Extensive fish culture in earthen ponds (Esteros)

Partner 3: Group ICMAN-CSIC

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Cádiz
Group ICMAN – CSIC. WP 3.6

Participants: Partner 3 (ICMAN- CSIC)

Inst. Ciencias Marinas de Andalucía + Salina Ntra. Sra. Desamparados
Main tasks: WP 3.6 extensive polyculture

Also Involved in:

WP 1. National reviews
WP 3.2. Semi-intensive polyculture
WP 3.4. Eel extensive on-growing
WP 4. Product quality
WP 5. Certification
Objective:

The main objective is to valuate the integral possibilities of extensive fish culture areas, by comparing the production between ponds that have been working for many years and recent restored areas.
Landscape of marshes and saltponds
Swallowed by the ocean

Swallowed by the cities and industry

Emptied and dried

Fate of abandoned saltworks
- Tasks description

- Ponds characteristics

Project SEACASE – WP 3.6
 Experimental approach
Project SEACASE – WP 3.6
Experimental approach

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Experimental approach: New ponds
Task description:

1) Assessment of fish production at the end of the production cycle in each zone and condition.

2) Assessment of production additional high price products (crustaceans and eels).

3) Assessment of plankton and benthos during the annual on-growing cycle.

4) The influence of the bottom maturation time on benthos population.
Task description:

- **Determinations**

1) Physical parameter: Salinity, temp., pH,
2) Chemical Parameters: ammonia, nitrate, nitrite, phosphate, silicate
3) Biological Parameters:
   - Suspended organic matter
   - Microalgae: chlorophyll a;
   - Zooplankton: main groups; dominant species; total biomass (dry weight)
   - Benthos: main groups; dominant species; total biomass (dry weight)
   - Fish: size, weight, population estimation, final production
Traditional salt-pond management

Winter pond

- monks closed
- monks closed

JAN | JUN | DEC-JAN | JUN | DEC-JAN

Salt recollection
Fishing

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Sampling schedule

New pond → pond-monks closed → Old ponds → pond-monks closed

Fishing

6 12 18 24 months

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sampling
Results: More common species
WP 3.6 Salina Ntra. Sra. De los Desamparados

Annelida
  Polychaeta: *Nereis diversicolor*, *Capitella capitata*, *Oriopsis metchnikowi*
  Oligochaeta:

Nematoda

Mollusca
  Bivalvia: *Cerastoderma glaucum*, *Abra alba*
  Gasteropoda: *Hydrobia minorecensis*, *H. ulvae*, *H. ventrosa*,
  Sacoglossidae: *Limapontia depres*, *Calliopea bellulus*

Crustacea
  Amphipoda: *Microdeutopus sp.*, *Corophium sp.*, *Gammarus sp.*

Insecta: *Chironomus salinarius*
Benthos in Puerto Real

Pond 1 (small)

Pond 2 (large)

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Benthos in Puerto Real

Pond 3 (new)

Pond filled
Benthic Biomass in ponds

Biomass (dry weight)

Month
g m\(^{-2}\)

May Jul Sep Nov Mar May Jul Sep Nov Jan

Page dimensions: 595.0x842.0

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Benthos in Olhão

Pond 13

Pond 14

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Benthos in Portimão

Pond 5

- Anelida
- Mollusca
- Crustacea
- Insecta

Month

0707-0807-0907-1007-1107-1207-0108-0208-0308-0408-0508-0608-0708-0808-0908-1008-1108

Ind/m²

0 20000 40000 60000 80000 100000 120000

Pond-11

- Anelida
- Mollusca
- Crustacea
- Insecta

Month

0707-0807-0907-1007-1107-1207-0108-0208-0308-0408-0508-0608-0708-0808-0908-1008-1108

Ind/m²

0 20000 40000 60000 80000 100000 120000

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Nutrients and chlorophyll a in Puerto Real

![Graphs showing nutrient levels over time]

- **Silicate**
  - Pond 1
  - Pond 2
  - Pond 3
  - Outlet Channel

- **Phosphate**
- **Chlorophyll a**
  - Pond 1 Monk
  - Pond 1 Inside
  - Pond 2 Monk
  - Pond 2 Monk B
  - Pond 2 Inside
  - Pond 3 Monk
  - Pond 3 Inside

**Graph Details:**
- X-axis: Months from Jun-07 to Dec-08
- Y-axis: Values in µmol/L for Silicate and µg/L for Phosphate and Chlorophyll a

**Legend:**
- Pond 1
- Pond 2
- Pond 3
- Outlet Channel
- Pond 1 Monk
- Pond 1 Inside
- Pond 2 Monk
- Pond 2 Monk B
- Pond 2 Inside
- Pond 3 Monk
- Pond 3 Inside

**Analysis:**
- Silicate and phosphate levels vary seasonally, with peaks and troughs indicating nutrient availability.
- Chlorophyll a shows significant variation, particularly in Pond 2 Monk and Pond 3 Monk, suggesting algal activity.

**Conclusion:**
Understanding nutrient dynamics is crucial for managing aquatic ecosystems effectively.
BENTHIC MACROFAUNA COMMUNITIES IN COASTAL EARThern PONDS USED FOR FISH FARMING IN THE SOUTH ATLANTIC COAST OF THE IBERIAN PENINSULA

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* Instituto de Ciencias Marinas de Andalucía (CSIC), 11510 Puerto Real, Cádiz, Spain

INTRODUCTION
Macrobenthic communities inhabiting the sediment of coastal fish-farming earthen ponds have been studied for many years in coastal areas of the Gulf of Cádiz (SW Iberian Peninsula), one of the most important areas in terms of biodiversity and productivity. The aim of the present study is to assess the macrobenthic community structure and biodiversity of the sediment of earthen ponds used for fish farming in the South Atlantic Coast of the Iberian Peninsula.

RESULTS
A total of 10 different species were found in the three ponds. Polychaetes, nematodes, echinoderms, mollusks, and crustaceans dominated the macrobenthic community in terms of abundance and biomass. The analysis of the diversity of macrofauna showed significant differences between the three ponds. The highest diversity was found in Pond 1, followed by Pond 2, and finally by Pond 3. The diversity of macrofauna was statistically different between the three ponds.

REFERENCES
[Arias et al. (2010)]

PLANKTON AND PHYSICO-CHEMICAL CHARACTERISTICS IN EARThERN PONDS USED FOR TRADITIONAL EXTENSIVE FISH FARMING IN THE BAY OF CÁDIZ (SPAIN). COMPARISON BETWEEN OLD AND RECENT BUILT PONDS

M. Yúfera*, D. Quintana, A. M. Arias
* Instituto de Ciencias Marinas de Andalucía (CSIC), 11510 Puerto Real, Cádiz, Spain

INTRODUCTION
Many recent works have highlighted the importance of plankton in the aquatic environment, as it plays a key role in the cycling of nutrients and energy. The plankton community in earthen ponds has not been extensively studied. The main objective of this study was to analyze the plankton community and its physico-chemical characteristics in earthen ponds used for fish farming in the Bay of Cádiz (SW Iberian Peninsula). The study aimed to compare the plankton community and its physico-chemical characteristics in earthen ponds used for fish farming in the Bay of Cádiz.

RESULTS
The plankton community in the ponds showed a high diversity of species. The highest diversity was found in Pond 1, followed by Pond 2, and finally by Pond 3. The diversity of plankton was statistically different between the three ponds. The physico-chemical characteristics of the ponds showed significant differences, with Pond 1 having the highest values, followed by Pond 2, and finally by Pond 3. The differences in the physico-chemical characteristics were statistically significant.

REFERENCES
[Quintana et al. (2010)]
Fishing results: Salina Ntra. Sra. Desamparados
Season 2007 & 2008

Total Weight Fished (Kg)

- Fundulus heteroclitus
- Halobatrachus didactylus
- Symphodus quinquemaculatus
- Engraulis encrasicolus
- Sardina pilchardus
- Pomatoschistus microps
- Gobius paganellus
- Sarpa salpa
- Spondylosoma cantharus
- Diplodus vulgaris
- Diplodus annularis
- Atherina boyeri
- Diplodus sargus sargus
- Liza saliens
- Liza aurata
- Liza ramada
- Chelon labrosus
- Chelon labrosus-
- Mugil cephalus
- Dicentrarchus punctatus
- Dicentrarchus labrax
- Solea senegalensis
- Anguilla anguilla
- Sparus aurata
- Sparus aurata-

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Fish Mean Weight

<table>
<thead>
<tr>
<th>Fish</th>
<th>Mean Weight per Fish (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sparus aurata</td>
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<tr>
<td>Anguilla anguilla</td>
<td></td>
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<tr>
<td>Solea senegalensis</td>
<td></td>
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<tr>
<td>Dicentrarchus labrax</td>
<td></td>
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<tr>
<td>Mugil cephalus</td>
<td></td>
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<tr>
<td>Fundulus heteroclitus</td>
<td></td>
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<tr>
<td>Pomatoschistus microps</td>
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<tr>
<td>Spondyliosoma cantharus</td>
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</tr>
</tbody>
</table>

Pond 1 (small)  Pond 2 (large)

**Total Weight**

- MOLLUSCA
- Sepia officinalis
- CRUSTACEANS
- Melicertus kerathurus
- Carcinus maenas
- Palaemonetes varians
- Palaemon serratus

**Mean Weight per Animal (g)**

- MOLLUSCA
- Sepia officinalis
- CRUSTACEANS
- Melicertus kerathurus
- Carcinus maenas
- Palaemonetes varians
- Palaemon serratus

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Total Weight Fished

- Fundulus heteroclitus
- Halobatrachus didactylus
- Symphodus quinquemaculatus
- Syngnathus acus
- Engraulis encrasicolus
- Sardina pilchardus
- Pomatoschistus microps
- Gobius paganellus
- Sarpa salpa
- Spondylosoma cantharus
- Diplodus vulgaris
- Diplodus annularis
- Atherina boyeri
- Diplodus sargus sargus
- Liza saliens
- Liza aurata
- Liza ramada
- Chelon labrosus
- Chelon labrosus
- Mugil cephalus
- Dicentrarchus punctatus
- Dicentrarchus labrax
- Solea senegalensis
- Anguilla anguilla
- Sparus aurata
- Sparus aurata

Total Weight Fished (Kg)

- Pond 1 (small)
- Pond 2 (large)
- MW Pond 3 (new)

3400

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<table>
<thead>
<tr>
<th>Fish</th>
<th>Mean Weight per Fish (g)</th>
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<tr>
<td>Sparus aurata</td>
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</tr>
</tbody>
</table>

Legend:
- Pond 1 (small)
- Pond 2 (large)
- Pond 3 (new)

**Total Weight**

- Carcinus maenas
- Palaemonetes varians
- Palaemon serratus

**Mean Weight**

- Carcinus maenas
- Palaemonetes varians
- Palaemon serratus

 MWpond2 large
 TWpond2 large
 TWpond 3 new

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### Fishing results: Salina Ntra. Sra. Desamparados 2007

<table>
<thead>
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<th></th>
<th>pond 1</th>
<th>pond 2</th>
<th>total</th>
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<tbody>
<tr>
<td>fish</td>
<td>2994.69</td>
<td>3746.22</td>
<td>6740.91</td>
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<tr>
<td>crustaceans</td>
<td>241.96</td>
<td>349.38</td>
<td>591.34</td>
</tr>
<tr>
<td>Molluscs</td>
<td>0.2</td>
<td>3.74</td>
<td>3.94</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3236.85</strong></td>
<td><strong>4095.79</strong></td>
<td><strong>7332.64</strong></td>
</tr>
<tr>
<td>Water surface</td>
<td>7.74</td>
<td>18.76</td>
<td>4.69</td>
</tr>
<tr>
<td>Production Kg/ha</td>
<td><strong>418.20</strong></td>
<td><strong>218.33</strong></td>
<td><strong>276.70</strong></td>
</tr>
</tbody>
</table>

Considering just water surface area
### Fishing results: Salina Ntra. Sra. Desamparados 2008

<table>
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<tr>
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<th>Estero 1</th>
<th>Estero 2</th>
<th>Estero 3</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>9.68 ha</td>
<td>26.8 ha</td>
<td>Availab. 6.7 ha</td>
<td></td>
</tr>
<tr>
<td><strong>fish</strong></td>
<td>2691.20</td>
<td>5722.80</td>
<td>1422.50</td>
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<tr>
<td><strong>crustaceans</strong></td>
<td>165.99</td>
<td>373.40</td>
<td>78.96</td>
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<tr>
<td><strong>molluscs</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Total</strong></td>
<td>2857.19</td>
<td>6096.20</td>
<td>1501.46</td>
<td>10454.85</td>
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<tr>
<td><strong>Water surface</strong></td>
<td>7.74</td>
<td>18.76</td>
<td>4.69</td>
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</tr>
<tr>
<td><strong>Production Kg/ha</strong></td>
<td>369.15</td>
<td>324.96</td>
<td>320.14</td>
<td>335.19</td>
</tr>
</tbody>
</table>

Considering just water surface area
Conclusions

- The benthos communities colonize quickly the sediment of new ponds
- Production in recent restored/built ponds is comparable to that observed in old ponds though species composition may be different
- Recovering ancient abandoned areas for extensive culture is feasible from the biological point of view
- Inter annual fluctuations in environmental and biological parameters are common
- Mortality episodes due to environmental conditions – as well as to predation by ichthyophagous birds.
Thank you

ACKNOWLEDGEMENTS
Salina Los Desamparados – J.M. Jiménez Derqui
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