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# Active coastal and marine restoration in Aotearoa New Zealand: a synthesis for regional councils

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# Active coastal and marine restoration in Aotearoa New Zealand: a synthesis for regional councils

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Prepared for Envirolink

This report summarises a peer-reviewed synthesis of coastal and marine restoration research and practice in Aotearoa New Zealand: Clark DE, Alder A, Gladstone-Gallagher RV, Aguirre JD, Benjamin ED, Berthelsen A, Bray T, Canepa J, Cornwall C, Crossett D, Desmond M, Evans T, Flowers GJL, Hewitt J, Ho M, Jeffs M, Littlewood K, McCowan T, Miller KI, Mitterwallner P, Pilditch C, Rameka W, Thomas S, Thrush S, Zabarte-Maeztu I, Hillman JR. Forthcoming 2026. Active coastal and marine restoration in Aotearoa New Zealand: progress, challenges and pathways forward. New Zealand Journal of Marine and Freshwater Research.

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# Contents

# Executive summary

Aotearoa New Zealand's coastal and marine ecosystems have undergone large-scale, long-term degradation, resulting in the loss of habitat and concomitant declines in endemic species diversity, abundance and productivity. Increased awareness of the importance of marine and coastal systems has prompted work to improve the management of some stressors and establish marine protection in specific areas; however, despite these efforts, natural recovery has remained slow or absent, prompting active interventions to repair degraded systems.

### Report scope

This report, which has been compiled for regional and unitary councils, summarises the current state of active coastal and marine restoration in Aotearoa New Zealand. It is based on a peer-reviewed synthesis of restoration research and practice across multiple aquatic coastal and marine habitats throughout the country.

The report provides an overview of current progress in active restoration efforts and the key ecological and implementation challenges. We also outline opportunities for council involvement in more effective restoration practice. The habitats considered for this synthesis are salt marsh, seagrass, rocky reefs and soft sediment environments, and artificial aquatic habitats.

### Salt marsh

Saltmarsh restoration is the most mature form of coastal restoration in Aotearoa New Zealand, with proven success where site conditions and pressures are well managed. Best practice increasingly integrates planting with hydrological restoration and pressure reduction. For councils, it offers a low-risk opportunity to deliver ecological and climate benefits, with the key challenge being integration into broader catchment and coastal management rather than project implementation.

### Seagrass

Seagrass restoration in Aotearoa New Zealand remains at an early to intermediate stage, with trials demonstrating that re-establishment is possible but typically limited to small spatial scales and with variable success. Transplanting has produced the most reliable outcomes but is labour-intensive, can affect donor meadows and is difficult to scale, prompting growing interest in seed and fragment-based approaches. These approaches show promise but remain under development. For councils, seagrass restoration is best approached cautiously as a learning-focused investment, supported by strong pressure-reduction measures to improve water clarity and sediment conditions.

### Rocky reefs

Rocky reef restoration has shown strong and consistent success, particularly through the removal of overabundant urchins / kina, which can rapidly trigger kelp forest recovery within 1 to 2 years. However, maintaining these outcomes typically requires ongoing management, as urchin populations can quickly re-establish without complementary measures such as predator recovery or spatial protection. By contrast, active seaweed reseeding approaches have produced mixed, site-specific results and remain limited to small-scale applications. For councils, the key lesson is that restoring reef ecosystems depends primarily on addressing underlying ecological drivers rather than relying on planting or translocation, with greatest success achieved when integrated into broader fisheries management and marine spatial planning.

### Soft sediments

Soft-sediment restoration encompasses a diverse range of approaches, including shellfish translocation, shell addition and habitat modification, but outcomes remain highly site-dependent. While these interventions can enhance biodiversity and ecosystem function, success is often constrained by ongoing pressures such as sedimentation, eutrophication and physical disturbance. For councils, soft-sediment restoration should be approached as a targeted and coordinated effort, with the greatest success achieved when combined with catchment-scale management, appropriate fisheries controls and sustained reductions in sediment and nutrient inputs.

### Artificial aquatic habitats

Artificial and engineered habitats are an emerging but still evolving component of marine restoration in Aotearoa New Zealand. While they can enhance local biodiversity and provide social benefits, their outcomes are variable and there is scant evidence that they fully replicate natural ecosystem functions. For councils, the use of artificial habitats is best applied selectively, alongside clear objectives and monitoring, and as part of broader restoration or infrastructure development rather than as substitutes for protecting or restoring natural habitats.

### Barriers to scaling up restoration

The synthesis revealed six main ecological and implementation barriers currently limiting marine and coastal restoration across the country:

- **Restoration in degraded and changing environments**

Restoration often occurs in environments where key stressors (e.g. sedimentation, nutrients, legacy impacts) remain unresolved, limiting long-term success despite short-term gains. Climate change further increases uncertainty, highlighting the need to integrate restoration with catchment management, ki uta ki tai approaches and future-focused planning, rather than treating it as a standalone action.

- **Addressing ecological knowledge gaps**

Active coastal and marine restoration remains an emerging field, with key knowledge gaps around where, when and at what scale interventions achieve lasting, self-sustaining recovery. Addressing this requires long-term monitoring, coordinated trials and stronger collaboration, with councils playing a key role in enabling shared learning and evidence-based investment.

- **Navigating governance and regulatory complexity**

Governance and regulatory complexity are major barriers to scaling coastal and marine restoration, with fragmented responsibilities across land, freshwater and marine systems leading to misalignment between management and restoration efforts. Unclear and inconsistent permitting pathways further constrain progress, highlighting the need for clearer guidance and streamlined processes to support broader uptake, particularly for low-risk and community-led initiatives.

- **Strengthening social and cultural foundations for restoration**

Strong social and cultural foundations are critical to successful coastal and marine restoration, with effective projects co-designed alongside iwi, hapū and local communities to reflect mātauranga Māori and shared stewardship values. However, limited visibility can constrain public support, highlighting the need for councils to enable engagement, build capacity, and support community-led initiatives to sustain long-term success.

- **Broadening expectations and perceptions of success**

Expectations of 'success' in coastal and marine restoration often rely on short-term or narrow metrics that do not reflect long-term ecological recovery or broader social outcomes. Recognising restoration as a staged, adaptive process helps reset expectations, allowing councils to value interim gains and support more realistic pathways to sustained recovery.

- **Scaling up restoration**

Achieving meaningful ecological outcomes requires moving beyond isolated, small-scale trials to coordinated efforts at larger spatial and temporal scales capable of addressing system-level pressures. This will depend on longer-term investment and stronger alignment across projects, with councils playing a key role in connecting pilot initiatives to broader planning, funding and implementation pathways.

### Practical actions for councils

Councils can take a number of practical steps to maximise the value of coastal and marine restoration. This includes embedding restoration as a core outcome within strategic planning, prioritising sites where success is most likely, and linking restoration efforts with pressure-reduction initiatives such as catchment, fisheries and spatial management. Success will also depend on investing in co-design and partnerships with iwi, hapū and communities; enabling learning at scale through coordinated projects and shared monitoring; and advocating for clearer policy and sustained funding to support long-term implementation.

### Key messages for decision-makers

Active coastal and marine restoration in Aotearoa New Zealand is promising but still emerging, with the main limitation being scale and coordination rather than a lack of effort or interest. Councils play a central role in enabling success through strategic planning, partnerships and sustained investment. Restoration progress should be assessed over the long-term, recognising the value of learning and interim gains, rather than relying solely on short-term ecological outcomes.

# 1. Introduction

## 1.1 Purpose of this report

This report has been compiled for regional and unitary councils and summarises the current state of active coastal and marine restoration in Aotearoa New Zealand. It is based on a peer-reviewed synthesis of restoration research and practice across multiple aquatic coastal and marine habitats, which primarily focused on ecologically driven, research-led initiatives (Clark et al. 2026 [Forthcoming]). The synthesis identifies key ecological and implementation challenges and outlines opportunities to advance restoration practice. In this report, the key messages and insights are reframed with a focus on practical implications for council planning, policy and investment.

The report is also informed by discussions held during a workshop with members of the Coastal Special Interest Group (C-SIG). Council scientists and planners shared perspectives on the challenges they face in delivering coastal and marine restoration, and the potential solutions and enabling actions. Insights from the workshop helped ground the synthesis in real-world implementation contexts and ensured this report focused on the issues pertinent to councils.

The perspectives and insights presented here have a basis in ecological science and reflect its underlying assumptions and ways of framing problems and solutions. We acknowledge that this focus does not fully capture the perspectives of indigenous-led and community-led restoration practitioners, whose knowledge systems, values and approaches offer complementary and equally important ways of understanding and progressing coastal and marine ecosystem restoration.

## 1.2 Why coastal and marine restoration matters for councils

Healthy coastal ecosystems such as salt marshes, seagrass meadows, rocky reefs and soft sediment habitats are critical assets to regional councils and their communities, as they:

- improve water quality and help manage nutrients and sediment
- support biodiversity and fisheries
- reduce coastal erosion and flood risk
- contribute to climate resilience and, in some cases, blue carbon goals
- hold deep cultural and community value for iwi, hapū and coastal communities.

While pressure reduction (e.g. catchment management, marine protection) remains essential, in many places natural recovery is slow or not occurring, which has led to growing interest in active restoration interventions. Coastal ecosystem restoration aligns with the Aotearoa New Zealand Coastal Policy Statement 2010 (NZCPS; Department of Conservation 2025) objectives related to safeguarding coastal integrity, preserving natural character, enhancing public access, and addressing coastal hazard risks by improving natural coastal defences (Objectives 1, 2, 4, 5 and 7). Furthermore, contemporary restoration acknowledges the role of tangata whenua and coastal communities as kaitiaki and supports their involvement in the management of the coastal environment (Objectives 3 and 6).

As an emerging field, research and experimentation in restoration ecology align well with the priorities outlined in the *Regional council research, science & technology strategy 2020* (RCSAG 2021). In particular, these activities contribute to building a knowledge base for novel restoration approaches in Aotearoa New Zealand; they also strengthen links with international research to inform cost–benefit analyses of habitat enhancement, as well as support the development and expansion of effective restoration plans (Priorities 1, 3 and 4). In addition, restoration initiatives deliver broader co-benefits, including improvements in biodiversity (Priority 6) and enhanced risk management by identifying and addressing uncertainties and potential risks associated with restoration practice (Priority 7). More broadly, these efforts support improved coastal management and help build regional science capability through collaboration, knowledge sharing and resource coordination among councils (Priorities 8 and 10).

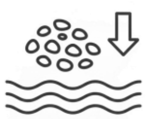
Restoration and its monitoring efforts align with the C-SIG strategic priorities (2025–28; Carbines et al. 2025). These priorities emphasise collaborative, nationally consistent approaches to coastal science, integrated ki uta ki tai management, and the strengthening of ecosystem resilience under increasing pressure from climate change and cumulative stressors. The C-SIG strategy highlights the importance of coordinated monitoring, data sharing and the development of tools and guidance to support decision-making. The strategy also focuses on improving understanding of how coastal ecosystems respond to multiple interacting pressures; these targets all benefit the progression and scaling up of restoration (see Section 4). The strategy further identifies restoration as a key pathway towards enhancing ecosystem resilience, alongside the need for improved knowledge, methodologies and partnerships across councils, agencies, iwi and communities. Together, these priorities reinforce the role of restoration within an integrated, evidence-based approach to sustainable coastal management.

## 1.3 What is meant by ‘active restoration’?

Active coastal and marine restoration involves deliberate interventions to help degraded aquatic ecosystems recover. In Aotearoa New Zealand, these approaches broadly fall into three categories:

**1. Active removal of pressures**
Removing or reducing stressors that block recovery; for example, stock and vehicle exclusion in salt marshes, mangrove removal from former sandflats and urchin / kina removal from rocky reefs.

**2. Species-based restoration**
Rebuilding populations of key habitat-forming species; for example, planting saltmarsh vegetation, transplanting or seeding seagrass, transplanting shellfish species and reseeding seaweed.



**3. Structural restoration**
Adding or modifying physical structure to restore habitat complexity; for example, shell or rock addition to soft sediments, artificial reefs and ‘living shoreline’ designs integrated into coastal infrastructure.

It is important to note that these approaches are complementary to, rather than substitutes for, protection and catchment management.

# 2. Progress in active coastal and marine restoration

Active coastal and marine restoration is gaining momentum across Aotearoa New Zealand, but progress remains uneven and, in most cases, limited in scale. Interest and activity have increased markedly over the past decade, with a growing number of councils, iwi, community groups and research organisations trialling a variety of active interventions across a range of coastal and marine habitats. However, most of these efforts are small, short-term projects that are closely tied to research or pilot funding, rather than embedded, long-term restoration programmes.

Progress towards well-established and effective approaches varies substantially among habitat types. Across all habitats, active restoration is most effective when it operates alongside pressure reduction and long-term management planning. It is also important to maintain realistic expectations of the indicators that constitute success. With this approach, councils can have a consistent and influential role in creating the conditions that support successful restoration.

Overall, marine and coastal restoration interventions in Aotearoa New Zealand span a wide range of ideas, methods and pilot projects, reflecting a strong base of innovation, experimentation and commitment to environmental recovery. However, this diversity has not yet consistently translated into durable, large-scale outcomes. The primary limitation is not a shortage of approaches, but the difficulty of moving beyond isolated, short-term trials to coordinated efforts at spatial and temporal scales sufficient to overcome ongoing pressures and deliver sustained ecological change.

## 2.1 Salt marsh

Figure 1. Salt marsh in Te Tauihu o Te-Waka-a-Māui (top of the South Island). Photo credit: Anna Berthelsen, Cawthron Institute.

Saltmarsh restoration represents the most mature and well-established area of coastal restoration practice in Aotearoa New Zealand (Table 1; Figure 1). Across the country, a growing number of projects have successfully demonstrated that native saltmarsh vegetation can be re-established and expanded where site conditions are suitable and pressures are appropriately managed. Active planting using nursery-grown native species is now widely applied, supported by regional guidance documents, accumulated practitioner experience and a solid evidence base showing ecological benefits.

However, success is strongly dependent on addressing underlying site conditions. Projects that focus solely on planting without restoring tidal hydrology or controlling trampling and weeds often require ongoing intervention and maintenance to persist. In response, more recent projects increasingly combine planting with hydrological restoration, access controls and catchment-scale pressure reduction. While hydrological restoration (such as removal of tidal barriers or re-wetting of drained areas) offers significant long-term potential, it remains less common due to higher costs, consenting complexity and uncertainty about future ecological response to sea-level rise.

For councils, saltmarsh restoration offers a relatively low-risk opportunity to deliver measurable ecological gains, climate-adaptation co-benefits and community engagement outcomes. The key challenge is not technical feasibility, but long-term integration; ensuring restoration is embedded within catchment planning, coastal hazard management and ongoing land-use controls, rather than delivered as isolated projects.

Table 1. Overview of active restoration approaches trialled in salt marsh in Aotearoa New Zealand, summarising the current level of evidence, typical scale of application, key constraints and implications for regional and unitary councils.

| Restoration approach | Current level of evidence | Typical scale to date | Key constraints and risks | Implications for councils |
|---|---|---|---|---|
| **Active planting (nursery-grown native species)** | **High** – well-established and widely applied | Site scale (> 200 sites nationally) | Requires precise matching of species to tidal elevation; nursery lead-in times; long-term weed and grazing control | A reliable and effective approach where hydrology and pressures are addressed; well suited to council-led programmes and partnerships |
| **Hydrological restoration (barrier removal, re-wetting)** | **Moderate** – only a few large NZ examples | Site to catchment–estuary scale | High upfront cost; consenting complexity; uncertain responses under climate change | Offers high long-term gains but requires integrated land–sea planning and long-term commitment |
| **Geomorphic reshaping (e.g. chenier ridges)** | **Low–moderate** – limited applications | Localised shoreline reaches | Some upfront costs; maintenance requirements; further work to determine optimal size / structures | Appropriate for erosion-prone sites but requires strong technical design and monitoring |
| **Access exclusion (stock and vehicle fencing)** | **High** – widely used | Widespread | Ongoing maintenance and enforcement needed | Low-cost, high-value intervention that often underpins the success of other restoration actions |
| **Weed and pest plant control** | **High** – routine practice | Widespread | Requires repeated effort; chemical use considerations | Essential supporting action for maintaining and expanding saltmarsh extent |

Key references: Bergin 1994; Bay of Plenty Wetlands Forum 2007; Bellingham and Davis 2008; Greater Wellington Regional Council 2009; Tasman District Council 2010; Roberts and Stevens 2021; Stevens 2021, 2024; Handley 2022; Berthelsen and Alder 2024; Department of Conservation 2026.

## 2.2 Seagrass

Figure 2. Subtidal seagrass meadow at Great Mercury Island / Ahuahu. Photo credit: Dana Clark, Cawthron Institute.

Seagrass restoration in Aotearoa New Zealand remains at an early to intermediate stage of development (Table 2; Figure 2). A range of active restoration techniques have been trialled over the past two decades, including transplanting clumps or shoots, propagating beach-cast fragments and developing seed-based approaches. While these efforts have demonstrated that seagrass can be re-established under suitable conditions, success has been variable and typically limited to small spatial scales.

Transplanting clumps or shoots has delivered the clearest evidence of success to date, particularly when undertaken in sheltered locations with appropriate light, sediment conditions and seasonal timing. However, these methods are labour-intensive, can impact donor meadows and are difficult to scale up to ecologically meaningful extents. As a result, current research has increasingly shifted towards lower-impact and potentially scalable approaches, such as beach-cast fragment propagation and seed-based restoration, which offer strong long-term promise but need to be tested through field deployments.

For councils, seagrass restoration is best approached strategically, with pilot projects and targeted trials. Support for method development and monitoring will also help advance restoration knowledge and capability. When combined with actions that improve water clarity and sediment conditions, these initiatives can lay the foundation for broader restoration success. Although large-scale restoration techniques are still being refined, current investments are providing important lessons that will support future recovery efforts.

Table 2. Overview of active restoration approaches trialled in seagrass meadows in Aotearoa New Zealand, summarising the current level of evidence, typical scale of application, key constraints and implications for regional and unitary councils.

| Restoration approach | Current level of evidence | Typical scale to date | Key constraints and risks | Implications for councils |
|---|---|---|---|---|
| **Transplanting clumps / sods** | **Moderate** – demonstrated success at some sites | Small patches (local scale) | Labour-intensive; impacts donor meadows; limited scalability; no genetic diversification | Suitable for pilot projects and high-value sites, but constrained at large scales |
| **Transplanting shoots** | **Low–moderate** – variable success | Very small patches | Anchoring difficulty; storm losses; no genetic diversification | Potential lower-impact alternative to clumps, but still experimental |
| **Beach-cast fragment propagation** | **Early / experimental** | Nursery only | Unreliable material supply; not yet out-planted | Promising low-impact, community-engaging approach, but not yet field-tested |
| **Seed-based restoration** | **Early / experimental** | Nursery only | Labour-intensive seed handling; out-planting not yet proven | High long-term potential for scalable restoration, but requires further investment and method development |

Key references: Turner 1995; Cade 2016; Gibson and Marsden 2016; Matheson 2016, 2017; Zabarte-Maeztu 2021; Hindmarsh and Hooks 2022; Fearn et al. 2023; Barr et al. 2024; Berthelsen et al. 2024; Crossett et al. 2026; Brettle et al. 2026 [Forthcoming]; Whittall et al. 2026 [Forthcoming].

## 2.3 Rocky reefs

Figure 3. Rocky reef in Hauraki Gulf / Tīkapa Moana with a flourish of macroalgal species. Photo credit: Frances Dickinson, benthics.com.

Rocky reef restoration has benefited from a growing body of research demonstrating that, in many locations, removal of active pressures can trigger rapid and substantial ecosystem recovery (Table 3; Figure 3). In particular, experimental removals of overabundant urchins have consistently led to the re-establishment of kelp forests within 1 to 2 years, often without the need for additional planting or seeding. This makes urchin removal one of the most effective and well-supported restoration tools currently available in temperate marine systems.

While urchin removal has proven highly effective at initiating rapid kelp recovery, it is not a one-off solution. In most cases, these interventions require ongoing, often intensive, management to maintain reduced urchin densities. Without continued removals or complementary measures that restore natural predators or limit reinvasion, urchins are likely to recolonise restored sites over time, leading to a return to barren states. As a result, urchin removal can become costly and labour-intensive over the long term unless it is embedded within broader management frameworks, such as fisheries controls, marine protection or sustained maintenance programmes.

By contrast, attempts to actively reseed seaweed using transplanted juveniles, cultured recruits or induced-seeding techniques have produced mixed and highly site-specific outcomes. While these approaches have shown promise in some sheltered or carefully controlled environments, they remain sensitive to wave exposure, grazing pressure, sediment movement and biofouling, and have generally only been successful at small spatial scales. As such, they are best viewed as complementary tools within a broader restoration toolkit, rather than primary restoration strategies.

Rocky reef restoration has also included the translocation of key grazers (e.g. pāua) and is beginning to explore the reintroduction of key predators (e.g. kōura / crayfish) to help restore lost ecosystem functions. Grazer translocations have primarily been motivated by local fisheries objectives and have shown promise in some contexts. By contrast, predator reintroductions remain experimental and may be further constrained by limited source populations in some regions.

For councils, the evidence suggests that enabling recovery of rocky reef ecosystems often hinges on addressing ecological drivers, particularly grazing pressure and food-web structure, rather than relying on intensive grazer removals, or species transplantations or translocations. Restoration initiatives are most effective when integrated with fisheries management, marine protection or broader spatial planning that supports predator recovery to reduce the likelihood of repeated degradation.

Table 3. Overview of active restoration approaches trialled on rocky reefs in Aotearoa New Zealand, summarising the current level of evidence, typical scale of application, key constraints and implications for regional and unitary councils.

| Restoration approach | Current level of evidence | Typical scale to date | Key constraints and risks | Implications for councils |
|---|---|---|---|---|
| **Urchin removal** | **High** – repeatedly demonstrated in NZ | From hundreds of $m^2$ to > 20 ha across > 10 sites | Labour-intensive; costs rise quickly with area; does not address underlying drivers of high urchin densities; requires ongoing management unless predator recovery occurs | Highly effective for initiating kelp recovery where urchins are the primary driver of degradation; best used as part of a broader management strategy (e.g. protection, predator recovery, repeat removals) |
| **Urchin exclusion fencing** | **Early / experimental** – limited trials | Very small (e.g. 2 m × 2 m cages) | Technically complex; scaling to large areas unproven; requires durable designs to withstand waves and storms | A potential complementary tool where removals alone are insufficient; not yet suitable for broad deployment without further testing |
| **Seaweed reseeding – lab-cultured juveniles (e.g. green gravel, tiles, seeded lines)** | **Low–moderate** – site- and species-dependent | Small patches (typically multiple 1 $m^2$ plots with green gravel approaches at scales of 100–200 $m^2$) | High sensitivity to wave exposure, sediment mobility, grazing and fouling; requires nursery facilities; scaling up remains challenging | Useful for targeted trials or demonstration projects, particularly where natural recruitment is absent; not yet a standalone solution at scale |
| **Seaweed reseeding – inducing seeding of reproductive adults** | **Low–moderate** – mixed outcomes | Small, experimental sites | Uncertain spore release and settlement; loss of transplants; donor reef impacts; variable success among sites | Low-cost and conceptually attractive; best suited to sheltered locations and as a complementary technique rather than a primary restoration tool |

| Restoration approach | Current level of evidence | Typical scale to date | Key constraints and risks | Implications for councils |
|---|---|---|---|---|
| **Transplanting wild seaweed juveniles** | **Low** – primarily diagnostic | Very small scale | Labour-intensive; not scalable; limited long-term persistence | Best used to test whether environmental conditions can support kelp, rather than as an applied restoration method |
| **Shellfish enhancement on rocky reefs (e.g. pāua reseeding, translocation)** | **Moderate** – biologically effective, economically constrained | Small to moderate, some large-scale fishery trials | High costs; variable survival; limited economic viability under current assumptions | Can support cultural, ecological and fisheries objectives in specific contexts |
| **Crayfish ongrowing / enhancement** | **Low** – restoration not yet demonstrated | Pilot and aquaculture-focused | Hatchery production not viable (need to be wild sourced); restoration outcomes not proven | Currently more relevant to aquaculture development than ecosystem restoration; future relevance depends on technological advances |

Key references: Tong et al. 1987; Schiel 1993; Osumi 1999; Roberts et al. 1999, 2001, 2007, 2010; Gardner et al. 2000, 2006; Clarke 2001; Roberts 2001; Roberts and Lapworth 2001; Shears and Babcock 2002, 2003; Booth and Cox 2003; Jeffs 2003; Taylor and Schiel 2003; Haggit and McComb 2005; Keys 2005; Mills et al. 2005, 2006; Nelson et al. 2005; Roberts 2005a, 2025b; Watts and Keeley 2008; Green and Gardner 2009; Roberts and Watts 2010; Taylor et al. 2010; Green et al. 2013; Alestra et al. 2014; Alestra and Schiel 2015; Hesse et al. 2015, 2016a, 2016b; Le et al. 2022a; Miller et al. 2022, 2024; Praeger et al. 2022; Crossett 2023; Crossett et al. 2023, 2025; Lis 2023; Miller 2023; Miller and Shears 2023; Lawton and Magnusson 2024; National Science Challenge – The Deep South | Te Kōmata o Te Tonga 2024; Wood et al. 2024; Gerrity and Schiel 2025; Lafont and Shears 2025; Lawton and Praeger 2025; Lis and Aguirre 2025; Love Rimurimu 2025; McCowan 2025; O'Neill et al. 2025; Williams 2025; Te Kohuroa Rewilding Initiative 2026; Parry et al. 2026.

## 2.4 Soft sediments

Figure 1. Soft sediment seafloor of Hauraki Gulf / Tīkapa Moana featuring a bioturbating heart urchin / kina pākira. Photo credit: Shaun Lee, https://blog.shaunlee.co.nz/

Restoration of soft sediment habitats, including shellfish beds and subtidal and estuarine sand and mudflats, encompasses a wide range of techniques and objectives, reflecting the diversity of these environments (Table 4; Figure 4). Active restoration efforts have included translocation of adult shellfish (e.g. toheroa, pipi, tuangi / cockles), deployment of shell material to provide habitat structure, small-scale mussel reef creation (e.g. kūtai / green-lipped mussels), mangrove clearances, seabed remediation and, in some contexts, fisheries-based enhancement measures (e.g. reseeding).

Evidence to date indicates that many of these approaches can enhance local biodiversity and ecosystem functioning, but outcomes are highly dependent on site conditions, scale and persistence of underlying pressures such as sedimentation, eutrophication and physical disturbance. In particular, shellfish translocations have often been limited by predation, storm damage, recruitment bottlenecks or degradation of surrounding habitats, leading to variable long-term success.

Soft sediment restoration is therefore rarely a 'plug-and-play' solution for councils. Small pilot projects can provide valuable information about site suitability and restoration potential; however, meaningful recovery typically requires coordinated action across catchments, careful site selection and realistic expectations about timescales and outcomes. Structural interventions such as shell addition can play an important supporting role but are most effective when combined with sustained reductions in sediment and nutrient inputs.

For councils, the overarching lesson from soft sediment restoration is that the greatest and most enduring recovery outcomes are likely to be achieved when active restoration is combined with broader catchment-to-coast management that reduces sediment and nutrient inputs, supports appropriate fisheries and management, and takes a long-term planning perspective.

Table 4. Overview of active restoration approaches trialled in soft sediment habitats in Aotearoa New Zealand, summarising the current level of evidence, typical scale of application, key constraints and implications for regional and unitary councils.

| Restoration approach | Current level of evidence | Typical scale to date | Key constraints and risks | Implications for councils |
|---|---|---|---|---|
| **Translocation of adult infaunal shellfish (e.g. tuangi / cockles)** | **Moderate** – repeated small-scale trials | Small plots at many sites | Reliance on healthy source populations; limited long-term data | Useful for local enhancement and learning, but scale and sustainability remain uncertain |
| **Mussel reef restoration (adult and juvenile translocations)** | **Low–moderate** – mixed outcomes | Small to medium deployments | Predation, recruitment bottlenecks, storm impacts | Requires careful site selection and often pilot trials before scaling |
| **Structural restoration (addition of shells or shell hash)** | **Moderate** – strong experimental support | Small experimental plots | Logistics of shell supply; burial under sediment | Effective for enhancing biodiversity and ecosystem function, often as a supporting intervention |
| **Seabed remediation (sediment removal)** | **Low** – very limited trials | Very small, experimental | High technical and disposal challenges | Not currently suitable for routine application beyond specific industrial contexts |
| **Fisheries-based enhancement (e.g. reseeding)** | **Moderate** – mixed historical results | Fishery scale | Enforcement challenges; habitat degradation often unresolved | Likely ineffective without simultaneous habitat restoration and pressure reduction |
| **Mangrove clearance** | **Variable** – site dependent | Many sites | Persistent sediment legacy; slow recovery | Requires clear objectives and realistic time frames; not a substitute for addressing catchment drivers |

Key references: Bartrom 1990; Bull 1990; Nesbit 1999; Booth and Cox 2003; Talman et al. 2004; Thrush et al. 2006; Cummings et al. 2007; Sandwell et al. 2009; Marsden and Adkins 2010; Brown 2011; Jones et al. 2011; Adkins 2012; Hewitt and Cummings 2013; Thrush et al. 2013; Williams et al. 2014; Keeley et al. 2017; Lundquist et al. 2017; van Kampen 2017; Wilcox and Jeffs 2017, 2019; Ross et al. 2018; Wilcox et al. 2018, 2020; Alder et al. 2021, 2022a, 2022b; Fleming 2021; Hillman et al. 2021; Sea et al. 2021, 2022a, 2022b; Soliman et al. 2021; Thomas et al. 2021; Benjamin et al. 2022a, 2022b, 2023a, 2023b, 2024; Paul-Burke et al. 2022; Skelton and Jeffs 2023, 2024; Stokes et al. 2023; Toone et al. 2023a, 2023b, 2023c, 2023d, 2024; Alder and Hillman 2024, 2025; Williams et al. 2024; Burnham et al. 2025; van Kampen et al. 2025; Lam-Gordillo et al. 2026a, 2026b; Prinz et al. 2026.

## 2.5 Artificial aquatic habitats

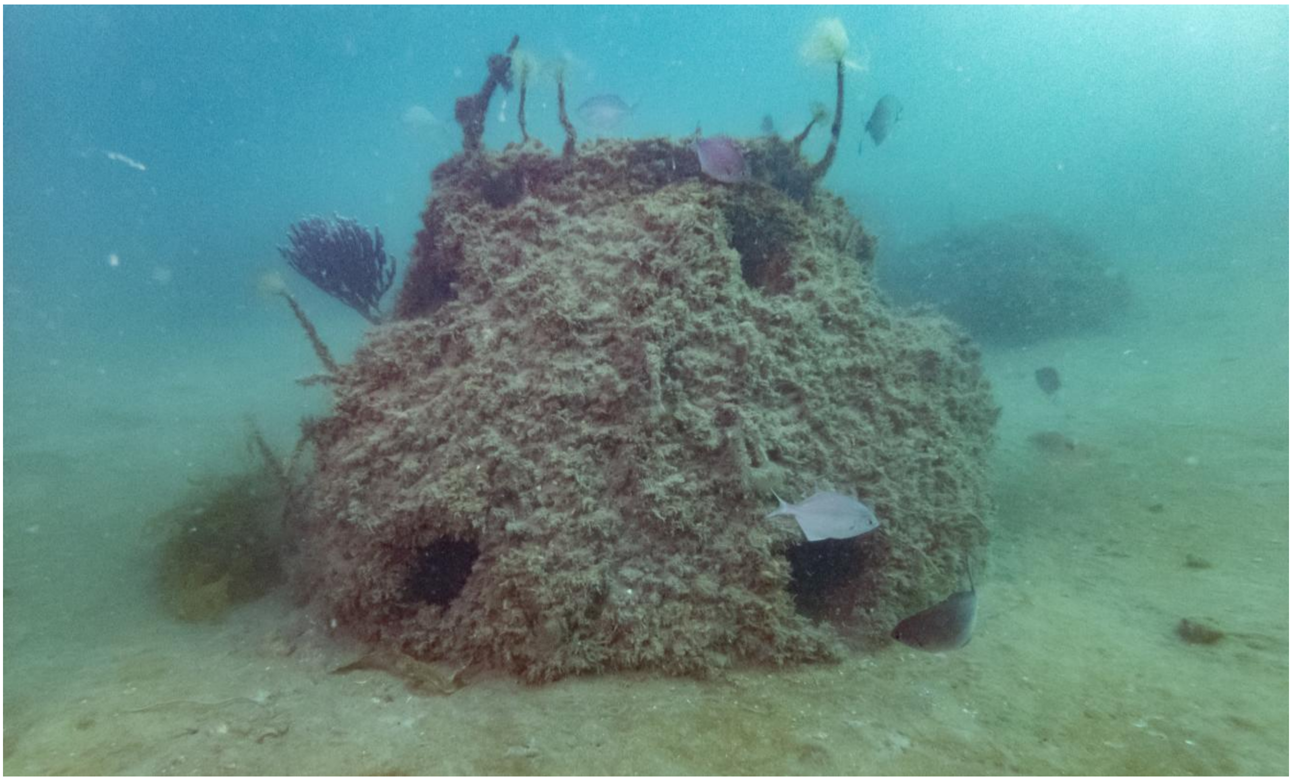


Figure 2. Artificial aquatic habitat (reef ball) in the Long Bay-Okura Marine Reserve. Photo credit: Shaun Lee.

Artificial and engineered habitats, including artificial reefs, wrecks, living seawalls and purpose-built structures, represent an emerging and sometimes controversial area of coastal and marine restoration in Aotearoa New Zealand (Table 5; Figure 5). To date, these approaches have been implemented in a relatively ad hoc manner, often with limited long-term ecological monitoring. Available evidence suggests such structures can enhance local biodiversity and provide social and recreational benefits, particularly in heavily modified or urbanised environments.

Importantly, artificial habitats do not replicate all the functions of natural ecosystems and carry risks related to cost, design failure, unintended pest-species attraction and community acceptance. Their role is therefore best understood as context-specific rather than universal, and potentially valuable where natural habitat recovery is constrained. However, they do not represent a substitute for protection or the restoration of natural systems.

For councils, artificial habitat approaches are most defensible when integrated into infrastructure projects, compensation frameworks or urban design initiatives, and when accompanied by clear ecological objectives and monitoring requirements.

Table 5. Overview of active restoration approaches trialled in artificial aquatic habitats in Aotearoa New Zealand, summarising the current level of evidence, typical scale of application, key constraints and implications for regional and unitary councils.

| Restoration approach | Current level of evidence | Typical scale to date | Key constraints and risks | Implications for councils |
|---|---|---|---|---|
| **Shipwrecks and large engineered reefs** | **Low–moderate** – limited monitoring | Few, discrete sites | High cost; consenting complexity; uncertain ecosystem equivalence | Can provide habitat and social benefits but should not replace restoration of natural habitats |
| **Pre-fabricated reef modules** | **Low–moderate** – variable outcomes | Small deployments | Design suitability; risk of burial or invasive species | Promising in some contexts but requires robust monitoring and purpose-specific design |
| **Living seawalls / eco-engineered shorelines** | **Emerging** | Small urban trials | Expense; limited long-term ecological data | Well suited to urban environments when integrated into infrastructure projects |
| **Use of natural materials (e.g. boulders, wood, shell)** | **Moderate** – strong freshwater precedent | Small–moderate | Material stability; site exposure | Lower-risk option that may support habitat complexity if well designed and located |

Key references: Larcombe and Russell 1971; Russell 1975; Black 1999; Jaffrey 2004; Robertson and Jacobs 2011; Hickford and Schiel 2013; Holmes and Goodwin 2021; Barrett et al. 2024; Te Ara Tupua 2024; Ellis-Smith et al. 2025; Gallagher 2025; Murray 2025; Alder et al. 2026; Opotiki Community REAF Trust 2026.

## 2.6 Priority areas to advance active coastal and marine restoration

The habitat-specific reviews presented above highlight that active restoration in Aotearoa New Zealand is progressing across a diverse range of coastal and marine ecosystems, although the stage of development, effectiveness and scalability of restoration approaches vary considerably among habitats. While some approaches, such as saltmarsh revegetation and mussel reef restoration, are supported by a growing evidence base, others remain at an earlier stage of development and require further testing and refinement.

Across all habitats, restoration outcomes are generally strongest when active interventions are combined with efforts to address the underlying causes of degradation. Continued investment in monitoring, adaptive management and the sharing of lessons across projects will also be important for improving restoration success and building confidence in restoration as a management tool.

Table 6 summarises the priority areas that could help advance active coastal and marine restoration in Aotearoa New Zealand. These priorities are intended to highlight where further coordination, evidence generation, method development or enabling conditions may be needed. They should not be interpreted as actions that councils are expected to deliver independently, but rather as areas where collaborative effort across councils, iwi and hapū, researchers, communities, industry and central government could help accelerate restoration outcomes.

Table 6. Current restoration approaches and priority areas for advancing active coastal and marine restoration across major habitat types in Aotearoa New Zealand.

| Habitat | Current focus of active restoration | Priority areas to advance restoration |
|---|---|---|
| **Saltmarsh** | Reducing physical pressures, replanting native saltmarsh vegetation and restoring tidal hydrology | Clarify how effective pressure removal (e.g. fencing, weed control) is on its own compared to when combined with active planting; plan restoration under future sea-level rise by modelling tidal flows and shore elevation change; assess long-term durability and maintenance needs of hydrological and geomorphic modifications (e.g. drains, cheniers); ensure long-term monitoring and compliance |
| **Seagrass** | Small-scale trials of transplants and emerging low-impact techniques | Address the underlying causes of seagrass loss (e.g. turbidity, sedimentation); improve habitat suitability assessment to identify locations most likely to succeed; refine seed-based and beach-cast fragment techniques; develop reliable methods for out-planting seeds or seedlings; support projects as trials and learning opportunities rather than guaranteed restoration outcomes |
| **Rocky reefs** | Reduction of grazing pressure and targeted reseeding trials | Integrate urchin removal with predator recovery and fisheries management to reduce reinvasion risk; develop scalable and cost-effective removal approaches; better understand how warming, storms and other stressors interact with grazing pressure; reserve active reseeding for sites where drivers of kelp loss have been addressed and environmental conditions are suitable |
| **Soft sediments (estuaries and embayments)** | Shellfish translocations, shell addition and pressure removal | Refine site selection, recruitment limitations and scaling of shellfish translocations; extend trials beyond short time frames to assess persistence; apply mangrove clearance cautiously based on site exposure and sediment dynamics; recognise limits of recovery in heavily modified upper estuaries without broader system change |
| **Soft sediments (subtidal)** | Shellfish translocations, shell addition and limited remediation experiments | Improve understanding of recruitment bottlenecks and juvenile habitat requirements; assess where structural additions (e.g. shell, fibres) meaningfully enhance recovery; treat seabed remediation (e.g. sediment removal) as a niche, site-specific tool due to cost and complexity; integrate restoration with fisheries and seabed management |
| **Artificial and highly modified aquatic habitats** | Installation of artificial reefs, living seawalls and engineered structures | Evaluate whether artificial structures meaningfully restore habitat function relative to natural analogues; compare designs, materials and placement to determine what works best for native species; assess long-term ecological trade-offs and risks; apply the principle of the 'right structure in the right place', particularly in urban or heavily modified settings |

# 3. Main barriers to scaling up restoration

The synthesis identified six recurring ecological and implementation challenges to scaling up coastal and marine restoration that are particularly relevant to councils (Figure 3).


Figure 3: Summary of the key implications for regional and unitary councils to support more effective, coordinated and scalable coastal and marine restoration in Aotearoa New Zealand, based on the challenges and opportunities outlined in this report.

## 3.1 Restoration in degraded and changing environments

Many coastal and marine restoration projects in Aotearoa New Zealand are attempted in environments where the underlying drivers of degradation remain unresolved. High inputs of catchment-derived sediment and nutrients continue to affect many estuaries and nearshore systems, while legacy impacts from historical land use, habitat modification and fishing pressure can suppress natural recovery. These existing pressures reduce the likelihood that restoration interventions will persist or deliver intended ecological outcomes, even where short-term gains are observed.

Climate change further complicates restoration planning and investment. Sea-level rise, warming water and changing disturbance regimes can alter habitat suitability over time, meaning that sites that appear suitable today may not remain so in the future. As a result, restoration is unlikely to succeed unless it is explicitly linked to efforts that reduce ongoing pressures, integrate land–sea management (ki uta ki tai) and anticipate future environmental change. For councils, this highlights the importance of aligning active restoration with catchment management, spatial planning and climate-adaptation frameworks, rather than treating restoration as a standalone action.

## 3.2 Addressing ecological knowledge gaps

Active coastal and marine restoration remains a relatively young field, and key ecological knowledge gaps continue to constrain progress. In many habitats, there is limited understanding of the conditions under which restoration interventions are most likely to succeed. More information is also needed on the spatial scales required to trigger self-sustaining recovery and the time frames over which benefits can reasonably be expected. Short monitoring periods and a lack of long-term datasets make it difficult to assess whether apparent early success translates into enduring ecosystem recovery.

Addressing these gaps requires continued investment in monitoring, shared learning and coordinated experiments across multiple sites and regions. Councils have an important role to play in supporting standardised monitoring approaches, facilitating data sharing and backing collaborative projects that test restoration approaches across environmental gradients. While uncertainty should not be a barrier to action, clearer evidence about what works, where and at what scale will be critical for guiding future investment and building confidence among funders and communities.

## 3.3 Navigating governance and regulatory complexity

Governance and regulatory complexity present a significant barrier to scaling up coastal and marine restoration. Restoration spans land, freshwater, coastal and marine domains, yet planning and management responsibilities are often fragmented across agencies and policy frameworks. This can result in misalignment between catchment initiatives, coastal planning, fisheries management and restoration efforts, reducing overall effectiveness.

In addition, regulatory pathways for active restoration are frequently unclear or inconsistent across regions. Activities such as species translocations, seabed modification or the installation of structures can fall into regulatory grey areas, creating uncertainty, delays and additional costs for project proponents. For councils, clearer regulatory guidance and more consistent permitting pathways, particularly for low-risk or community-led projects, would help reduce barriers to implementation and support broader uptake of restoration initiatives.

## 3.4 Strengthening social and cultural foundations for restoration

Strong social and cultural foundations are critical to the success of coastal and marine restoration. The most effective projects are typically co-designed with iwi, hapū and local communities, building on mātauranga Māori, local knowledge and shared stewardship values. These partnerships help ensure restoration goals are locally relevant, culturally appropriate and supported over the long term.

However, coastal and marine restoration often lacks the visibility and accessibility of land-based projects, making it harder to build public awareness, social licence and sustained volunteer or funding support. Councils can play an enabling role by supporting engagement, communication and capacity-building, and by investing in restoration approaches that allow meaningful community involvement. Strengthening these social foundations is essential not only for delivery, but for maintaining momentum and trust as projects scale up.

## 3.5 Broadening expectations and perceptions of success

Expectations of what constitutes 'success' in coastal and marine restoration can strongly influence investment decisions and perceptions of progress. Restoration is often judged using short-term or narrow metrics, such as survival of planted material or the area treated, which may not reflect longer-term ecosystem recovery or broader social and cultural benefits. Unrealistic expectations of rapid or complete recovery can also undermine confidence when outcomes take longer to materialise.

Recognising restoration as a staged and adaptive process can help reset expectations. Before ecological responses become measurable, progress may first be seen in improved environmental conditions, increased knowledge, stronger partnerships or enhanced community engagement. Framing success as progress along a recovery trajectory, rather than an immediate end point, allows councils to acknowledge interim gains, learn from challenges and build durable pathways towards long-term outcomes.

## 3.6 Scaling up restoration

Ultimately, achieving meaningful ecological outcomes will require restoration to move beyond isolated, small-scale trials toward coordinated efforts at larger spatial and temporal scales. Many current projects are limited by short funding cycles, site-by-site implementation, and a focus on pilot studies, all of which constrain the ability to address system-level pressures or trigger self-sustaining recovery.

Scaling up will likely involve a mix of larger demonstration projects and networks of smaller, strategically aligned interventions, supported by longer-term funding and shared infrastructure. Councils can act as convenors and integrators, helping align restoration with wider planning, investment and policy processes. Clear pathways from pilot projects to broader implementation will be essential for translating early innovation into lasting environmental gains.

# 4. Key actions and messages

## 4.1 Practical and immediate actions for councils

Based on the synthesis, the following actions taken by regional and unitary councils are likely to deliver the greatest value:

1. **Embed restoration in strategic planning**

   Treat restoration as a core outcome alongside protection and mitigation, not an add-on.

2. **Prioritise where restoration can work**

   Use information on catchment pressures, habitat condition and climate exposure to identify realistic restoration sites.

3. **Link restoration to pressure reduction**

   Align coastal and marine restoration projects with catchment, fisheries and spatial planning initiatives.

4. **Support co-design and partnerships**

   Invest early in relationships with iwi / hapū, communities and practitioners.

5. **Enable learning at scale**

   Coordinate projects across regions, use shared monitoring frameworks and share lessons openly.

6. **Advocate for enabling policy and funding**

   Use evidence from pilot and demonstration projects to inform national reform and investment.

## 4.2 Key messages for decision-makers

- Active coastal and marine restoration in Aotearoa New Zealand is promising but still emerging.
- The main limitation is scale and coordination, not lack of effort or interest.
- Councils are central to creating the conditions for success through planning, partnerships and sustained investment.
- Progress should be judged by trajectory and learning, not just short-term ecological metrics.

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