Reproductive cycle of wreckfish *Polyprion americanus* in captivity

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Wreckfish reproduction (2013)

- Poor knowledge available on the process of gametogenesis, either in wild or captivity
- Spawning rare and limited egg production with strip-spawning (*in vitro* fertilization)

Description of the reproductive cycle
- Recognize possible reproductive dysfunctions
- Establish broodstock management procedures
- Implement spawning induction protocols
Wreckfish broodstocks
### Wreckfish broodstocks

<table>
<thead>
<tr>
<th>Broodstocks</th>
<th>IEO</th>
<th>CMRM</th>
<th>MC2</th>
<th>HCMR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of fish</td>
<td>13</td>
<td>21</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>Females</td>
<td>10</td>
<td>12</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Males</td>
<td>3</td>
<td>9</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Tank</td>
<td>110 m³</td>
<td>35 m³</td>
<td>180 m³</td>
<td>15 m³</td>
</tr>
<tr>
<td>Photoperiod</td>
<td>Natural</td>
<td>Simulated natural</td>
<td>Natural</td>
<td>Simulated natural</td>
</tr>
<tr>
<td>Temperature</td>
<td>Natural</td>
<td>Natural</td>
<td>Natural</td>
<td>16° C</td>
</tr>
</tbody>
</table>
Wreckfish broodstocks - temperature

The graph shows the temperature (°C) for different months from January to December for the years 2015 and 2016. The data is categorized by broodstock enterprises: IEO, AF, CMRM, and HCMR.
Biopsy collection

- Bimonthly from August until January
- Monthly from February until July

Sperm collection

Blood collection

Histological analysis

Sperm evaluation

Sex steroid hormones
Reproductive cycle – max oocyte diameters

Oocyte diameter (μm)

Month

2015

2016

January
February
March
April
May
June
July
August
September
October
November
December

HCMR
IEO, MC2 and CMRM

*
Reproductive cycle – oogenesis

Ld-lipid droplets
eVg-early vitellogenesis
aVg-advanced vitellogenesis
lVg-late vitellogenesis
eOM-early oocyte maturation
FOM-final stages of OM
OV-ovulation

Vitellogenesis in Winter
Maturation in Spring
Vg oocytes 1400 µm
Eggs 2000 µm
Reproductive cycle – oogenesis

po-primary oocytes
c-a-cortical alveoli
Ld-lipid droplets
eVg-early vitellogenesis
aVg-advanced vitellogenesis
lVg-late vitellogenesis
eOM-early oocyte maturation
FOM-final stages of OM
OV-ovulation

Vitellogenesis in Winter
Maturation in Spring
Vg oocytes 1400 μm
Eggs 2000 μm
Reproductive cycle – oogenesis

- 19% of the females with arrested oocyte development at the cortical alveoli stage (350 µm)

- 65% of the females with complete vitellogenesis, but no maturation (~1200 µm)

- 16% of the females spawned spontaneously (2000 µm)
Estradiol high during vitellogenesis
Testosterone peaked at maturation
17α,20β-DHP low and unchanged (irrelevant as MIS?)
Sperm was produced almost all year
Sperm quality

Sperm motility (%)

Duration of motility (min)

Month

2015

2016
Sperm quality

Szoa density
(x10⁹ ml⁻¹)

Sperm survival
(days)

Month
Sperm quality - summary

- sperm density between $4.5 - 11.5 \times 10^9$ szoa ml$^{-1}$
- sperm motility always >$60\%$
- motility duration 1.5 - 6 min
- survival of sperm at (4°C) for 3 - 10 days
Testosterone and 11-ketotestosterone increased with increased sperm production.

- **Males**
  - Testosterone (ng/ml)
  - 11-ketotestosterone (ng/ml)

  ![Bar chart showing changes in testosterone and 11-ketotestosterone levels across different conditions.]

- **Key Points**
  - **17,20β-DHP variable (1-2.5 ng/ml) and unchanged**
  - No sperm → Fluent male
  - No sperm → Fluent male

- **Legend**
  - a, b, c

- **Graphical Note**
  - Testosterone and 11-ketotestosterone increased with increased sperm production.
Relative fecundity (eggs kg female$^{-1}$)

**Fertilization (%)**

**Year**
- 2015
- 2016

**Month**
- March
- April
- May
- June
- July

**Graphs**
- 2015:
  - Fertilization (%)
  - Relative fecundity (eggs kg female$^{-1}$)
- 2016:
  - Fertilization (%)
  - Relative fecundity (eggs kg female$^{-1}$)
Better spawning and egg quality over time (2017-2018)
Reproductive cycle in captivity – Females

1. Undergo gametogenesis, but maturation and egg production may take some years to reach adequate levels
2. Reproduction under fluctuating or constant low temperature
3. Plasma T and E$_2$ followed the proper fluctuations during oogenesis, but 17,20$\beta$-DHP was not correlated to reproductive stage (not the MIS?, sample timing?)

Better understanding of the required environmental conditions, to ensure that more fish complete gametogenesis and mature/spawn.
Reproductive cycle in captivity – Males

1. Produce sperm all-year round (natural or captivity-induced?)
2. Plasma T and 11-KT followed the proper fluctuations during spermatogenesis, but 17,20β-DHP was not correlated to reproductive stage (not the MIS?)
3. Sperm was of good quantity and quality

Sperm availability and quality is not limiting to reproduction in captivity, but breeding behavior may not be fully expressed. More focus on environmental requirements for successful spawning
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