Exploratory assessments of small pelagics off Canary Islands using data-limited methods

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Artisanal fisheries in Canary Islands

- Multi-gear, multi-species, polyvalent and opportunistic artisanal fleet (>600 vessels)
- Small pelagic fishing is carried out by purse seiners (25-30 vessels)
- 4 main target species: *S. colias, T. picturatus, S. aurita, S. pilchardus* – each considered a single stock.

**Target species**

- Chub mackerel, *Scomber colias*
- Round sardinella, *Sardinella aurita*
- Horse mackerel, *Trachurus picturatus*
- Sardine, *Sardina pilchardus*
**Data-limited approaches:** variety of situations, characterized by “poor” data and/or Knowledge

→ often rely on strong assumptions (e.g. “equilibrium” -constant recruitment and constant M and F over a period of years... or likely productivity or depletion level)

→ expert judgment needed to determine if assumptions are “adequate” and to interpret results appropriately
## Assessment: data-limited approaches

<table>
<thead>
<tr>
<th><strong>Length – based methods</strong></th>
<th><strong>Data needed</strong></th>
<th><strong>Output</strong></th>
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</table>
| LBI                       | • Catch@length in numbers  
• Biological parameters | **Range of indicators** and their expected values when exploitation is consistent with sustainability objectives |
| LB-SPR                    |                   | Estimates **F/M** and **SPR/SPR0** |
| LCA+YR                    |                   | Estimates **Fcur, Fmax, F0.1** |

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| BioDyn                       | • Time series of catch and biomass indices  
• Initial values of $r$, $K$ and $B/K$ | Estimates **BMSY, FMSY, B0.1, F0.1** |
| CMSY                        | • Time series of catch  
• Prior ranges of $r$ and $B/K$ | **FMSY** and **BMSY** (estimated internally, as model parameters) + CI  
**Time series of $F/FMSY$ and $B/BMSY$ + CI** |
| JABBA                       | • Time series of catch and biomass indices  
• Prior ranges of $r$ and $B_0/K$ |          |
| SPICT                       | • Time series of catch and biomass indices or effort  
(trial configurations failed to converge) |          |
• Landings in the Canary Islands for the period 2013-2021.
• Proxy of abundance index: LPUE (tons/fishing days of the fleet) in the period 2013-2021.

• Length frequencies of the landings. Availability in the period 2013-2021 differed among species.
• Life-history parameters.
Results (I): Length-based methods

<table>
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<tr>
<th>Year</th>
<th>$L_c / L_{mat}$</th>
<th>$L_{25%} / L_{rat}$</th>
<th>$L_{max} / L_{inf}$</th>
<th>$P_{opt}$</th>
<th>$L_{mean} / L_{opt}$</th>
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</thead>
<tbody>
<tr>
<td>2013</td>
<td>0.92</td>
<td>1.13</td>
<td>0.64</td>
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<td>2014</td>
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**LBI**
- $L_c$ generally above $L_{mat}$: opportunity to spawn prior to entry to the fishery
- Indication of depletion of large animals
- $L_{mean}$ far from $L_{F=M}$: fishery is operating with a target length that is not sustainable

**LB-SPR**
- SPR has been well below the range of 30–40% (sustainable) for the entire time series

**YR**
- $F_{cur}$ exceeds $F_{max}$
Results (II): Production models

CMSY
• Prior ranges of depletion at the start of the time series had a great influence on the estimated B/BMSY and F/FMSY status.

JABBA

Biodyn
• Sensitivity to values of $r$ and $K$, reliable values for the stock unavailable
• Apparently, current $B$ exceeds BMSY
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**LBI**
- $L_c$ below $L_{mat}$: fishery operating on sizes below the length of maturity
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Results (II): Production models

CMSY
• Estimated biomass trajectory is descendent and stock status in the terminal year is below BMSY

JABBA

Biodyn
• Sensitivity to values of r and K, reliable values for the stock unavailable
• Fcur exceeds FMSY

Sardinella spp
Results (I): Length-based methods

| Year | Lc/Lmat | Lc/Lmat | Lc/Lmat | Lc/Lmat | Lc/Lmat | Lc/Lmat | Lc/Lmat | Lc/Lmat | Lc/Lmat | Lc/Lmat | Lc/Lmat | Lc/Lmat | Lc/Lmat | Lc/Lmat | Lc/Lmat | Lc/Lmat | Lc/Lmat | Lc/Lmat | Lc/Lmat | Lc/Lmat | Lc/Lmat |
|------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 2013 | 1.10    | 1.10    | 0.85    | 0.82    | 1.17    | 0.96    |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |
| 2014 | 0.97    | 1.03    | 0.92    | 0.96    | 1.15    | 1.03    |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |
| 2015 | 0.93    | 0.90    | 0.92    | 0.44    | 1.09    | 1.07    |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |
| 2016 | 0.90    | 0.80    | 0.86    | 0.35    | 1.07    | 1.01    |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |
| 2017 | 0.85    | 0.85    | 0.88    | 0.41    | 1.08    | 1.06    |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |
| 2018 | 0.77    | 0.77    | 0.60    | 0.45    | 1.04    | 1.09    |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |
| 2019 | 1.03    | 1.03    | 0.89    | 0.60    | 1.19    | 1.02    |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |
| 2020 | 1.10    | 1.10    | 0.88    | 0.95    | 1.19    | 0.97    |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |

LBI
• $L_c$ below $L_{max}$: fishery operating on sizes below the length of maturity
• No concerns regarding fishing on large individuals
• Exploitation consistent with optimum yield and FMSY proxy ($L_F=M$)

LB-SPR
• SPR has been above the range of 30–40% (sustainable) most of the years, even reaching values of unfished stock (!) for some years

YR
• Unrealistic $F_{max}$
Results (II): Production models

CMSY
- Estimated biomass trajectory is descendent and stock status in the terminal year is below BMSY

JABBA

Biodyn
- Sensitivity to values of $r$ and $K$, reliable values for the stock unavailable
- Results are very unrealistic

*Sardina pilchardus*
**Length-based approaches**

- Parameter values for \( \text{Lmat} \), growth and natural mortality may not be representative for some stocks.
- Length distribution must represent catch (rather than landings only). Only recent discard information (from 2017) is available for these stocks.
- Assumptions of equilibrium, steady-state stock and predetermined shape of selectivity curve may be violated.

**Surplus production-based approaches**

- SPiCT multiple trial assessments with different configurations failed to converge or estimate parameters.
- Short time-series and lack of contrast in data negatively affect the performance of these models.
- LPUE might not be a suitable indicator of population abundance.
- CMSY and JABBA provide opposite perception of \( S.\colias \) and \( Trachurus \) spp status.
- CMSY and BioDyn assessments are strongly dependent on good knowledge of priors of initial depletion and ‘guesstimates’ of \( r \) and \( K \).
- Since clupeids landings (mainly \( S.\ pilchardus \)) have drastically decreased during last years of the time series, BioDyn results for these species might not be realistic.

→ These exploratory assessments cannot be used in a quantitative manner to provide scientific advice in terms of catch or effort limits

→ Further work (catch data rather than landings, standardized CPUE, sensitivity analysis...) and (ideally) longer time-series is required to improve the quality of the assessments
Merci pour votre attention