Applied policy in the Mediterranean lagoons

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Main characteristics in lagoons

• An intermediate zone between land and sea
• Area of mixed fresh and salt water
• Shallow depths, sandy or muddy substrate, rich of organic residuals
• Area linked to the nearest estuary and in relation with the local sea currents
• Area strictly related to the surrounding coastal zone
Vegetation and fauna in relation with water salinity and substratum

Fish fauna depending on predominant salinity and temperature
Conflicts in coastal lagoon areas

Conflicts related to land use
• Demand of land for constructions (vacation houses)
• Demand of land for agriculture (plantations in sandy coastal areas)
• Demand of areas for public infrastructures (sport camps, industrial areas)

Conflicts related to water availability
• Decreasing quantities of freshwater resources

Main tendencies according to the regional policies
• Lagoons as water extensions suitable for aquaculture
• Existence of active cooperatives for extensive fish farming
• Lack of clear legislation for the surrounding areas
Main problems in lagoons
Fish production in lagoons

- 10% of the Mediterranean fish production
- 2% of the Greek fish production
- High variability of mean production (400 Kg/hectare-10 Kg/hectare)
- Diversification of production in the last 20 years

Fluctuation of fish production

- Water quality {mixture of marine and freshwater}
  Salinity \(16\% \text{ - } 38\%\)
- Water temperature \(0\text{°} - 26\text{°C}\)
- Exchange of water between lagoons and the sea
- Oxygen concentration is a limiting factor in very shallow areas and during the summer
High productivity

• Fast recycling of nutrients from substratum to bacteria
• High coefficient of nutrient utilization due to the narrow depth
• Abundant food availability in all levels of food chain
• Abundant biomass of few resistant species

Fish populations

• Mostly migratory species, showing a periodical migration pattern to the lagoon
• Euryhaline species living in waters whose salinity fluctuates periodically
• Eurythermal species supporting large oscillation in temperature
Fish populations

- Permanent inhabitants
  - 1-2 species Labridae, 1 Blennidae, 3-4 Sygnathidae, 3-4 Gobiidae, 1 Atherinidae
- Immigrants – Periodical and opportunistic immigrants
  - Periodical {sea bream, sea bass, grey mullets, eels, flatfishes}
  - Opportunistic {red mullets, stripped sea bream, piper gurnards, }

Fish population structure

- According to the depth and the surface of water
- In shallow lagoons mostly fish ageing 0+, 1+ (eels and grey mullets)
- In deeper or extended lagoons, fish ageing 0+, 1+, 2+, 3+. More productive areas, where is possible to utilize all food resources.
Fish biological cycle

Fish cycles in lagoons
Biological cycles

• Cycle of Potamoschistus marmoratus
• Larvae and young fish 0+, enter from the sea (autumn). After 10-11 months (late spring-summer) they return for reproduction in the sea and then mostly die. Eggs and larvae enter with high tide currents inside the lagoons.

Biological cycles

• Cycle of Sparus aurata (sea bream)
• Young fish 0+ enter in the lagoon at the end of winter (February)
• Feeding inside the lagoon for 8-10 months (March-October)
• Migration toward the sea in autumn (October-November)
• Reproduction in the sea and feeding for 2-4 months (December, January-February)
• Return to the lagoons for another year
Biological cycles

- Cycle of *Anguilla anguilla* (eel)
- May-June young transparent eels enter in the lagoon
- Feeding inside the lagoons for 4-8 years depending on their sex
- Massive migration to the sea in late autumn or winter
- Spawning in the sea and massive dead

Migration of species

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>In</th>
<th>Out</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>M. cephalus</em></td>
<td>Grey mullet</td>
<td>Autumn</td>
<td>Summer</td>
</tr>
<tr>
<td><em>M. saliens</em></td>
<td>Grey mullet</td>
<td>Autumn</td>
<td>Summer</td>
</tr>
<tr>
<td><em>M. auratus</em></td>
<td>Grey mullet</td>
<td>Spring</td>
<td>Autumn</td>
</tr>
<tr>
<td><em>L. ramada</em></td>
<td>Grey mullet</td>
<td>Spring</td>
<td>Autumn</td>
</tr>
<tr>
<td><em>S. solea</em></td>
<td>sole</td>
<td>Spring</td>
<td>Autumn</td>
</tr>
<tr>
<td><em>S. auratus</em></td>
<td>Sea bream</td>
<td>Spring</td>
<td>Autumn</td>
</tr>
<tr>
<td><em>D. labrax</em></td>
<td>Sea bass</td>
<td>Spring</td>
<td><strong>All the year</strong></td>
</tr>
<tr>
<td><em>D. sargus</em></td>
<td>White Sea Bream</td>
<td>Spring</td>
<td>Autumn</td>
</tr>
<tr>
<td><em>A. anguilla</em></td>
<td>Eel</td>
<td>Spring</td>
<td>Autumn</td>
</tr>
</tbody>
</table>
Fishing

Fishing
Fish Management

• Fish is an essential part of the brackish water ecosystem (preys and predators)
• Fish is an index of water quality
• Fish can reduce eutrophication
• Fish are the main prey for many bird species
• Wild fish is the main resource for extensive aquaculture
• Fishery is necessary for the maintenance of the local traditional cooperatives

Management of fish populations

• Knowledge of the period and intensity of migration
• Possibility to manage water salinity, adding fresh or saline water in the lagoon
• Control of the communicating canal
• Successful migration of fry or adults
Management of fish populations

- Protection of spawning grounds in the nearest coastal zone
- Improvement of water circulation especially during the entrance or the exit of fish
- Monitoring of the abundance of fish populations
- Reduce fishing of undersized or young fish
- Avoidance of genetic contamination

Human capital
Human capital

• Traditional fishery is important for the conservation of coastal lagoons
• In extensive aquaculture, fishermen control water circulation, remote areas for illegal fishing and illegal hunting
• At long term the conservation in these areas depends on the presence of local fishermen cooperatives

Relation of extensive aquaculture and nature conservation

• Birds prey on fish populations, usually species of commercial value
• Fish enter only in open lagoons
• Traditional fishery must be directed toward mature fish and could be complementary with bird predation
Fishing cooperatives

- Training of cooperative members and sensitization in nature conservation
- Exploitation of traditional products as fish roe, processed fish fillets
- Certification of products and creation of quality labels

Thank you for your attention