

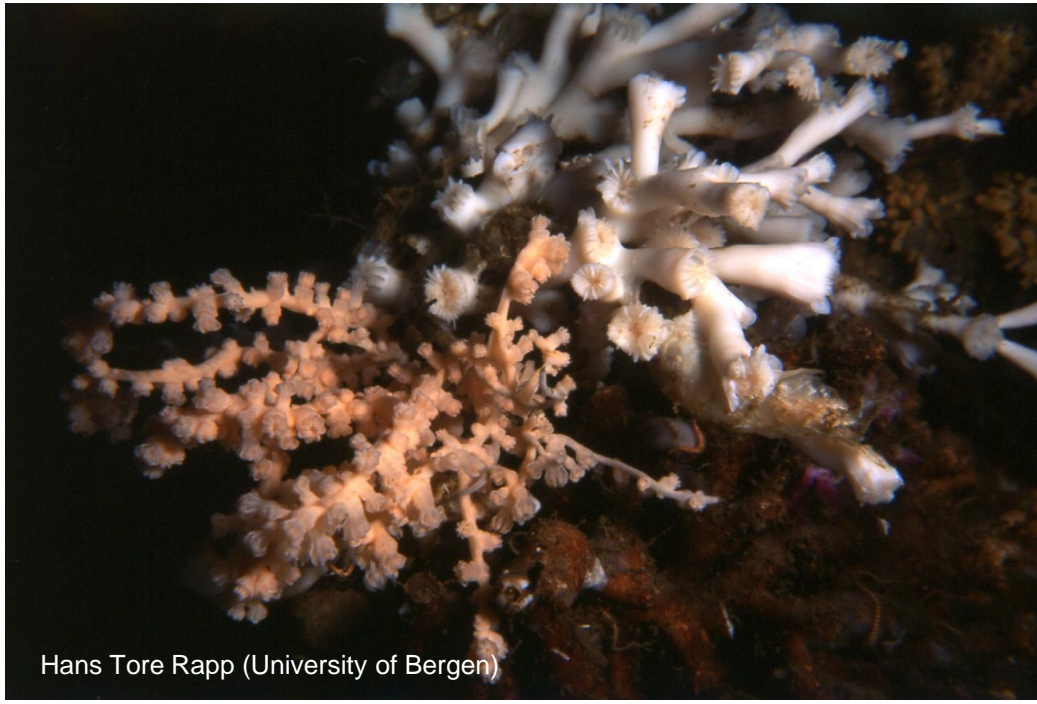
# Southern Ocean octocorals and Norwegian taxonomic riddles



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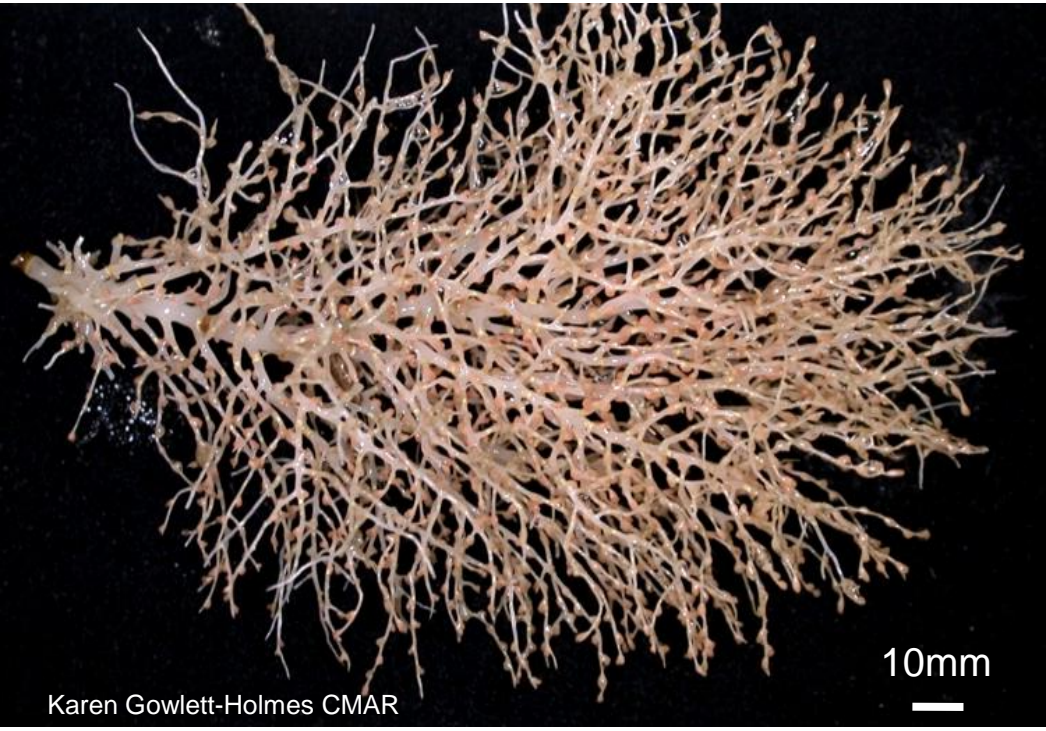
**Introduction:** Deepwater octocorals in the Southern Ocean are poorly known even though they represent one of the most diverse and abundant coral groups in these regions. Multiple surveys of seamounts around Australia by CSIRO Marine and Atmospheric Research (CMAR) collected a great unrecognised diversity of octocorals, increasing the number of species recorded from deep Australian waters from 6 to >150 (CMAR unpub. data). Due to the inadequate and outdated nature of the taxonomic literature from the area it remains impossible to confidently identify them, however a significant number have been shown to be undescribed taxa. Trawling, long-line fishing and climate change all pose significant threats to these vulnerable coral communities and there is an urgent need to increase understanding of the diversity, extent and connectivity of the populations.



New genus originally classified as *Anthothela grandiflora* – Trondheimsfjord, Norway

**Objective:** To assess the diversity, distribution and connectivity of a selection of octocoral samples collected from the Tasmanian seamounts. This involves a full taxonomic review of two genera, *Primnoisis* (Isididae) and *Anthothela* (Anthothelidae) using morphological and molecular methods and an investigation of resulting biogeographic patterns.

**Methods:** Morphological analysis, using qualitative assessment of colony form and sclerite shape and position, was used to review and describe new and existing species (Alderslade 1998). For the molecular analysis two mitochondrial gene regions (mutS and igr1-COI) were sequenced and used to generate phylogenetic trees for comparison and integration with the morphological taxonomy (McFadden *et al.* 2011). Samples were obtained from many institutions and museums (see acknowledgements).



*Primnoisis* new species – Tasmanian seamounts

## Anthothela: cryptic and confused

**Key results:** 1) *Anthothela* is a polyphyletic genus containing at least two other genera (*Victorgorgia* and a new genus) (Fig.1). Based on molecular and morphological differences, two existing *Anthothela* species have been reclassified to *Victorgorgia* along with three new species from southern Australia (e.g. Fig.2D).

2) A cryptic Norwegian genus, confused with *Anthothela grandiflora* for 100 years, was determined based both on morphological and molecular results (Fig.2C). At this stage the new genus has only been recorded in Norwegian waters.

3) Samples of *Anthothela* which are morphologically variable and geographically separated (southern Australia, Norway and USA) form a single well supported clade. (Fig.2A & Fig.2B). The two mitochondrial gene regions may not be sufficiently informative to delimit species within true *Anthothela*.

4) The new genus is morphologically like *Anthothela* yet phylogenetically closer to *Alyconium* (Fig.1). The two families, Anthothelidae and Alyconiidae, are phylogenetically intertwined with both families needing further revision.

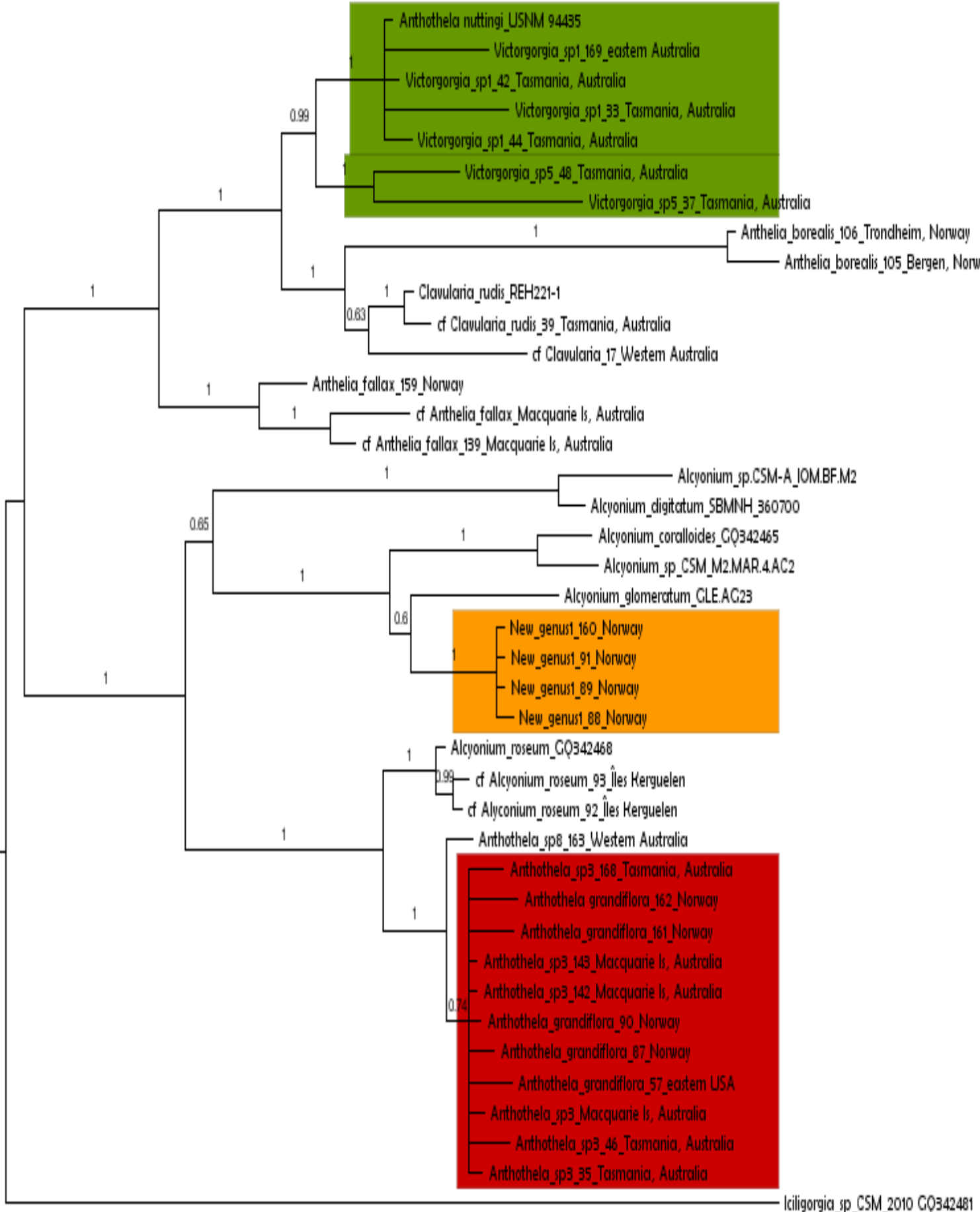


Fig. 1: Phylogenetic tree using mutS and igr-COI gene regions – concatenated 2013nt, MrBayes partitioned model (msh =K2+I, itr-COI=T93+G), 1000000 gen, average standard deviation of split frequencies <0.005, Bayesian posterior probabilities displayed

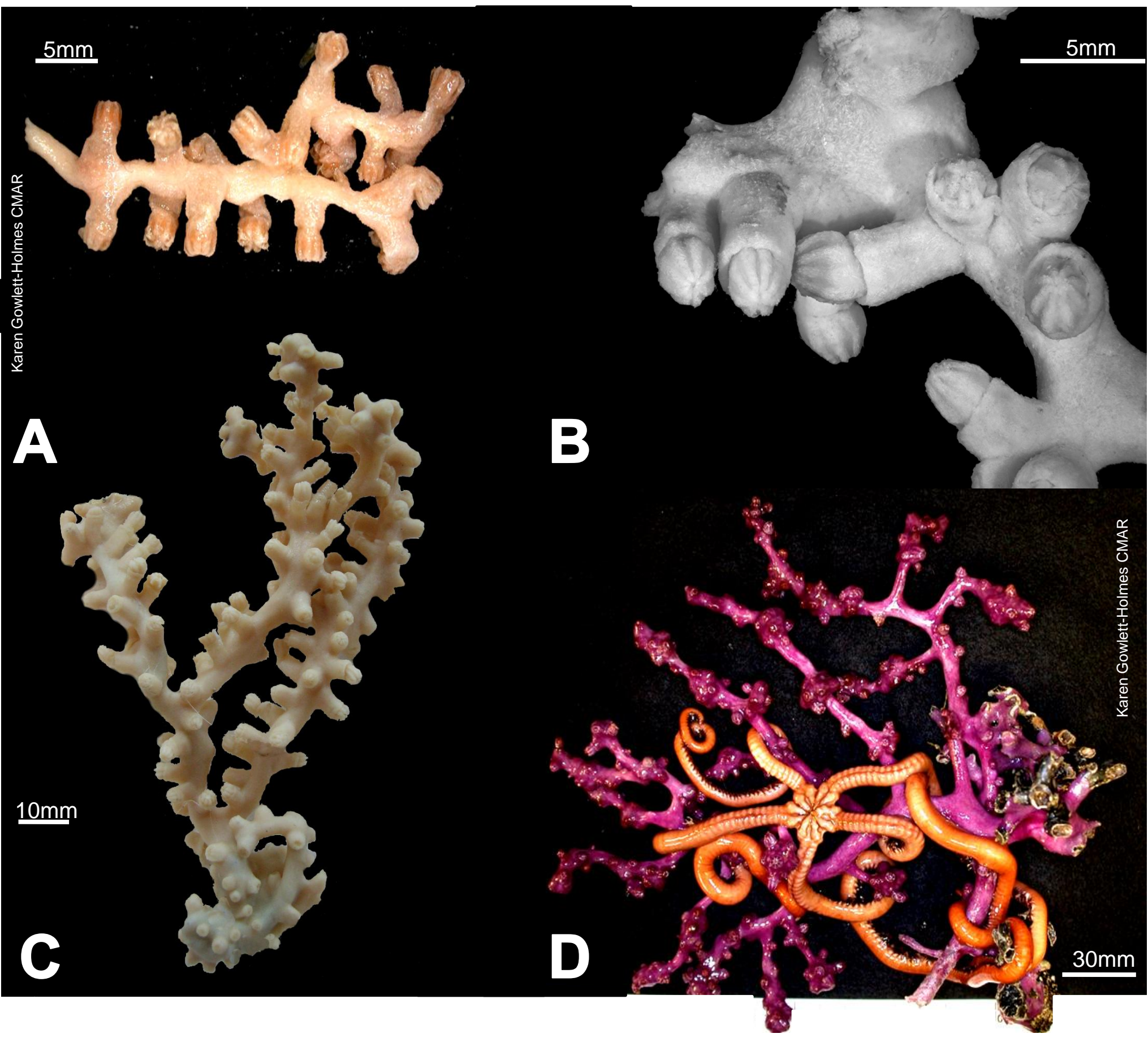


Fig.2 A: *Anthothela* sp.3- Tasmanian seamounts; B: *Anthothela grandiflora* – holotype Norway; C: New genus1 – Norway; D: *Victorgorgia* sp1 – Tasmanian seamounts

### Acknowledgements:

Fresh samples for molecular analysis were obtained from: CMAR, Australian Antarctic Division (AAD), National Institute of Water and Atmospheric Research (NIWA), Collaborative East Antarctic Marine Census (CEAMARC), Norwegian University of Science and Technology (NTNU), Hans Tore Rapp (University of Bergen), Muséum national d'Histoire naturelle (MNHN) - REVOLTA, IPEV program 1124 and New Zealand Ministry of Fisheries Observer Services

Other samples also obtained from: Australian Museums (TMAG, MAGNT, AM, SAM, WAM), Norwegian University of Science and Technology, University Museum of Bergen, Natural History Museum, University of Oslo, Natural

History Museum of Denmark, Museum für Naturkunde, Muséum national d'Histoire naturelle, National History Museum (UK), National Museum of Natural History (USA), Harvard Museum of Natural History, Peabody Museum of Natural History, Museu Oceanográfico Univali (Brazil), Zoologisch Museum – University of Amsterdam, Museum of Evolution – Uppsala University  
**References:**  
Alderslade 1998, Revisionary systematics in the gorgonian family Isididae, with descriptions of numerous new taxa. Rec.West.Aust.Mus. No. 55, 1-359

McFadden *et al.* 2011, Limitations of mitochondrial gene barcoding in Octocorallia. Mol.Ecol.Res.11:19-31

## Primnoisis: islands of endemism

**Key Results:** ) Molecular results group *Primnoisis* into seven consistent phylogeographic clades reflecting separated populations from seamounts, sub-Antarctic islands and the Antarctic continental shelf (Fig.3, colours correspond with Fig.4A). Average genetic distances between clades are >1% (p-distance) suggesting clades represent distinct species (McFadden, 2011).

2) Morphological groupings do not consistently predict these clades. For example, one phylogenetic clade mixes three morphological groupings, *P. fragilis*, *P. gracilis* and *Primnoisis* sp2. Conversely, another morphological group, *P. antarctica*, does not predict the phylogenetic division found between sub-Antarctic and Antarctic specimens of *P. antarctica* (Fig.3).

3) Samples from the Tasmanian seamounts form a well-supported clade basal to all the other specimens (p-distance 1.8-2.5%). They represent an isolated, endemic species (Fig.4A) yet are not easily distinguished morphologically.

4) Two species (Fig.4B & Fig.4C) have an extensive distribution along the Antarctic continental shelf perhaps reflecting the influence of the Antarctic Circumpolar Current (ACC) while specimens from further north have more limited distributions suggesting limited connectivity between these populations (Fig.4A)

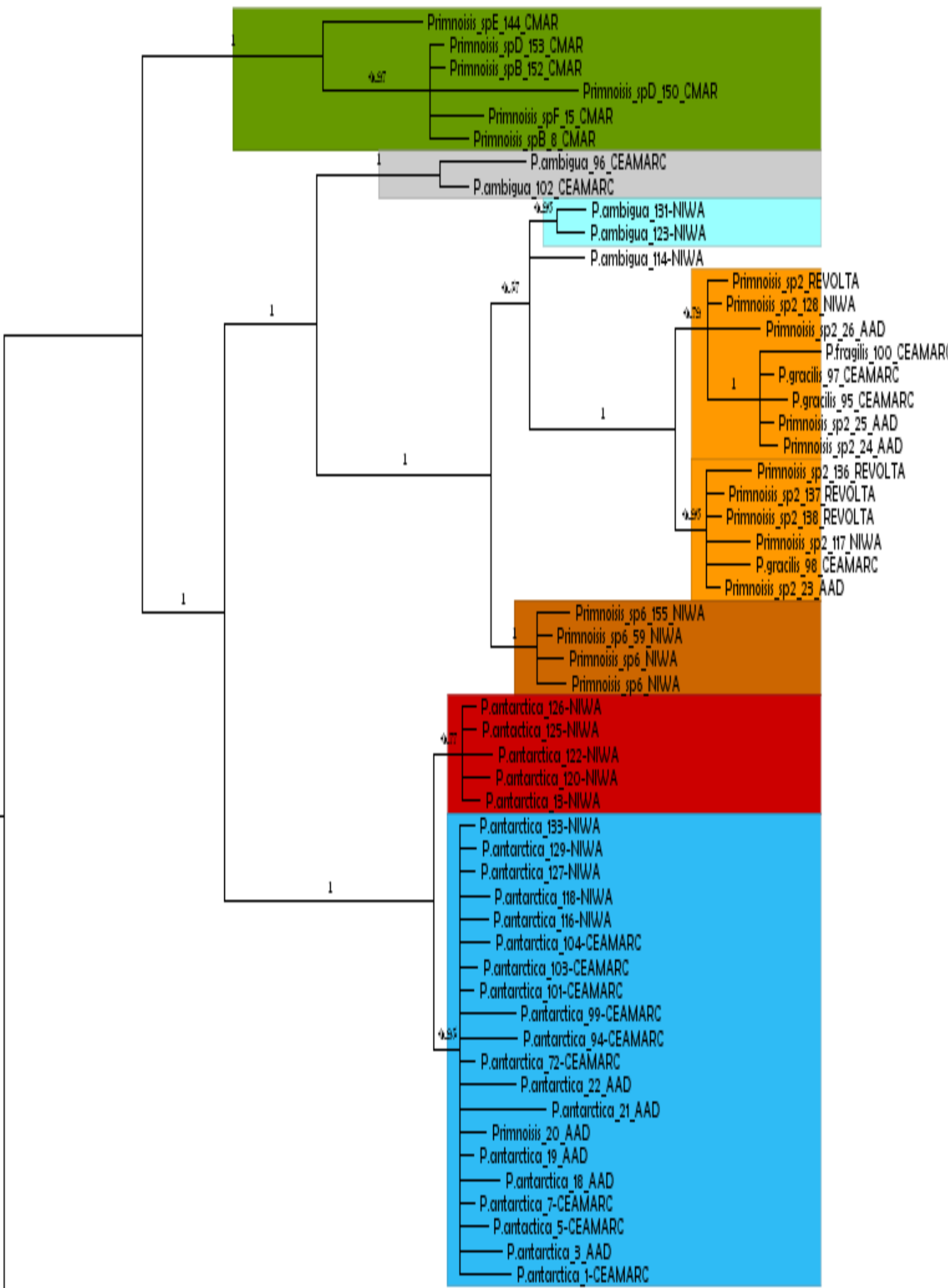


Fig. 3: Phylogenetic tree using mutS and igr-COI gene regions – concatenated 2106 nt, MrBayes, JC model, 1000000 gen, average standard deviation of split frequencies <0.005, Bayesian posterior probabilities displayed.

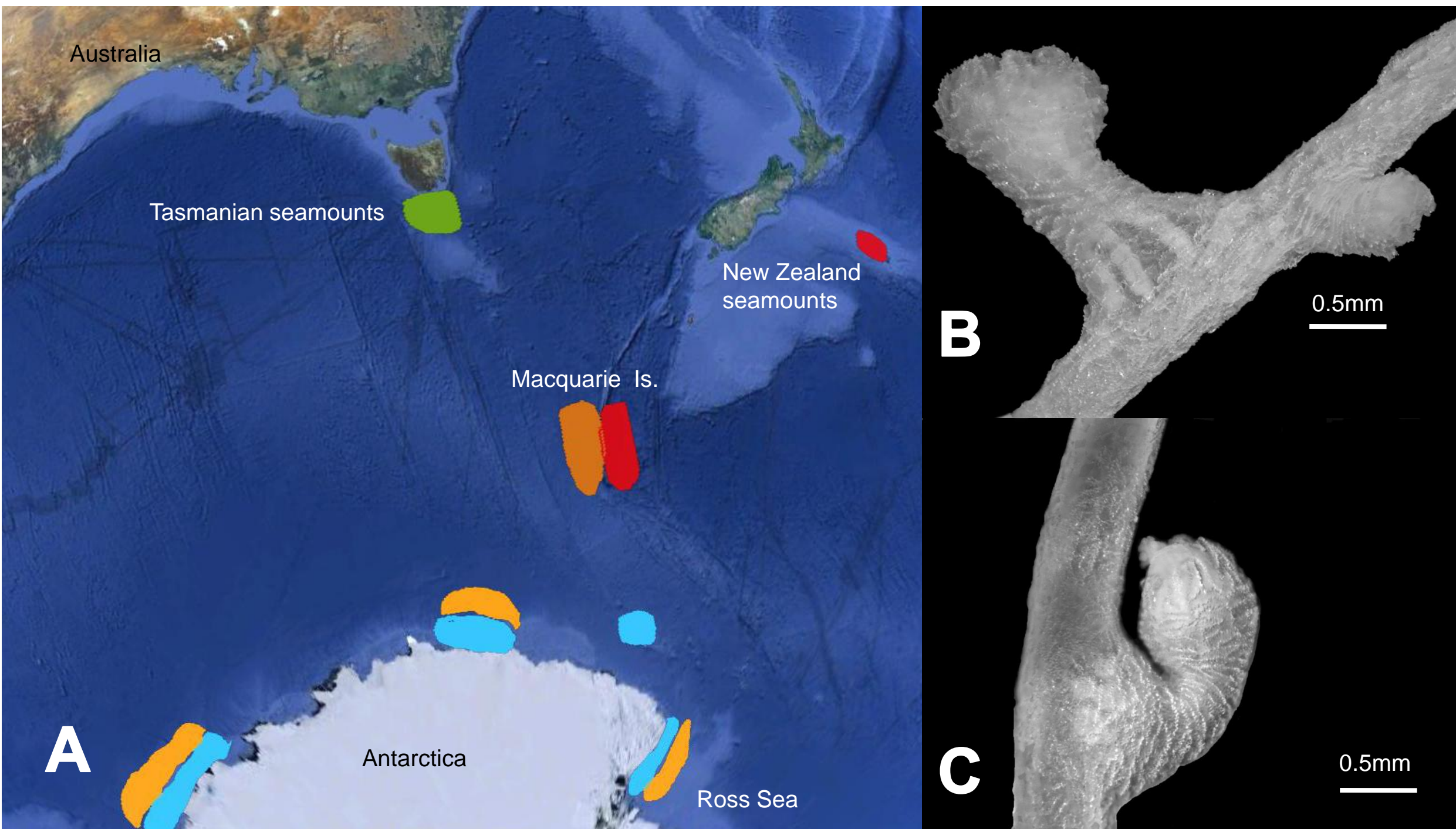


Fig.3 A. Map with phylogeographic clades colour-coded to Fig1 B. *Primnoisis antarctica* – Holotype; C. *Primnoisis* sp – Tasmanian seamounts

**Conclusions:** Both genera were found to have significant unrecognised diversity and taxonomic confusion. *Anthothela* was split into three genera with five undescribed species while *Primnoisis* was found to have at least three undescribed species with limited connectivity between populations. Understanding the diversity present, the limited distributions and the high degree of endemism, particularly in the seamount populations of *Primnoisis*, is crucial to managing and mitigating threats to this diversity such as climate change and fishing impacts.

