Investigating fish bycatch uncertainties to improve Antarctic krill fishery management

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Introduction

Antarctic Krill (*Euphausia superba*) is actively fished in the southwest Atlantic sector of the Southern Ocean (statistical subareas 48.1-48.3). The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) currently manages the spatial efforts of the fishery; however, much uncertainty remains about the impacts of the fishery on the ichthyoplankton community despite having strict management measures in place.

Fish bycatch can often be overlooked when compared to bycatch of higher predators, while larval and juvenile fish are frequently taken as bycatch in the krill fishery. Moreover, reliable estimates of fish bycatch depend on accurate identification of the species caught, which for larval fish is notoriously difficult.

Driven by an ecosystem approach to fisheries management this project aims to develop enhanced, easy to use identification guides underpinned by integrative taxonomy analysis where morphological identification is cross-referenced with genetic identification (Mitochondrial DNA). Utilising the comprehensive biological archive at British Antarctic Survey (BAS) as well as samples collected by fishery observers between 2022 and 2024.
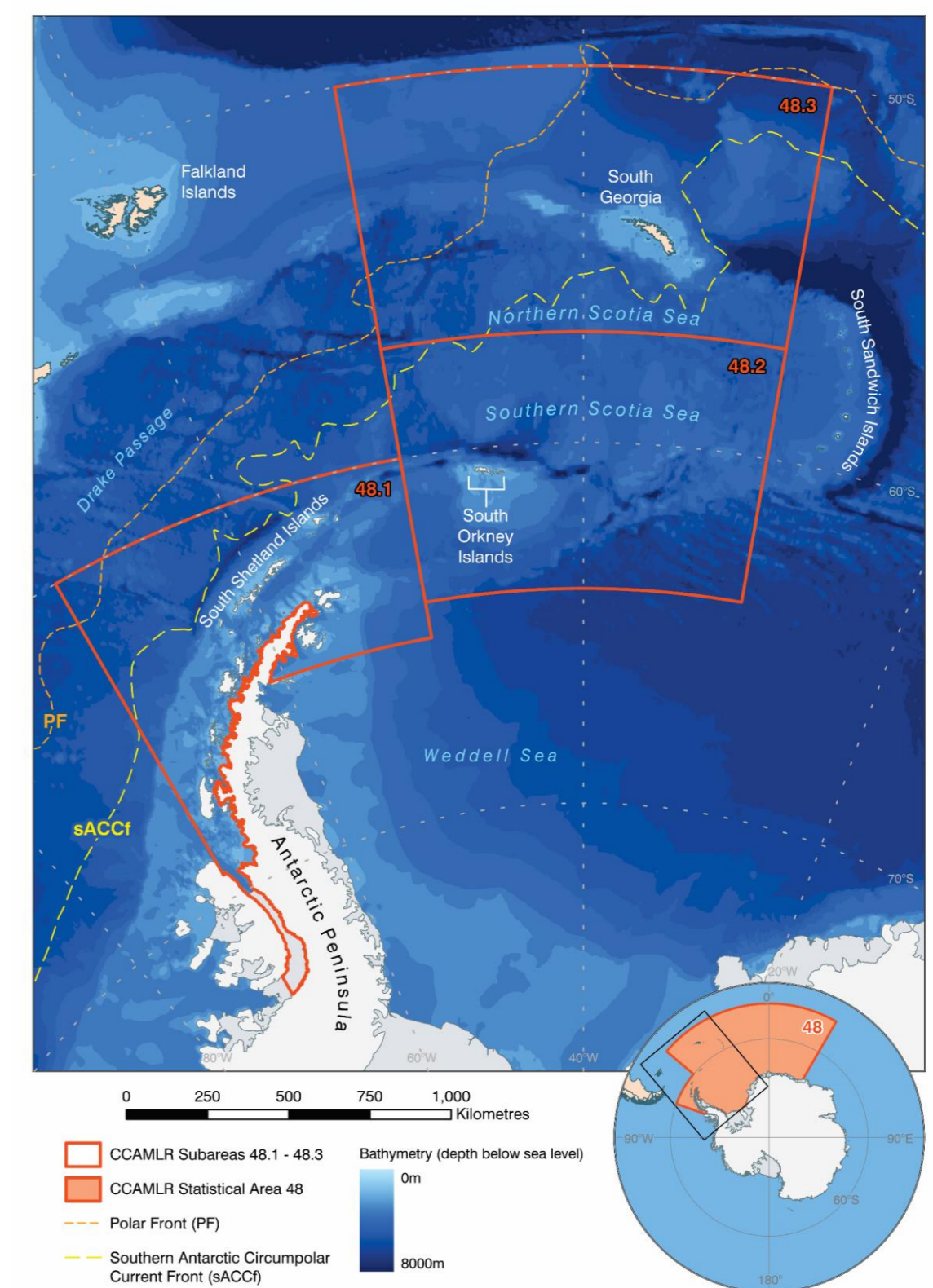

Figure 1: CCAMLR Statistical Area 48 showing statistical subareas where the krill fishery operates. Produced by the Mapping and Geographic Information Centre, © British Antarctic Survey, UK Research and Innovation, 2023.

Fish diversity uncovered by genetic identification based on mitochondrial DNA

- A total of 515 samples were targeted for genetic identification, with special focus on the top 20 most abundant bycatch fish species.
- Species-specific PCR primers aided in generating partial *cox 1* and control region sequences for 81 species in 51 genera and 23 families (Fig 2a).
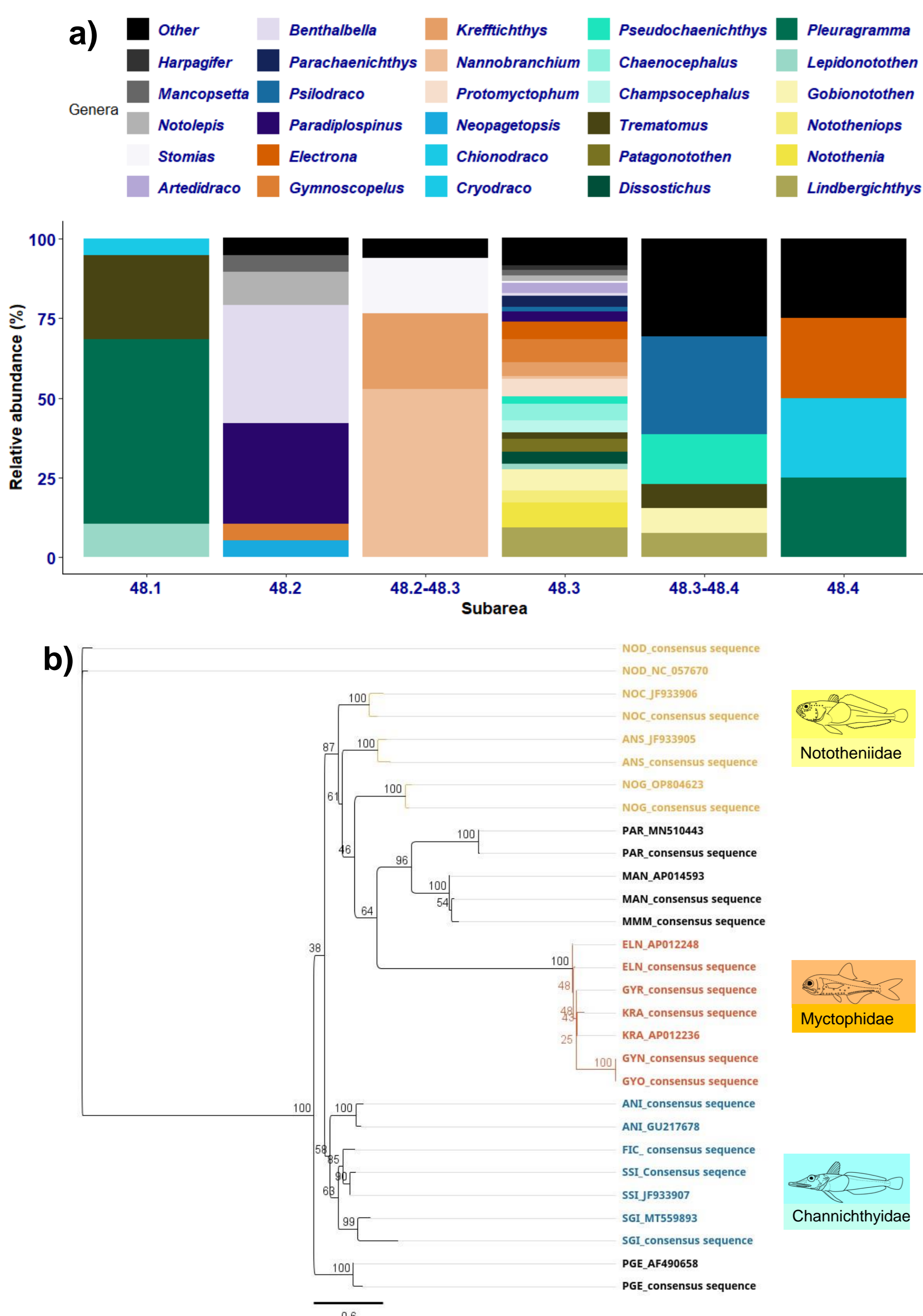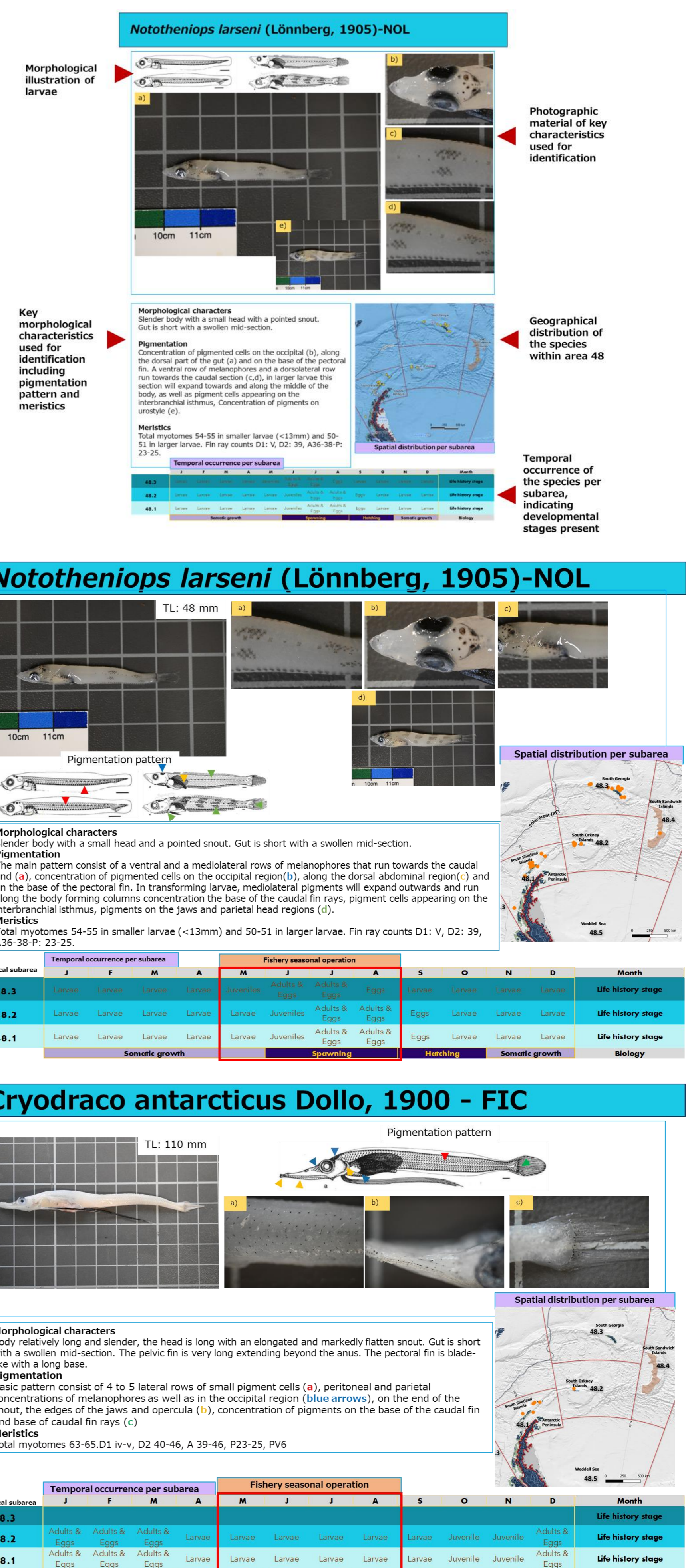- Among the most diverse families were Nototheniidae, Myctophidae and Channichthyidae.

- DNA sequences from both mitochondrial regions formed concordant species clusters that also agreed with public reference sequences, with the control region yielding the highest resolution phylogeny (Fig 2b). In the case of species that lack a reference, like in the case of myctophid species, these were grouped closer to each other or to their closes match contained within the myctophid branch.
- New sequences for *cox1* and control region will be uploaded to open-access databases to enhance public DNA references for marine species.

Improving observers' identification tools

- Larval and juvenile fish make up a large proportion of fish bycatch. Accurate identification of these stages are crucial for clear reporting.
- Identification material are sparse or lacking morphological information on several species, which decreases the taxonomic resolution when reporting.
- We are developing enhanced ID guides underpinned by genetics and supported by spatio-temporal analysis of where, when and which fish are present in area 48.

Figure 2: Diversity of fish bycatch revealed by genetic identification, showing genera present per subarea (a) and phylogenetic relationships for top 20 most abundant bycatch species in a maximum likelihood tree for control region (b), together with reference sequence (GenBank accession numbers given). NOD: *Lindbergichthys nudifrons*, NOC: *Notothenia coriiceps*, ANS: *Pleuragramma antarcticum*, NOG: *Gobionotothen gibberifrons*, PAR: *Paradiplospinus gracilis*, MAN: *Neochiropsetta milfordi*, MMM: *Mancopsetta maculata*, ELN: *Electrona antarctica*, GYR: *Gymnoscopelus braueri*, KRA: *Krefftichthys anderssoni*, GYN: *Gymnoscopelus nicholsi*, GYO: *G. opisthopterus*, ANI: *Champsocephalus gunnari*, FIC: *Cryodraco antarcticus*, SSI: *Chaenocephalus aceratus*, SGI: *Pseudochaenichthys georgianus*, PGE: *Parachaenichthys georgianus*.

Nototheniops larseni (Lönnberg, 1905)-NOL

Nototheniops larseni (Lönnberg, 1905)-NOL

Cryodraco antarcticus Dollo, 1900 - FIC

Where are we now?

- Finalising molecular identification of 2024 fishing season.
- First draft of ID guide was circulated to fishery observers to obtain valuable feedback on readability and ease of use.
- Completing the literature review on life history stages of fish bycatch.
- Spatial analysis exploring the overlap between fishery's operations and life history stages.

Concluding remarks

We present enhanced identification tools both morphological and genetic to improve the reporting on fish bycatch in support of an ecosystem-based management of the Antarctic krill fishery by CCAMLR.

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Want to know more about the project?
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