# Submission on the Draft Policy on Fish Aggregating Devices and Artificial Reefs

## Great Barrier Reef Park Authority

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# Contents

# 1. Introduction

Thank you for the opportunity to make a submission to the Great Barrier Reef Park Authority (***Reef Authority***) in response to *Draft Policy on Fish Aggregating Devices and Artificial Reefs* (***Draft Policy***). Author details are provided at the end of the submission.

The contributing authors to this submission are drawn from part of a larger team of researchers working on the feasibility of using robotic systems to aggregate damaging local coral debris and low-grade gravel fragments into artificial reefs. The proposed robotic system would be deployed to reduce damaging coral rubble into artificial reefs to aid reef restoration. We note that while we all come from various research institutions, this submission is made in our individual capacities and do not reflect the position of our respective institutions.

# 2. Summary and recommendations

A summary of recommendations is presented below.

- **We recommend that the Draft Policy make explicit that an exception to the prohibition on the deployment of Artificial reefs exists beyond the exceptions set out in paragraph 13 of the Draft Policy**

  In our view, the exception to the general prohibition on the deployment of artificial reefs should be clarified to explicitly allow artificial reefs to be deployed for:

  - small-scale research purposes;
  - habitat restoration practices; and
  - management tool to prevent natural habitat overfishing and to restore depleted populations due to habitat loss and fishing pressures on natural habitats.

  We recommend that under the artificial reef deployment policy, any consideration of whether an artificial reef project application falls within an exemption category evaluates the artificial reef's impact on the surrounding environment, as well as the chances of success for the artificial reef to achieve its set conservation and management goals.

- **The Draft Policy is based on research that does not take into account the most recent research advances in the field of Green Marine Engineering, Conservation and Habitat Restoration**

  In Section 3, we provide a summary of the most recent advances in this research field that may assist the Great Barrier Reef Park Authority in further examining the suitability of the Draft Policy.

- **The Definition of 'Artificial reef' is too broad and could be tailored to prevent unintentional chilling effect on research that may support stronger environmental outcomes for the Great Barrier Reef**

# 3. Recent advances in the field of Green Marine Engineering, Conservation and Habitat Restoration

We note that the research supporting the Draft Policy is based on a literature review that was conducted two years ago. In our view, more recent research point to advances in the research field that may support a less restrictive approach to the deployment of artificial reefs. We recommend that the Draft Policy permit the use of artificial reefs for:

- small-scale research purposes;
- habitat restoration practices; and
- management tool to prevent natural habitat overfishing and to restore depleted populations due to habitat loss and fishing pressures on natural habitats.

In addition, we recommend that under the artificial reef deployment policy, any consideration of whether an artificial reef project application falls within an exemption category evaluates the artificial reef's impact on the surrounding environment, as well as the chances of success for the artificial reef to achieve its set conservation and management goals.

We provide a summary of these recent research advances below:

1. At paragraphs 24 and 25 of the Draft Policy, the Reef Authority observes that artificial reefs can act as fish attracting devices (FADs), which may lead to high risks of overfishing. However, the majority of reef failure to produce biomass or achieve conservation goals are linked to poor site selection and the lack of incorporation of ecological knowledge into the reef design (Baine, 2001, Blount et al., 2021). Recent research on artificial reef demonstrated that artificial reefs can be effective in producing new biomass if appropriate design and placement strategies have been put in place. Artificial reefs support similar fish communities in terms of fish abundance, biomass, richness and diversity as natural reefs (Blount et al., 2021, Higgins et al., 2022, Paxton et al., 2020). As such, artificial reefs can be used as an effective tool for fisheries management.
2. Other studies highlight that artificial reef research is limited to short term monitoring practices and artificial reef management is often lacking in vigour. Improving artificial reef management practices can have beneficial impacts on artificial reef success to achieve conservation goals (Lima et al., 2019).
3. In the times of climate change impacts that lead to extensive habitat losses – green marine engineering is a vital tool for climate change mitigation (Komyakova et al. 2022). In that space artificial reefs can provide habitat structure required to support fish populations. Policy should be targeting approaches that can evaluate risk associated with artificial reef failure and chances of artificial reef success to achieve their goals, as opposed to complete prohibition.
4. Recent review (Higgins et al., 2022) has identified that artificial reefs have frequently been unsuccessful in the conservation of targeted species (42% success rate), however as stated many failures are due to poor design and poor placement. Improvement in the space of reef design requires extensive, trans-disciplinary research – full prohibition would prevent development of such research. Policy should consider exemption for temporary artificial reef deployments of small scale that allow research development.
5. Same review (Higgins et al., 2022) has highlighted that artificial reefs have been highly successful for the purposes of creation of nursery habitats and increase of coral cover (71% success rate), making artificial reefs a vital tool in coral reef restoration and protection targets.
6. Artificial reefs have been used to prevent trawling and redirect tourism pressures away from sensitive natural habitats (Pickering et al., 1999, González-Correa et al., 2005, Polak and Shashar, 2012, Sutton and Bushnell, 2007), acting as an effective conservation tool. In that space, use of artificial reefs as a

pressure redirection in combination with marine protected areas can benefit environmental and social goals of GBRMPA.

# 4. Definition of Artificial Reef

The Draft Policy proposes at paragraphs 10 and 11 the following definition for an 'Artificial reef':

> **Artificial reef** means a facility (including, but not limited to, goods or equipment)—
>
> (i) that remains, is affixed to, or is placed on, the seabed to replace existing, natural habitat (whether degraded or not) with different or new artificial habitat; and
>
> (ii) is intended to, or may lead to, an increase or change in recreational or commercial use and entry at a location, not limited to fishing or diving; and
>
> (iii) has a purpose to artificially increase or artificially concentrate populations of marine plants or animals which, previously, were less abundant, or were not located, in the area.
>
> An artificial reef includes underwater artwork.

A proposed carve-out from the definition of 'Artificial reef is provided at paragraph 13 that states that an 'Artificial reef' does not include a facility with another primary purpose such as, but not limited to:

> (i) any purpose protected by a heritage statute;
>
> (ii) the safety of, or access for, vessels, aircraft or people;
>
> (iii) restoration or adaptation interventions of a natural habitat (as per the Joint Policy on Great Barrier Reef Interventions);
>
> (iv) ecological sustainable use of marine resources by Traditional Owners consistent with their traditional practices.

However, we recommend that this definition be reviewed and to be clarified to expressly exclude from the definition of 'Artificial reef' small-scale research and other innovative strategies that may not clearly fall within the exceptions listed in paragraph 13 (see our recommendation at Section 2), We set out our reasons for the suggested amendments in Sections 4.1 and 4.2 below.

## 4.1 Inclusion of underwater artwork in the definition of 'Artificial reef'

We note that the inclusion of 'underwater artwork' in the definition of 'Artificial reef' will mean that any underwater public artwork that has the potential to serve as an artificial reef would be prohibited under the Draft Policy. This prohibition could potentially extend to all underwater artwork given the ability for reefs to form over a variety of surfaces. Such a prohibition would then diminish creative responses to bring awareness to the Great Barrier Reef or create further barriers for innovative solutions that may bring positive environmental outcomes to the reef. Such prohibitions would prohibit the recently constructed Wonder Reef on the Gold Coast, a dive attraction that features nine buoyant sculptures that offer innovative responses to the climatic threats facing the Great Barrier Reef, including the use of:

- structural engineering to ensure the installation is 'built to withstand the harsh marine environment including cyclonic maximum wave heights of over 18 metres';
- 'environmentally-friendly geopolymer concrete';
- uncoated steel with aluminium anodes to maximise marine growth; and
- an alternative approach to piling in offshore structures through the use of 'gravity anchors'.[1]

[1] Wonder Reef (2022) *Designing the Wonder Reef* <https://www.wonderreef.com.au/learn/the-design/>.

Wonder Reef also claims to 'provide opportunities for globally significant education and research' while at the same time '[attracting] marine flora and fauna'.[2] Despite these innovative qualities, Wonder Reef would not clearly fall within the identified exceptions at paragraph 13 of the Draft Policy. For example, it is unclear if the underwater artwork would meet and fall within the exception of 'restoration or adaptation interventions of a natural habitat (as per the Joint Policy on Great Barrier Reef Interventions).

Prohibition of innovative solutions such as Wonder Reef could lead to a chilling effect on research aimed at increasing environmental outcomes for the Great Barrier Reef, particularly research that involve the fields of Architecture and Civil Engineering.

## 4.2 Chilling effect that negatively impacts achievement of the *Great Barrier Reef Marine Park Act 1975* (Cth)

Section 2A of the *Great Barrier Reef Marine Park Act 1975* (Cth) (***Marine Park Act***) states that the 'main object of this Act is to provide for the long term protection and conservation of the environment, biodiversity and heritage values of the Great Barrier Reef Region'. However, where there is general prohibition on the deployment of artificial reefs, this may have a chilling effect on research that could support the achievement of the stated main object of the Marine Park Act. Any exception to this as set out in paragraph 13 of the Draft Policy should be broad enough to permit the meeting of this main object.

As stated above, we make this submission as part of a larger team of researchers working on the feasibility of using robotic systems to aggregate damaging local coral debris and low-grade gravel fragments into artificial reefs. The proposed robotic system would be deployed to reduce damaging coal rubble into artificial reefs to aid reef restoration.

In Australia, intensification of climate induced environmental threats, such as tropical cyclones, coral bleaching and crown-of-thorns starfish have led to formation of excessive amounts of rubble that has been seen to hinder reef recovery. Accordingly, stabilisation of coral rubble is a major goal of restoration projects carried out at Bait Reef, Whitsundays, Great Barrier Reef. Currently, to address coral rubble movement, divers manually fill biodegradable hessian bags to form stable coral bommies to allow the crystalline coralline algae to bind the rubble to form a stable substrate. While this process creates artificial reefs that provide marine habitats to enhance biomass and diversity, improving fish population and products in commercial aquaculture, it is highly labour intensive.

Artificial reefs have long been utilised to counteract the decline in coral reefs globally and to increase marine product output in aquaculture. Artificial reefs can be deployed for a range of purposes, such as mitigation tools for decline in coral habitats, provision of substratum for sea-based aquaculture, fisheries enhancement, conservation and coastal protection. However, traditional construction of artificial reefs often utilise sunken objects (found objects) such as decommissioned train carriages, tanks, discarded vehicular tyres, concrete blocks and PVC pipes. These materials tend to lack the structural complexity and diversity of refugia of natural habitats, leading to negative environmental outcomes, such as pollution, facilitation of invasion and formation of ecological traps (Airoldi et al., 2015, Heery et al., 2017, Komyakova et al., 2021, Komyakova et al., 2022).

Computer modelling and automated construction techniques (that is, using a robotic arm or 3D-printing process) have been used to create highly-customisable artificial reefs that can model and construct artificial reefs that are closer to the natural habitats found in reef environments, providing the key aspects of void availability and spatial diversity. Our research project offers the ability to use a naturally occurring material (coral debris) for these automated construction processes, and in doing so, reduce an environmental hazard that is causing harm to marine habitats.

Given the research backgrounds of team members, the research project would fall under all limbs of the proposed definition of 'Artificial reef', including the inclusion of underwater artwork. It is currently unclear as to whether our project scope will fit squarely within the exception provided at paragraph 13 of the Draft Policy, or

[2] Ibid.

that our research would be best located within the Scientific Research Zone set out in the Joint Policy on Great Barrier Reef Interventions. It is also unclear if our project would fall within the scope of 'Coral nursery / coral gardening'. Further, as observed at paragraph 24 of the Draft Policy, 'the Reef Authority has granted few permissions for facilities that may constitute a FAD or artificial reef'.

In light of this, we observe that where the Draft Policy prohibits the deployment of artificial reefs without a clear exception for small-scale research, the approach has the potential to chill research that may advance the international state-of-the-art for automated construction for ecological large scale submerged artificial reefs. This is because Part VAA Offences and penalties under the Marine Park Act are civil penalty provisions and without clear guidance on whether such research would fall within the conduct in contravention of the Marine Park Act, this would lead to a more muted approach to seeking out innovative solutions to 'provide for the long term protection and conservation of the environment, biodiversity and heritage values of the Great Barrier Reef Region'.

# 5. Further resources


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# 6. Contributing authors and contact details

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Valeriya Komyakova is an environmental scientist studying the management of human impacts on the marine environment. She has over 15 years' experience in fish and invertebrate ecology and fish-habitat association research in tropical and temperate environments, including green-engineering of artificial reefs. Dr Komyakova's research was the first to demonstrate potential ecological trap formation due to artificial reef deployments and pathways towards mitigation of this impact through improved reef design options.

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Brydon Wang is a lawyer and scholar researching at the confluence of technology, law and construction with 20 years of industry experience in construction and project delivery. His co-edited book on *Large Floating Structures* (Springer) ranks globally as the top Offshore Engineering Book and he has written on both the regulation of 3D printing technologies in the construction industry and the interaction of artificial reefs with environmental law and their potential use in ocean and blue carbon methodologies. Brydon also holds a Master of Public Policy and Management.

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Dan Luo is a researcher in Architecture and Civil Engineering with expertise in digital design and optimisation, robotic fabrication and construction. She is the Chief Investigator of the project outlined in Section 4.2.

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Nic Bao is registered architect in Australia, UK and US, as well as a researcher in architectural engineering and technology at RMIT. He has practised with tier 1 architecture firms in Australia as a project architect and directs his own practice, BDW Architects. Nic has published over 40 high-impact journal papers, book chapters and international conference papers. His work has been exhibited widely including Venice Biennale and National Gallery of Victoria (NGV). His research explores design methodologies for establishing a complementary relationship among architecture, computational design, structural optimisation, behavioural algorithms, robotic fabrication, additive manufacturing, and intelligent construction. Nic holds a PhD in both Architecture and Civil Engineering from RMIT University, and a Master of Architecture from the University of Melbourne.