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To: Joel Lauterbach (Operations Manager, Whangarei); Kirstie Knowles (Aquatic Director)

CC: Mathilde Richer de Forges (Manager, Marine Ecosystems Team); Evan Davies (Marine Reserve Ranger, Northland); Kirsten Rodgers (Technical Advisor, Marine Ecosystems Team)

From: Monique Ladds, Technical Advisor Marine

Subject: Urchin numbers at Poor Knights marine reserve reducing biodiversity

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Purpose

1. To inform Operations and Biodiversity Directors of destructive impacts of urchins at the Poor Knights Islands Marine Reserve.
2. To raise this critical issue through the Operations and Biodiversity lines, due to the significant threat to the biodiversity at Poor Knights Marine Reserve.
3. To highlight the need to inform and involve Mana whenua in management (monitoring and removal)
4. To present options and the associated benefits and risks, and seek a decision to progress the preferred option

Context

- The Poor Knights Islands marine reserve (est. 1981) is an internationally renowned diving and snorkelling destination due to its unique ecosystems and incredible biodiversity
- The Poor Knights Islands Marine Reserve is most renowned for its vertical reef walls and caves that are covered with an amazing diversity of flora and fauna including sponges, bryozoans, ascidians, anemones, and encrusting algae
- *Centrostephanus rodgersii* – long spine black urchin **(the urchin)** naturally occurs in northeastern New Zealand, first recorded in 1897, usually in low numbers
- The urchin occurs throughout the South Pacific and its range expansion in Australia from the Great Barrier Reef has devastated kelp forests in Tasmania, and is showing similar patterns in Victoria and New South Wales
- Monitoring since 1999 has shown a 2.7x increase in density between 1999-2022[2] at Poor Knight marine reserve, exacerbated by climate change, and the species are now forming urchin barrens
- The urchins have been grazing on algae, seagrass, tunicates, and encrusting invertebrates, such as bryozoans and sponges[1], all key species of the Poor Knights marine reserve, posing a real risk of extensive ecological destruction to this unique ecosystem

- Its only known predators in New Zealand are large rock lobsters *(Jasus edwardsii)* and packhorse crayfish (*Sagmariasus varreauxi*), of which harvesting has greatly reduced the populations of in northeastern New Zealand, meaning there are few natural predators to control the urchin
- The urchin is not an invasive species in New Zealand, and this expansion is best categorised as a "native pest" or "species irruption" scenario
- Experience from Australia shows that rehabilitation of barrens is possible to recover healthy reef ecosystems if urchin densities are reduced to relatively low levels.
- This particular species was removed in Tasmania demonstrating that it is possible to recover relatively large areas of habitat provided sufficient resources were available to reduce urchin numbers[1]
- This work will help us to achieve Goals 10.2.2-3, 11.3.1-3 and 13.3.1-3 of Te Mana o Te Taiao around managing and protecting native biodiversity and TB4 Implement adaptation actions from DOC's Climate Change Adaptation Action Plan

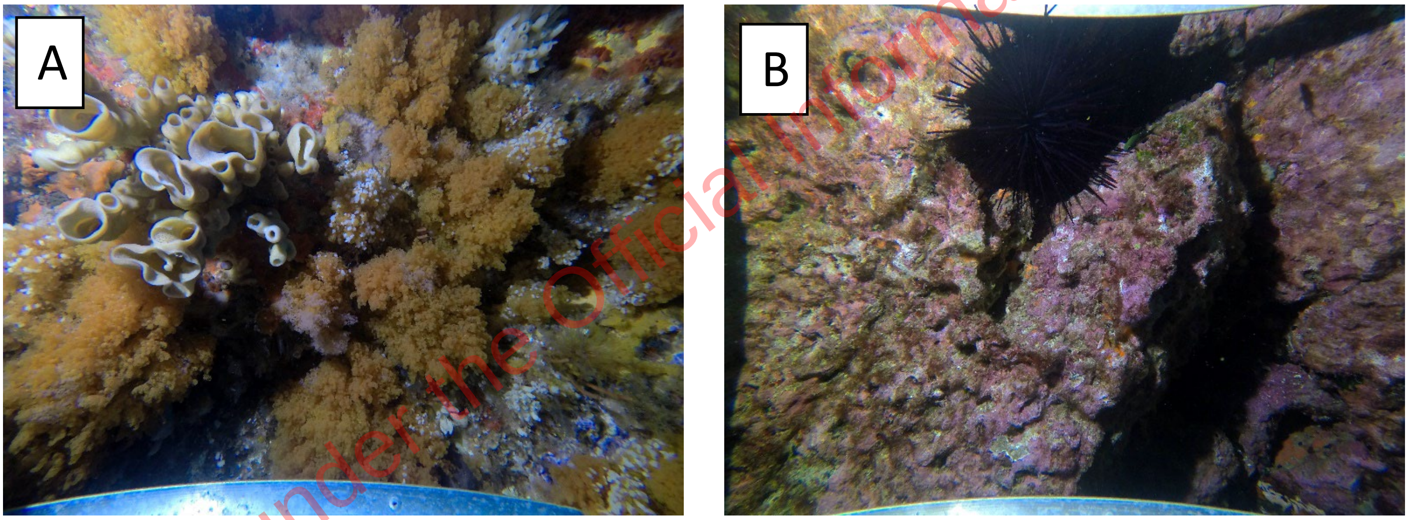

Figure 1. Example of an area where urchins have not grazed (A), and after urchins have grazed (B).

[1] https://www.imas.utas.edu.au/research/fisheries-and-aquaculture/fisheries/Long-spined-sea-urchin-Centrostephanus-Rodgersii

Management options

All proposed options should be considered in partnership with mana whenua.

Option	Advantages	Disadvantages	Likelihood of success
1. A trial removal program is designed and implemented to assess feasibility and the recovery of biodiversity (see next section for details)	Is feasible to do in the current financial year in partnership with the University of Auckland Marine Science Department This option has the potential to allow us to work with Treaty Partners in a meaningful and productive work stream Will give us a realistic idea of how to manage the changing ecosystem Will be in a relatively small control area DOC can utilise local resources already in place, such as, vessel, vehicles and local marine ranger time/experience Low cost due to resources already in place and utilising partnerships	If the program works, ramping up removal throughout the marine reserve could be expensive This would be the first time that active management has occurred inside a marine reserve so expectations would need to be managed carefully	High – the effectiveness of this approach has been demonstrated in Tasmania Results are expected to be seen within 1-2 years
2. More monitoring	Add to the wealth of knowledge gathered about the issue	Supplementary funding/resourcing required Delaying action could result in irreversible loss Delaying action has reputational risk in that DOC did nothing given the evidence	Med – it is feasible to do more monitoring, but not necessarily required to inform understanding of the issue Urchin barrens are already well understood across the country and have a high public awareness
3. Do nothing	No cost to the department in time or resources	Delay in action will likely result in spread throughout Poor Knights Islands marine reserve With no intervention, and continuing ecological damage from this species, there is risk to DOC's reputation as the management agency served with protecting and preserving biodiversity Reputational risk. Failure to carry out any action given what the evidence shows.	Poor – the urchin population will likely continue to increase
4. Complete eradication	Protect the biodiversity values of one of New Zealand's most unique places	DOC staff are not resourced to deal with this incursion in addition to BAU work	Unknown – The cause of the incursion has to be determined. Evidence from Australia shows some success but a lot of effort

Recommendation

Option 1 – a trial removal programme to test feasibility of removal, re-invasion and ecosystem response. This option would be undertaken in collaboration with mana whenua and University of Auckland Marine Science Department researchers who have been monitoring the Urchin.

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Agree/Disagree

Director Biodiversity

Agree/Disagree

Director Northern North Island Operations

If disagree, please indicate preferred alternative option 2-4

Supplementary information

Details of Option 1 – trial removal programme

- To (1) better understand the impact of *the Urchins* on rock wall communities and (2) investigate how controlled removals can be used to protect and restore rock wall biodiversity from the impacts of *the Urchins* we propose undertaking controlled removals at 3 rock wall sites at the Poor Knights Islands.
- The Urchins will be removed from a 50 x 20 m (1000m2) rock wall area at each site and subsequent changes in the rock wall biodiversity will be compared to adjacent control locations on a six-monthly basis (up to 2 years). The area will typically include a 50 m length of rock wall to 20 m depth.
- The Urchins will be culled by SCUBA divers by piercing the urchins in-situ. Based on an average density of 0.7 m-2 on rock walls at the Poor Knights, ~700 urchins will be crushed at each site. Culling of sea urchins in-situ has been found to be 1.9-4.4x faster than collection and ensures that the resources from the sea urchins stay in the same system and can provide food for other organisms. Collecting of the Urchins would be particularly difficult given their large size and difficulties handling.
- Removal at a site is estimated to take 2 dives by 4 divers, providing minimal disruption and only a short-term disturbance. This would be carried out discretely in areas not frequented by the public. The short-term and one-off nature of the removal is also expected to only have a temporary effect on fish behaviour.
- The Urchins are extremely unlikely to reinvade these removal areas due to the large size of the area, strong homing nature and limited movement of these urchins. It is expected post removal that the sessile invertebrate community will recover quickly, followed by a recovery of associated species such as nudibranchs.
- Monitoring of the areas in the treatment (urchin removal) and appropriate control sites will be conducted by Auckland University.
- The cost of the program is expected to be covered predominantly by ongoing projects already underway at Auckland University. DOC will provide in-kind resources (boat) and time.

Additional information about the problem

- The Poor Knights Islands (Tawhiti Rahi Island and Aorangi Island) lie slightly west of the East Auckland Current, and are more strongly affected by this southward-flowing current of tropical water than any other offshore islands or mainland north-eastern coast
- As ocean temperature continues to warm there is the threat that other non-native sea urchin species will be able to establish at the Poor Knights Islands. This year, a sea urchin tentatively identified as the tropical Indo-Pacific species *Diadema savignyi* has been observed at the Poor Knights Islands. The threat from any future arrivals cannot be known, but any knowledge gained from monitoring and managing the threat from *Centrostephanus rodgersii* will be extremely valuable to managing any potential future threats.
- It is found at locations influenced by the warm waters of the East Auckland Current, ordinarily in low numbers without producing urchin barrens
- *Centrostephanus rodgersii* numbers are expected to rise with oceanic warming, and in recent years this has been evident in the increasing density at the Poor Knights Islands
- *Centrostephanus rodgersii* has demonstrated the capacity to overgraze temperate reef habitats, creating barrens habitat devoid of macroalgal growth with negative impacts on ecosystem health[3]
- In Australia *Centrostephanus rodgersii* populations have expanded in number and range over the past two decades as the ocean has warmed, causing widespread ecological damage to marine ecosystems and industries that depend on them. For example, *Centrostephanus rodgersii* populations expanded into eastern Tasmania following oceanic warming and overfishing of rock lobsters (their natural predators)[4], which has been described as "the single largest biologically mediated threat to the integrity of important shallow water rocky reef communities", due to its destruction of Tasmanian rock lobster and abalone habitats
- Urchin barrens are generally deeper (~10-15m) than kina barrens that are present on the mainland coast and other offshore islands. At the Poor Knights Islands the number of kina have decreased,

become more cryptic, and urchin barren habitat associated with this species has largely decreased because of the higher abundance of predatory fish (mainly snapper) inside the marine reserve that prey on kina.

- It is unlikely that natural predators will be able to slow the growth of these new urchin barrens:
  - The increase in numbers of predatory fish like snapper inside the Poor Knights marine reserve have had no apparent influence on urchin populations
  - The only known predators of these urchins, rock lobsters and packhorse crayfish, are uncommon in the Poor Knights Islands Marine Reserve

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