

# Identifying gaps in life history traits of Southern Ocean fishes to improve ecosystem-based management

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## Rationale & study aims

- Bycatch is a global problem requiring accurate life history information to develop conservation and management strategies.
- Antarctic krill fishery operates across the Atlantic sector of the Southern Ocean catching larval, juvenile and adult fish.
- We synthesised life history information focusing on distribution, development, reproduction, age and growth to assess whether we have the basic information to understand population dynamics and latitudinal variation in life history parameters.

## Main findings

- Key life history traits (e.g. growth and reproduction) for species that are regularly caught as bycatch are missing.
- Several papers did not pass our criteria for extracting information on distribution, key developmental timings or max size meaning that published data if hard or not in an appropriate format to extract for temporal and spatial analyses which may help conservation or management decisions.
- Impact of unintentional extraction on the population of certain species will be difficult to quantify.

## Systematic literature search methods

- We used Web of Science to undertake a systematic literature search using Boolean operators to create targeted search strings for the top 20 species fish bycatch in the CCAMLR statistical areas 48.1, 48.2 and 48.3, which resulted in a total of 1442 records.
- Once all records were collated, we removed duplicates (n = 928), screened abstracts for appropriateness (n = 514), selected papers for full text analysis (n = 149) and finally included 90 papers to extract appropriate life history information from based on a series of criteria.
- Selection criteria included (1) methods written in sufficient detail to understand which CCAMLR statistical area samples were collected, (2) methods were written in sufficient detail to understand how the samples were processed, (3) data analyses were clear and appropriate, and (4) the paper was reporting primary results whereby data could be extracted from text, tables or figures.

## Summary of biological traits and life history information

- We found that 12 out of the 29 the species which appear in the top 20 bycatch species per statistical area had no published data, no extractable data from the peer reviewed publications or had published but were not sampled from the statistical areas of interest.
- 7 species had life history and biological information across our categories but not all had extractable information for each statistical area.
- Summary table of a selection of life history and biological traits synthesised from the literature or whether data was present. Bold CCAMLR statistical areas indicate that species was in the top 20 bycatch for that area. The method for growth and aging was by length different (LD) or using otoliths daily (d) or annuli (a) counts. Growth rate was calculated using a linear regression (Li), loglinear regression (LLi) or asymptotic analysis (Asy). Life history stages where data were available include larvae (L), juvenile (J) and adult (A).

| Species                              | CCAMLR area                             | Growth/ age method  | Growth rate | Adult max age | Max length (mm) | Life stages for age/ growth | Length at maturity | Fecundity | Spawning months | Egg size |
|--------------------------------------|---|---------------------|-------------|---------------|-----------------|-----------------------------|--------------------|-----------|-----------------|----------|
| <i>Anotopterus pharao</i>            | 48.1, <b>48.2</b> , 48.3                | No data             | No data     | No data       | No data         | No data                     | No data            | No data   | No data         | No data  |
| <i>Gymnodraco acuticeps</i>          | <b>48.1</b> , 48.2                      | LD                  | LLi         | No data       | No data         | No data                     | No data            | No data   | No data         | No data  |
| <i>Parachaenichthys charcoti</i>     | <b>48.1</b> , 48.2                      | Otoliths (d, a)     | Asy         | 9             | 522             | L, J, A                     | No data            | Yes       | Yes             | Yes      |
| <i>Icichthys australis</i>           | 48.2                                    | No data             | No data     | No data       | No data         | No data                     | No data            | No data   | No data         | No data  |
| <i>Chaenocephalus aceratus</i>       | <b>48.1</b> , <b>48.2</b> , <b>48.3</b> | Otoliths (a); LD    | Asy         | 17            | 760             | L, J, A                     | Yes                | Yes       | Yes             | Yes      |
| <i>Chaenodraco wilsoni</i>           | <b>48.1</b> , <b>48.2</b> , <b>48.3</b> | Otoliths (a)        | Asy         | 5             | 350             | J, A                        | Yes                | Yes       | Yes             | Yes      |
| <i>Champocephalus esox</i>           | <b>48.1</b> , <b>48.3</b>               | No data             | No data     | No data       | No data         | No data                     | No data            | No data   | No data         | No data  |
| <i>Champocephalus gunnari</i>        | <b>48.1</b> , <b>48.2</b> , <b>48.3</b> | Otoliths (d); LD    | Asy         | 15            | 515             | L, J, A                     | Yes                | Yes       | Yes             | Yes      |
| <i>Chionobathyscus dewitti</i>       | 48.1, 48.2, <b>48.3</b>                 | No data             | No data     | No data       | No data         | No data                     | No data            | No data   | No data         | No data  |
| <i>Chionodraco hamatus</i>           | <b>48.1</b> , 48.2                      | No data             | No data     | No data       | No data         | No data                     | No data            | No data   | No data         | No data  |
| <i>Chionodraco rastrospinosus</i>    | <b>48.1</b> , <b>48.2</b> , <b>48.3</b> | Otoliths (d, a)     | Li, Asy     | 12            | 490             | L, A                        | Yes                | Yes       | Yes             | Yes      |
| <i>Cryodraco antarcticus</i>         | <b>48.1</b> , <b>48.2</b> , <b>48.3</b> | Otoliths (a)        | Asy         | 18            | 665             | J, A                        | Yes                | No data   | No data         | Yes      |
| <i>Neopagetopsis ionah</i>           | <b>48.1</b> , <b>48.2</b>               | No data             | No data     | No data       | No data         | No data                     | No data            | No data   | No data         | No data  |
| <i>Pagetopsis macropterus</i>        | <b>48.1</b> , 48.2                      | No data             | No data     | No data       | No data         | No data                     | No data            | Yes       | No data         | Yes      |
| <i>Pseudochaenichthys georgianus</i> | <b>48.1</b> , <b>48.2</b> , <b>48.3</b> | Otoliths (d, a); LD | Asy         | 13            | 590             | L, J, A                     | Yes                | Yes       | Yes             | Yes      |
| <i>Paradiplospinus gracilis</i>      | <b>48.2</b> , <b>48.3</b>               | No data             | No data     | No data       | No data         | No data                     | No data            | No data   | No data         | No data  |
| <i>Muraenolepis microps</i>          | 48.2, <b>48.3</b>                       | No data             | No data     | No data       | No data         | No data                     | No data            | No data   | No data         | No data  |
| <i>Electrona antarctica</i>          | 48.1, <b>48.2</b> , <b>48.3</b>         | Otoliths (d)        | Li          | 3.6           | 103             | L, J, A                     | No data            | No data   | Yes             | Yes      |
| <i>Electrona carlsbergi</i>          | <b>48.1</b> , <b>48.2</b> , <b>48.3</b> | No data             | No data     | No data       | No data         | No data                     | No data            | No data   | No data         | No data  |
| <i>Gymnoscopelus nicholsi</i>        | <b>48.1</b> , <b>48.2</b> , <b>48.3</b> | No data             | No data     | No data       | No data         | No data                     | No data            | No data   | No data         | No data  |
| <i>Gobionotothen gibberifrons</i>    | <b>48.1</b> , <b>48.2</b> , <b>48.3</b> | Otoliths (d); LD    | Lli; Li     | No data       | 485             | L                           | Yes                | Yes       | Yes             | Yes      |
| <i>Lepidonotothen larseni</i>        | <b>48.1</b> , <b>48.2</b> , <b>48.3</b> | No data             | No data     | No data       | 235             | No data                     | Yes                | Yes       | Yes             | Yes      |
| <i>Notothenia coriiceps</i>          | 48.1, <b>48.2</b> , <b>48.3</b>         | Otoliths (a); LD    | Li          | 18            | 600             | L, J, A                     | Yes                | Yes       | Yes             | Yes      |
| <i>Notothenia rossii</i>             | <b>48.1</b> , <b>48.2</b> , <b>48.3</b> | Otoliths (a, d)     | Asy         | 24            | 670             | L, J, A                     | Yes                | Yes       | Yes             | Yes      |
| <i>Trematomus eulepidotus</i>        | <b>48.1</b> , <b>48.2</b> , <b>48.3</b> | No data             | No data     | No data       | 345             | No data                     | Yes                | Yes       | No data         | Yes      |
| <i>Trematomus loennbergii</i>        | <b>48.1</b> , 48.3                      | No data             | No data     | No data       | No data         | No data                     | No data            | No data   | No data         | No data  |
| <i>Pleuragramma antarcticum</i>      | <b>48.1</b> , <b>48.2</b> , <b>48.3</b> | Otoliths (a)        | Asy         | 12            | 245             | J, A                        | No data            | Yes       | No data         | Yes      |
| <i>Notolepis coatsi</i>              | <b>48.1</b> , <b>48.2</b> , <b>48.3</b> | Otoliths (d)        | Li          | No data       | No data         | L                           | No data            | No data   | No data         | No data  |
| <i>Melanostigma gelatinosum</i>      | 48.3                                    | No data             | No data     | No data       | No data         | No data                     | No data            | No data   | No data         | No data  |

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