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National Committee for Ecology, Evolution and Conservation Science submission to the Senate inquiry on climate-related marine invasive species

The Australian Academy of Science's National Committee for Ecology, Evolution and Conservation Science (NCEEC) welcomes the opportunity to comment on the Senate Environment and Communications References Committee inquiry into climate-related marine invasive species. This submission addresses terms of reference (a), (b) and (c).

The NCEEC:

- Recognises this inquiry as a key step to understand the impacts of *Centrostephanus rodgersii* and to identify regional concerns and management actions, including differing latitudinal, ecological and historical perspectives
- Recommends establishment of an inter-jurisdictional and integrated research program to identify effective restoration actions for Tasmania, and to investigate differences among states and stakeholder needs, including First Nations engagement
- Emphasises that climate change and associated stressors must be considered in any restoration effort, including risk assessments of climate-related drivers that can impair restoration efforts and destroy restored ecosystems.

The evidence base shows varying ecological requirements for management. Along with warming seas (Mabin et al 2019), the long-spined sea urchin *Centrostephanus rodgersii* is expanding into Tasmania from larvae originating in New South Wales (NSW). This process is well studied and well documented, and it is understood to be related to climate change (Ling, 2008, Mabin et al., 2019, Valentine and Johnson, 2004). It is associated with ecosystem shifts from kelp forests to barrens. The urchin is more abundant in northern Tasmania than southern Tasmania, with barrens also more prevalent in the north.

The catastrophic effects of *C. rodgersii* on Tasmanian marine ecosystems is similar to ecosystem shifts caused by urchins elsewhere in the world (Ling et al., 2015). However, in the Northern Hemisphere, these shifts are driven by periodic sea urchin disease and mass mortality of sea urchin predators over periods of decades (Filbee-Dexter and Scheibling, 2014, McPherson et al., 2021). Such phenomena are not seen in Australia.

Management of *C. rodgersii* is complex and should reflect regional conditions. In Tasmania, *C. rodgersii* is justifiably considered an invasive pest species. In contrast, in NSW barrens are contribute to a representative ecosystem, forming a mosaic of barrens and kelp habitat (Underwood et al., 1991, Fletcher, 1987). Public sentiment and management actions identifying this species and its associated barrens as undesirable, regardless of location, are therefore inappropriate. Many species such as perch, bream and cod use barrens as their hunting ground, while others use a mix of barrens and kelp habitats (Kingsford and Carlson, 2010). Research in NSW challenges assumptions of low biodiversity in barrens, revealing higher fish biodiversity there (Curley et al., 2003) or comparable microscopic biodiversity between barrens and macroalgal habitat (Coleman and Kennelly, 2019). The damselfish endemic to southeast Australia depends on well-cropped algal resources in the barrens and would be threatened without barrens (Tzioumis and Kingsford, 1995). Overall, *C. rodgersii* barrens are a dominant feature of NSW shallow subtidal ecosystems, showing stability over 50+ years (Glasby and Gibson, 2020).

Management options are available

Management options for urchin barrens include the removal of the urchins, macroalgal seeding, the introduction or protection of key urchin predators, or combinations of these (Cresswell et al., 2022, Ling and Johnson, 2012). However, the efficacy of such efforts over years remains unknown. There has been a concerted effort in Tasmania to reduce *C. rodgersii* numbers and to expand and develop the fishery (Cresswell et al., 2022). These efforts have been supported by the State government.

Along the mainland, the increase of predators through marine no-take zones has not affected either urchin density or barrens coverage (Glasby and Gibson, 2020, Knott et al., 2021). Lobster does not appear to readily prey on significant numbers of *C. rodgersii* in either NSW (Day et al., 2021) or Tasmania (Smith et al., 2022). These approaches therefore seem to have little if any impact on urchin numbers in Tasmania.

Centrostephanus rodgersii has been harvested in NSW for over 20 years, and there have been improvements in producing marketable product (Blount et al., 2017). Improving the yield of product in barrens provides a mechanism to reduce urchin density through sustainable harvesting and may represent an opportunity to be led by First Nations communities.

Importantly, management actions such as culling or harvesting (Tracey et al., 2015) should be guided by rigorous research to avoid deleterious, unanticipated outcomes on habitats critical to multiple species of fishes and invertebrates.

Finally, The Committee may wish to explore possible parallels with the way in which crown-of-thorn starfish on coral reefs have been dealt with. While there are important differences, the recent pest-management approach appears to have been fruitful.

Support is required for research and stakeholder consultation

It is crucial that an inter-jurisdictional program be instituted to understand differences in ecosystem impact and management actions in the established range of *C. rodgersii* in NSW and the invasive range in Tasmania.

In addition to the management options mentioned above, funding should be directed to research the potential for innovative or untested management options, such as using green gravel to seed kelp (Fredriksen et al., 2020).

Due to the various stakeholders involved in this issue and the broad latitudinal range, funding should also be directed to communication with stakeholder groups. Management of marine invasive species needs to consider where in fact a species is an invasive, not an endemic. Further, other considerations include, local and regional findings, different ecosystems and several communities.

To discuss or clarify any aspect of this submission, please contact Dr Stuart Barrow, National Committees Manager, at stuart.barrow@science.org.au.

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