 34.6 ± 0.8 | 30.1 ± 0.8 | 33.5 ± 0.8 |
| HSI | 2.4 ± 0.1 | 2.6 ± 0.1 | 2.3 ± 0.1 | 2.2 ± 0.1 | 2.2 ± 0.1 |

Trushenski et al (2011b)

# Objetivo final: Despesca RAS

# Peixe fresco

# DEGUSTAÇÃO

# LAQUA16

"Innovative Aquaculture under Environmental Challenges"

Lima, Peru

November 28 - December 1, 2016

# AGRADECIMENTOS


- ✓ MCTI - CNPq
- ✓ MPA
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ESTUDANTES