Te Hunga Takutai o Aotearoa
NEW ZEALAND COASTAL SOCIETY

Coastal News

Newsletter of the New Zealand Coastal Society: a Technical Group of Engineering New Zealand

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Eating away at the coast...

New Zealand's first long-term Infrastructure Strategy was released last May. To find out how it addresses infrastructure in the coastal environment, see the interview article beginning on page 3.

Coastal road erosion in Palliser Bay, 2007 (Photo: Public domain)

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Word from the Chair

Welcome to the November 2022 edition of *Coastal News*. This issue brings you feature articles on the challenges of managing infrastructure in the coastal context, gathering observations from communities on the December 2021 Tongan tsunami, and innovations in dune restoration. We really appreciate the work from our members in providing NZCS with such interesting content, stretching across multiple disciplines. Catch up on what's happening along nga Takutai o Aotearoa in the 'News from the Regions' section, plus we are proud to update you on our two NZCS 2022 Scholarship award winners – Benjamin Jones from the University of Auckland (PhD student) and Alisdair Hall from Massey University (MSc student).

It has been an exceptionally busy period for the Society as we have worked on the final stages of organising our conference as well as preparing for the release of our fifth Special Issue publication. The conference is the first one held since we came together in Invercargill in 2019. The local organising committee, led by Connon Andrews, has been working overtime to bring our members this event on the beautiful Waiheke Island. Additionally, this is an extra special occasion as it marks the 30th NZCS conference – what a fantastic milestone!

On the opening day of the conference, we released the Coastal News Special Issue 5 '*Coastal Adaptation: Adapting to coastal change and hazard risk in Aotearoa New Zealand*'. At an impressive 102 pages long, it is our biggest special issue yet. We are extremely grateful to all of those who contributed articles to the publication, as well as to those who put in many hours behind the scenes to pull it together – not least our super-editor extraordinaire Charles Hendtlass who worked tirelessly to ensure the deadline was met.

Don Neale and Craig Davis will be stepping down from the committee at the 2022 AGM. Craig joined the committee in 2018 and during that time has made some great contributions to the scholarships and awards portfolio. Don joined the committee in 2014 and during those eight years has done a superb job leading the publications portfolio. During his tenure both the *Coastal News* and the Special Issues have gone from strength to strength. Don also organised the superb 2013 conference in Hokitika. We would like to thank both Don and Craig for the significant input they have had whilst on the committee and acknowledge the time commitment that work entailed.

Lastly, you will find our Kupu Takutai Rua as an insert in this issue, focussing on coastal geographic terms with te reo Māori translations. This is NZCS's second resource developed for Te Wiki o te Reo Māori 2022 and we hope you find it useful in your korero this summer.

Thank you for your ongoing support to the NZCS, and we wish you a safe and relaxing summer break with your friends and whanau.

Amy Robinson and Mark Ivamy
NZ Coastal Society Co-Chairs

About the NZCS

The New Zealand Coastal Society was inaugurated in 1992 'to promote and advance sustainable management of the coastal environment'. The society provides a forum for those with a genuine interest in the coastal zone to communicate amongst themselves and with the public. The society's mission is to take a leading role in facilitating robust discussion and nationally-coordinated interactions to better manage and learn about our coastal and marine environment. The society currently has over 400 members based in New Zealand and overseas, including representatives from a wide range of coastal science, engineering and planning disciplines, employed in the consulting industry; local, regional and central government; research centres; and universities.

Membership applications should be sent to the NZCS Administrator Renée Coutts (nzcoastalsociety@gmail.com).

Infrastructure in a coastal context: Interview with Geoff Cooper of Te Waihanga

Interview by Shelly Farr Biswell, Te Waihanga

In May of this year, Te Waihanga released New Zealand's first long-term Infrastructure Strategy to set out the challenges we face and the changes needed over the next 30 years to build a stronger and more resilient Aotearoa. Shelly Farr Biswell, Te Waihanga Senior Communications, recently interviewed Geoff Cooper, Te Waihanga General Manager Strategy, to learn more about the Strategy and how it addresses infrastructure in the coastal environment.

Do you want to briefly describe what Te Waihanga (the New Zealand Infrastructure Commission) does?

Te Waihanga is relatively new on the scene. We were established as an autonomous Crown entity in 2019 to help the government and others to take a holistic and long-term view of our infrastructure. We work across government, sharing guidance on delivering critical projects, and identifying ways that New Zealanders can get value for money.

An important part of our initial work was developing Rautaki Hanganga o Aotearoa, the New Zealand Infrastructure Strategy. The Strategy identifies New Zealand's significant infrastructure challenges and provides a principles-based approach to address these challenges with the aim of achieving a thriving and resilient New Zealand. It represents the culmination of two years' independent investigation, and incorporates feedback from an extensive engagement process, along with guidance from a Te Ao Māori testing panel and a local government reference group.

What are some of the overarching challenges for New Zealand when it comes to infrastructure?

Like many other OECD countries[1], New Zealand has under-invested in infrastructure in the past. In many cases this has meant lower service quality and resulted in existing infrastructure under pressure. At the same time, the expectations of our infrastructure are increasing. Achieving a net-zero carbon economy is in large part an infrastructure problem; changing weather patterns and rising sea levels asks more of our resilience (see Figure 1); and we need more infrastructure for housing so that our children are not priced out of our cities.

The challenges ahead are cause for introspection. Are our current ways of working fit for purpose in the face of rising building costs and greater project complexity? Are our regulatory and legislative settings fit for purpose against rapid technological change? And how can we attract the best minds to get the job done, at the very time global competition for talent is intensifying?

What are some of the specific challenges facing coastal communities when it comes to infrastructure?

One of the biggest challenges is that even as the risks of coastal living are becoming more understood, the pressure to develop coastal land is strong. New Zealanders love living by the coast. One study estimates sea views raise the market price of a house by some 44%[2]. With new trends toward working from home and high prices in our cities, one might reasonably expect that the pressure to develop in more remote coastal living will only increase. At the same time, we have communities that have lived in remote coastal places for generations, with a strong connection to the land.

The Ministry for the Environment first cautioned of a collision between coastal development and climate change some 21 years ago[3]. Two decades on, we know more about where this collision will occur. The NZ SeaRise programme has mapped sea-level rise and vertical land movement under potential climate change scenarios (see Figure 2). We are still learning about the full impact on infrastructure, but we expect it will be significant. For instance, a 2019 study estimated that $8 billion worth of local government infrastructure is at risk from 1.5 metres of sea-level rise[4].

The Strategy doesn't have any easy answers when it comes to these issues, but it does provide recommendations on planning, decision making, financing and funding, and the types of information that we need to have available, such as robust risk assessments, good planning and regulatory policy and population modelling that can support some of the difficult choices we're going to need to make as a country.

Can you talk a little more about the intersection of infrastructure, insurance and planning?

Adaptation will require a closer collaboration between these three disciplines. As sea levels rise, in coastal areas we might expect a sequential retreat of insurance, credit (from

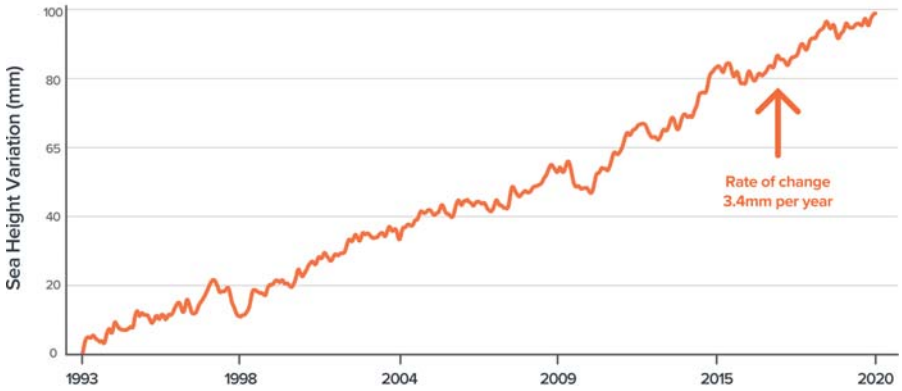

Figure 1: Satellite sea level observations, change in sea level from 1913 to 2021. For central and local government, using the best available hazard information and tools when developing regional spatial plans and planning documents and making other infrastructure investment decisions will help to reduce the risk of harm and the costs of poor investment. Source: Adapted from Physical Oceanography Distributed Active Archive Center (2021).

Figure 2: NZ SeaRise's interactive map that illustrates vertical land movement. Source: NZ SeaRise (see: https://www.searise.nz/maps-2).

banks and financial institutions) and existing infrastructure (including both economic and social). Insurance markets are a first mover because the sector is concerned with pricing risk by location – and we are learning more about the nature of that risk every day. For instance, many areas in New Zealand are expected to experience a 30 cm increase in sea levels over the next hundred years. According to Professor Tim Nash of Victoria University, this means a 1 in 50-year coastal storm flood will occur annually. For infrastructure owners, assets may become more difficult to insure at a reasonable cost, creating operating-cost pressures. Some assets may not be insurable at all. In light of such concerns, it is unsurprising to hear public comments from insurance providers asking for an end to building in flood-prone areas[5].

> *The point will come when homes become uninhabitable and homeowners will be forced to leave and live elsewhere... The inevitability of sea level rise means there is nothing unforeseen or sudden about it and insurers are likely to be unwilling to cover loss from this source.*
>
> *Tony Randerson, Chair of the Resource Management Panel*

One only needs to look at how much the insurance landscape has changed in California due to recent wildfires to understand the impending challenge[6]. Insurers have pulled back from underwriting homeowners insurance throughout the state, resulting in fewer homeowners insurance options, higher premiums, and more limited coverage terms. As insurers retreat, we should expect that mortgage applications in at-risk areas will be looked at differently as will the economic case for new infrastructure.

Those planning our future infrastructure will need to be aware of any such emerging trends and its cascading impact on spatial, infrastructure and asset management plans. The good news is that this is an area bustling with new tools and technology. Spatial geocoding and digital twin technology are just two technologies helping to rethink infrastructure planning to ease the transition; for instance, by guarding against lead infrastructure that might otherwise push new development to at-risk areas.

How might the infrastructure response be similar or differ across coastal communities?

When we're talking about coastal communities in a New Zealand context, we need to remember that 65% of us live within 5 km of the coast. Traditionally much of our social organisation is determined by proximity, that could be local communities, cities or regions. But as sea levels rise, coastal areas will be important communities of interest. Residents on the coastlines of Opotiki, Owhiro Bay and Cooks Beach may find they have more in common than before.

While some approaches to infrastructure will be common, many of the solutions will be more bespoke. To take one example, areas with greater density of population are likely to have very different mitigation options, since these areas can spread large capital costs more effectively. Tokyo provides one extreme example, where the city has invested some 2 billion dollars in towering cathedral caverns beneath the city, which can now withstand up to 50 mm of rain per hour[7]. Adaptation in Auckland might look quite different to a small New Zealand coastal town.

Similarly, the solutions for growing areas may differ from those with flat or declining population. As we discuss in the Strategy, areas with flat or declining population already face challenges in funding existing infrastructure, even before we think about new infrastructure for adaptation. These issues may become more important in the future as 56 of New Zealand's territorial authorities are expected to experience population stagnation or decline into the 2030s. Infrastructure providers will need to consider new ways to reduce or even decommission infrastructure to manage the financial burden of maintaining under utilised or at-risk assets. In contrast, areas with population growth can adapt as they build, using asset management programmes to change course in a more incremental way.

But one thing is true for all our coastal communities whether a dense urban metropolis or a sparsely populated coastal town; long-term infrastructure planning is essential. Sea-level rise and more extreme weather patterns are coming whether we plan for it or not. And as the OECD has stated, in terms of climate change measures, 'doing nothing will cost more than acting'[8]. Similarly, and perhaps decisively, as local communities around the country rethink the infrastructure of where we live, work and play, our communities will need to grapple with the impacts on our most vulnerable. For some, this is a moral imperative, but it is also essential to an enduring consensus on the path forward.

Can you talk about solutions to our current infrastructure challenges?

While all of us at Te Waihanga are aware of New Zealand's infrastructure challenges, we're also excited about the innovative work being done in both New Zealand and the rest of the world to address these issues. As many of your members know, for example, nature-based solutions, such as the restoration of coastal dunes, can support both climate change adaptation and mitigation objectives. Forward maintenance programmes give us the opportunity to rethink investment programmes, digital twins can allow new approaches to land-use planning, and

NAP unpacked webinars

The National Adaptation Plan (NAP) sets out the government's response to the risks our communities, built-environment, economy and natural environment will face from a changing climate. Led by the Ministry for the Environment, the NAP is the result of collaboration across government, and incorporates feedback from a wide range of stakeholders including, iwi/Māori, local government, industry, and community groups.

Te Waihanga has hosted two webinars to unpack what the NAP means for the infrastructure sector.

- Webinar 1 (www.tewaihanga.govt.nz/news/commission-news/nap-unpacked) features Monique Cornish, Principal Advisor, Policy, Te Waihanga; Joseph Hägg, Lead Advisor – Climate Change Adaptation, Waka Kotahi; and Antonia Reid, Policy Director, Building for Climate Change, Ministry of Business, Innovation & Employment.
- Webinar 2 (www.tewaihanga.govt.nz/news/commission-news/watch-nap-unpacked-webinar) features Monique Cornish, Principal Advisor, Policy, Te Waihanga; Ajay Makhija, Team Leader, Infrastructure Resilience, National Emergency Management Agency, Te Rākau Whakamarumaru; Richard Mowil, Project Manager, Lifelines Group; and Maiki Andersen, Senior Analyst, Climate Adaptation, Ministry for the Environment.

dynamic adaptive policy pathways are helping policymakers test different scenarios and consequences before committing to a particular direction.

In the Infrastructure Strategy, we recommend prioritising non-built options when choosing how to address infrastructure challenges, including using pricing to manage demand, making better use of existing infrastructure by adapting or repurposing it, using regulation and education to manage infrastructure demands, and considering lower-cost options before progressing to higher-cost options. When it comes to new infrastructure, we need adaptation issues to be front of mind.

There's currently extensive reform going on in the planning space, but the Strategy provides recommendations on creating a planning system that meets the pace of the challenges ahead. For example, meeting the net-zero carbon emissions target and building cities that are affordable for future generations means infrastructure will need to be built in certain locations at certain times.

What if people would like to learn more?

One of our key roles is to support government agencies, local authorities and others to procure and deliver major infrastructure projects. Our aim is to supplement, rather than replace, existing capability. As part of this we provide best practice guidance, along with procurement and delivery support. If NZCS members have questions, please feel free to get in touch.

You can contact me at:

geoff.cooper@tewaihanga.govt.nz

or go through our information email at:

info@tewaihanga.govt.nz.

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Coastal News is published three times a year (in both print and electronic formats) and is distributed to the Society's 400 members and corporate members, as well as being publicly available on the NZCS website. Total readership per issue is estimated at 500+, comprising professionals in coastal science, engineering and planning, and employed in the engineering industry, local, regional and central government, research centres, and universities.

If this is a group you would like to connect with, *Coastal News* has a range of advertising opportunities available, from small notices to a full page.

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Crowdsourcing tsunami observations in Aotearoa following the Hunga Tonga-Hunga Ha'apai eruption

Rachel Lawson, Sally Potter and Kate Clark, GNS Science

In December 2021 the Hunga Tonga-Hunga Ha'Apai (HTHH) caldera volcano in the Kingdom of Tonga, approximately 2000 km north-east of Aotearoa, awoke. On January 15 2022, after a period of unrest, a large eruption produced ash plumes and generated tsunami and shock waves, which were experienced globally.

In Aotearoa, a National Advisory for Tsunami Activity was activated from 8.14 pm on Saturday 15 January to 7.06 pm on Sunday 16 January 2022 (NEMA, 2022). GNS Science activated its internal coordinated incident management system (CIMS) focusing on monitoring tsunami threats, understanding tsunami propagation, and calculating impact assessments both nationally and in Tonga. Instrument records such as tidal gauges and DART (Deep-ocean Assessment and Reporting of Tsunamis) buoys recorded physical processes such as wave height and arrival time, but lacked insights into how communities were impacted. To address this, an interdisciplinary team of social, volcano, and tsunami scientists deployed an online survey to the New Zealand public between January 21st and February 13th, 2022.

Our survey was advertised through a GeoNet website news story, social media posts (on GeoNet Facebook and Twitter) and a television interview. Through the SurveyMonkey web survey we received 2072 observations, and through a GNS Science email address we captured a further 30 observations.

In total 17 images and videos were sourced. From the 39 questions, 10 focused specifically on people's experiences at the coast and observations of potential tsunami activity. Using the limited location information provided we geolocated 163 tsunami observations (of 295 total). For each quantitative question summary statistics were produced (minimum, mean, median, maximum, standard deviation), and aggregates based on location were calculated at regional authority and postcode scales.

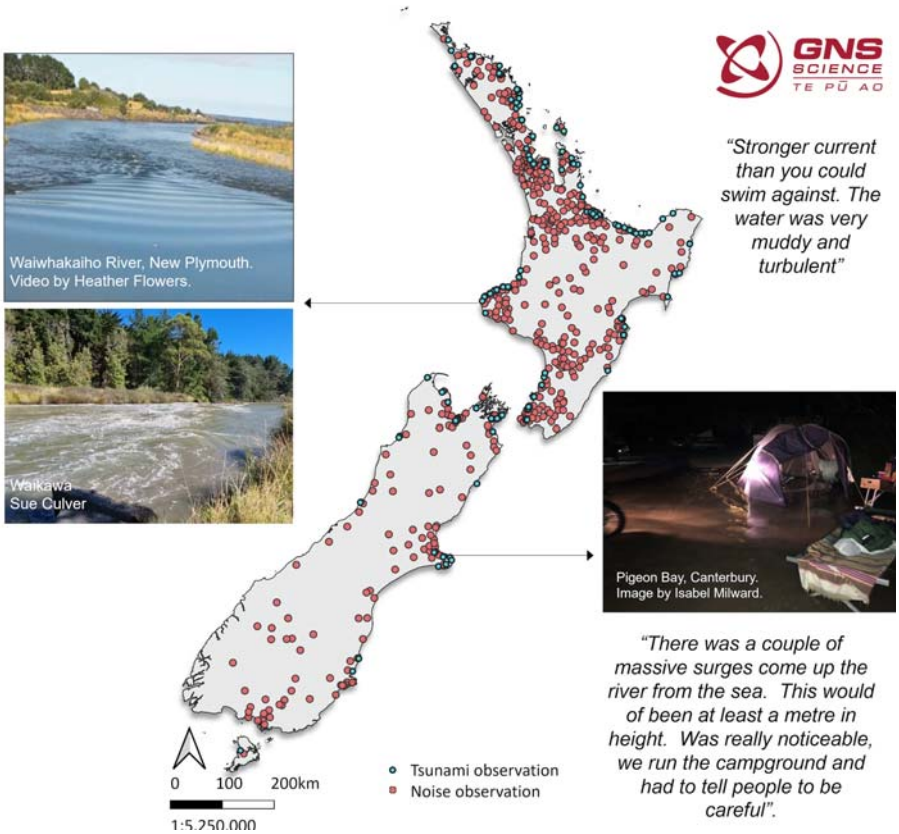

Figure 1: Location of crowdsourced observations following the January 15 2022, HTHH eruption with example responses/images from the public.

We conducted thematic analysis of free text to identify common topics, impacts noticed, details of physical changes (such as water colour/height), and people's responses.

Survey results

Participants who observed unusual sea conditions often saw unusual surges of water approaching or retreating the shore. Some observed impacts on the natural or built environment that they believe were caused by water movement.

The four closest New Zealand DART Buoys (NZ: A, B, C, D) located off the East Coast first recorded peaks in sea level between 2.8 cm and 3.7 cm arriving from ~7.43 pm to 8.13 pm NZDT (Gusman and Rodgers, 2022). The first credible crowdsourced reports observed changes in the late evening on the day of the eruption. Early reports were predominantly on the East Coast, as indicated by yellow stars in Figure 2, with most observations noting changes the following day.

When asked to describe changing currents and wave activity many respondents noted stronger than expected movement, unusual and unpredictable tides that were higher or lower than expected, and which did not align with expected tide levels. Furthermore, rather than a singular tsunami wave, multiple surges were witnessed, aligning with evidence from instrument records that often the waves arrive in sets. Many individuals reported a sudden drop or increase in water level, sometimes catching them off guard.

1. Did you notice any unusual sea conditions on 15 or 16th January 2022?
2. Location (Region, post code, town street or location)?
3. Start and end Date/Time (observing the sea, and observing unusual conditions)?
4. Did you notice unusual surges of water, either approaching the shore or retreating from the shore)?
   a. *If yes, how many surges did you notice, and how long did each last?*
5. Did you notice unusual changes in the water level or currents?
   a. *If yes, please estimate the change in water level between its highest and lowest points or describe the change in currents.*
6. Did you observe unusual colours or other appearances of the sea?
   a. *If yes, what did you notice?*
7. Were there any unusual sounds or smells associated with the sea?
   a. *If yes, what were the sounds and/or smells?*
8. Did you observe any impacts on the natural or built environment that were caused by the water movement?
   a. *If yes, what were they?*
9. If there are any other details you think it would be useful for us to know about the tsunami, please state them here.
10. Do you have any photos of the sea showing unusual behaviour, or of damage in coastal areas?

Table 1: Tsunami observation survey questions.

For example:

> *'There was a couple of massive surges come up the river from the sea. This would of been at least a metre in height. Was really noticeable we run the campground and had to tell people to be careful.' [sic]*

> *'We were fishing you were standing ankle deep then a surge would come in and you would be waist deep and retreating to shore. The shoreline was moving about 25 meters with a surge. Never seen anything like it.' [sic]*

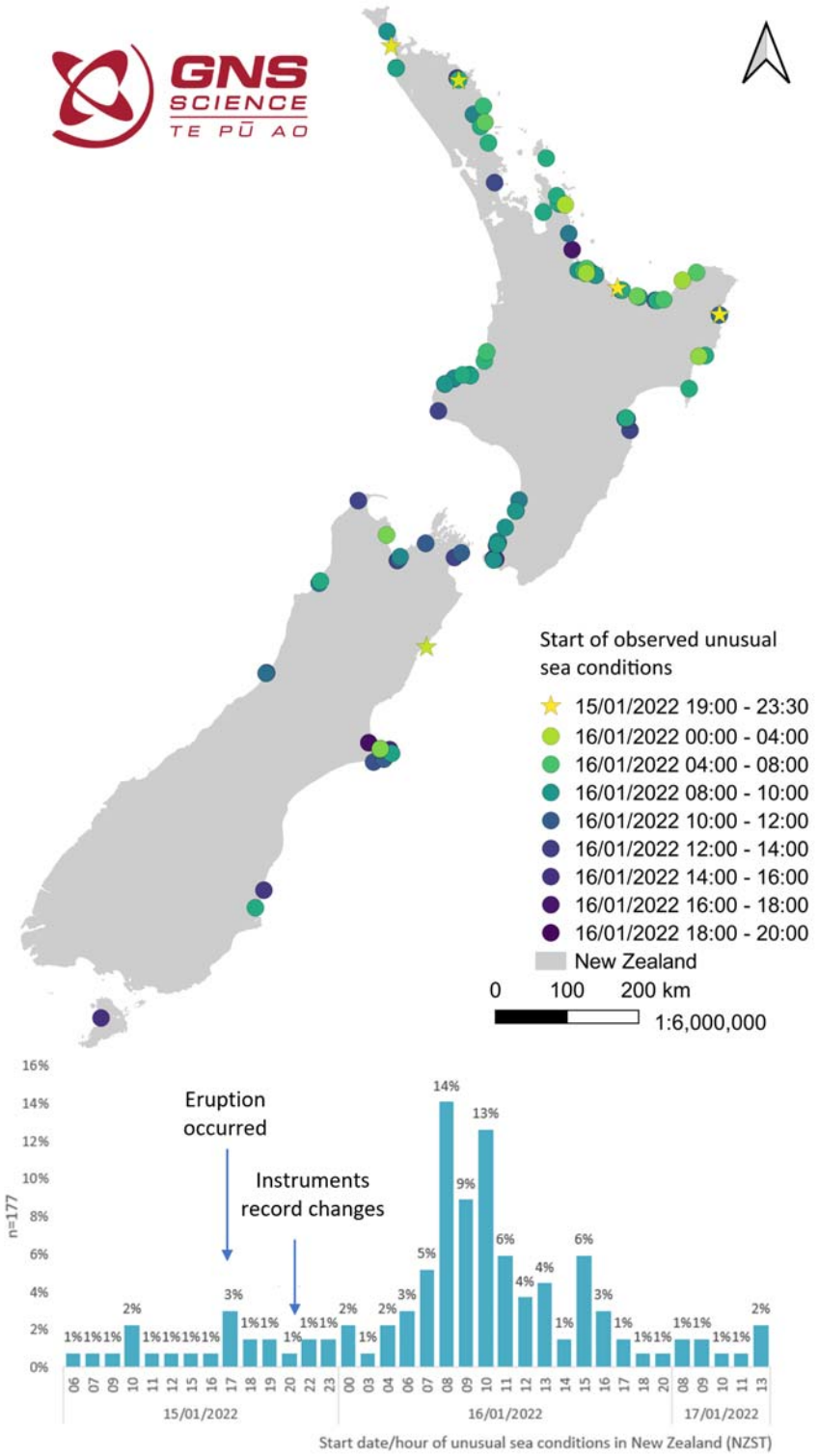

Figure 2: Start date and time of unusual water conditions, 15/16 January 2022.

Surges were witnessed at coastal beaches and inland rivers and streams, with images and text describing murkier, sediment-laden discoloured water.

Discussion

Crowdsourced data can build situational awareness for response agencies, identify impacts on the built and natural environments, provide insights into behavioral response to hazardous events, and fill gaps in the sensor networks. Following the HTHH tsunami activity, reports of damage at Tutukākā Marina were widely publicised. Our survey identified other impacted locations, such as flooded campgrounds in

Canterbury, and debris on roadways that may not be captured by other means. Our thematic analysis identified issues with delayed or missing tsunami warnings, and gave insights into the public's perceptions and experiences, made possible through social science survey methods.

There are, however, challenges with using crowdsourced data. In this case study, it was difficult for the public to differentiate between tsunami activity generated during the HTHH eruption, and ongoing surges from ex-tropical cyclone Cody. Misreporting, such as respondents reporting unusual sea conditions prior to the eruption occurring, was evident. Regardless, the public were highly engaged and willing to participate with over 1500 respondents willing to engage in follow up activities, including talking to a scientist.

Future work

This survey was created rapidly during the HTHH event response. We later identified some issues such as limited geolocation functionality. To overcome issues, increase the efficiency and repeatability, and to hasten dissemination of results to stakeholders and emergency response agencies, GNS science are redesigning the tsunami survey. We are engaging in expert elicitations, developing, and testing online data sharing portals, and exploring interactive public web visualisations using a new cloud-based platform.

Figure 3: Descriptions of unusual colour or appearances.

Acknowledgements

Thank you to our respondents for taking the time to provide their insights, images and videos. Full results will be made available in a GNS Science Report (in prep.).

Project team

Rachel Lawson, Sally Potter, Kate Clark, Sara Harrison, Mary Anne Thompson Clive, Geoff Kilgour, David Burbidge, Danielle Charlton, Christina Magill and Brad Scott.

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View of Nomuka, Tonga from an RNZAF flight two days after the 15 January 2022 volcanic eruption (Photo: New Zealand Defence Force).

Restoration of over-stablised coastal foredunes using excavated foredune notches

Duc Nguyen[1], Mike Hilton[2], Sarah Wakes[1]

Introduction

In recent decades, coastal foredunes on developed coasts have been managed to maximise vegetation cover and stability, and to increase dune height and uniformity, with the goal of reducing coastal flooding. Consequently, many foredunes are now relatively densely vegetated, high and narrow ridges of sand compared with their dynamic pre-managed form; particularly where native species have been replaced by marram grass. Such foredunes may protect the hinterland from marine flooding, but they also block sand exchange between the beach and the backdune. Therefore such foredunes may be less able to migrate landward in response to increased scarping related to ongoing eustatic sea-level rise. Paradoxically, the current 'stable' foredunes, which were developed to manage coastal hazards, might be both more vulnerable to erosion and susceptible to sea-level rise.

Excavation of 'notches' in foredunes – which are essentially artificial blowouts – aims to facilitate sand transport through the foredune to achieve a range of management objectives. Notches have been mainly used in Europe to enhance the biodiversity of the backdune environment where stability has resulted in a loss of habitat for indigenous species. The excavation of foredune notches to facilitate foredune landward migration, and increase foredune resilience to erosion, has been generally proposed. However, to date there has been no consideration of optimal notch morphologies to maximise sedimentation in a range of prevailing wind conditions.

The current study examines flow-form-sediment transport interactions in excavated foredune notches at St Kilda, Dunedin, New Zealand. St Kilda beach is a good example of a dune system that has undergone stabilisation to protect infrastructure and is now experiencing persistent erosion. The morphodynamics of excavated foredune notches are controlled by complex interactions between wind flow, notch morphology, and sand transport (Figure 1). The 'successful' excavated notch morphology (Figure 1a) might facilitate flow steering and acceleration from the beach to the notch in a range of incident wind conditions. In ideal conditions, high speed onshore winds should transport sand well inland of the foredune crest. In contrast, 'unsuccessful' notch morphologies (Figure 1b) result in flow deceleration and sand deposition inside the notch. In the long term, notch in-filling might occur, requiring the notches to be re-excavated.

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Methodology

The recent study used a range of methods for data collection. Wind flow through the notch was measured in the field using ultrasonic anemometers. Sand transport was measured during the wind events using sand traps and laser particle counters (LPC) (Figure 2). Event-scale notch morphodynamics were measured using erosion pins and RTK-GPS. Moderate-scale (months) landscape morphodynamics were described using Unmanned Aerial Vehicles (UAV, or drone). Ten field-based experiments were conducted at different locations in the St Kilda dune system (for example, notch throat, notch

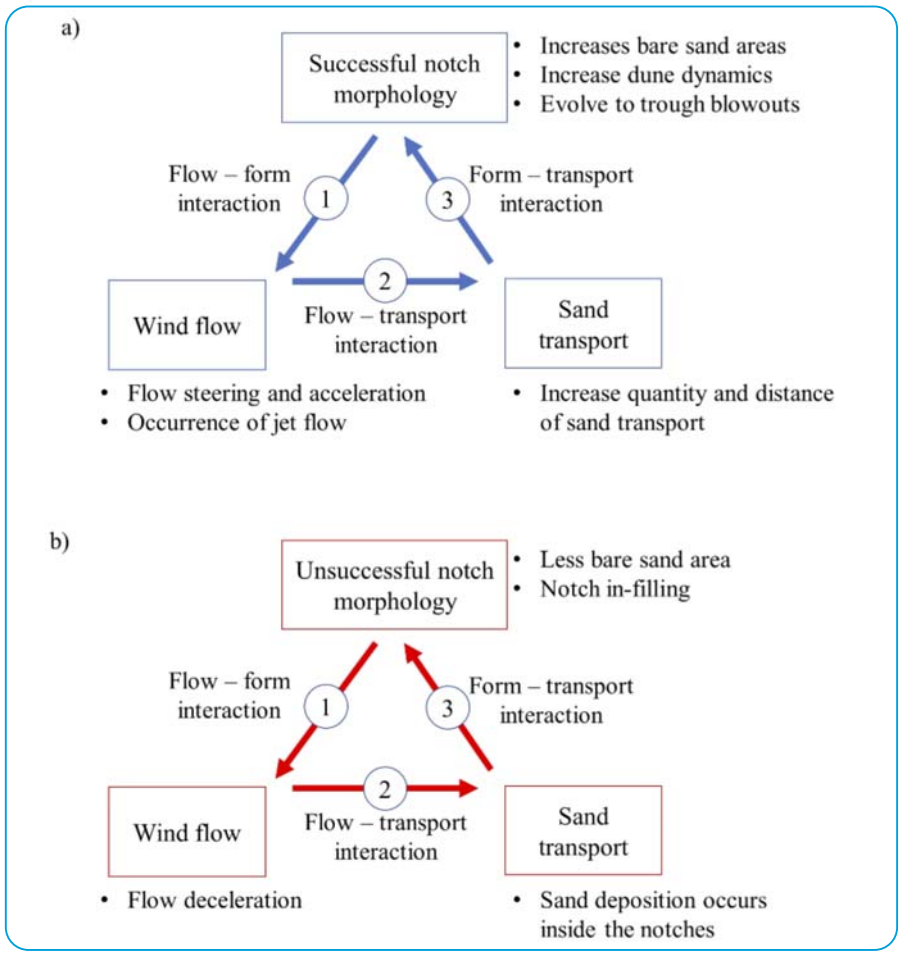

Figure 1: Complex interactions between excavated notch morphology, wind flow and transport (flow-form-transport interactions). The 'successful' notch morphology facilitates flow steering acceleration from the beach to the notches, thus increasing sand transport to the backdune (a). The 'unsuccessful' notch morphology results in flow deceleration and notch in-filling (b) (Nguyen, 2022).

Figure 2: Field-based experiment at Notch C, St Kilda, Dunedin using an array of ultrasonic anemometers (black) and a particle sand counter (LCP) (blue) (Nguyen et al., 2021).

crest) during various incident winds (for example, westerly and south-westerly winds) to capture the effects of various environmental conditions. These landscape morphodynamics were monitored over four years to quantify the long-term evolution of foredune notches and their effectiveness in destabilising sections of the foredune system.

The study combined field-based measurements with Computational Fluid Dynamics (CFD) modelling to examine wind flow dynamics over the complex dune landscape. Field-based wind measurements were used to validate the modelled wind simulated on CFD to select the best model setup (for example, domains, mesh size). The modelled winds were used to provide the results at the landscape scale (for example, at the locations that are not measured using anemometers) over a variety of incident wind conditions (measured on a high mast above the foredune). Overall, combining field-based experiment and CFD is a valuable approach to such problems and questions.

Results and implications

The current study found that excavated foredune notches result in wind flow steering from the beach through the notches to the backdune (Figure 3). Flow acceleration (speed-up) and deceleration (speed-down) from the beach to the notches occurs when the obliquity of incident wind angles to the notch axis decreases and increases, respectively. These results provide insights into the effectiveness of the excavated notches (Figure 4). For example, at St Kilda where the prevailing winds are alongshore and highly oblique onshore, sand transport is generally alongshore. The notches encourage sand transport and sand deposition behind the foredune when the winds are oblique onshore when otherwise sand transport would remain alongshore.

The current study also provides guidance to coastal managers in the design of excavated foredune notches. Flow deceleration occurs from the beach to the notches if the notches are excavated at a high oblique (angle) to the prevailing wind direction. This situation results in lower wind speeds inside the notch and lower rates of sand flux, resulting in sand deposition and notch-infilling. Notches should be excavated so that their long axis is almost parallel to the prevailing wind direction to facilitate flow acceleration and maximise sand transport to the backdune. For example, the angle between the long axis of notch C at St Kilda and incident wind direction should be less than 27° to promote flow acceleration from the beach through the notch.

On-going and future work

The coastal research group at the University of Otago has been continuing with this work, supported by the Coastal Programme of the Resilience to Nature's Challenges, Kia Manawaroa – Ngā Akina o Te Ao Tūroa and Dunedin City Council. A key focus is how to utilise this method on metropolitan coasts where foredunes are confined by hinterland infrastructure, and where the potential for foredunes to migrate is limited. The St Kilda study indicates that the rate and direction of sand transport through notches, and hence foredune evolution, can be controlled through careful notch design. In such circumstances it may be advantageous to achieve 10% or 20% 'rollback', over periods of years to decades, while longer-term solutions are designed and implemented.

Acknowledgements

Duc Nguyen acknowledges the New Zealand Coastal Society for providing a Doctoral Student Research Scholarship Award. We are also grateful for the support of the Dunedin City Council, and the School of Geography and Department of Mathematics and Statistics at the University of Otago. We also thank our colleagues and friends for their fieldwork assistance.

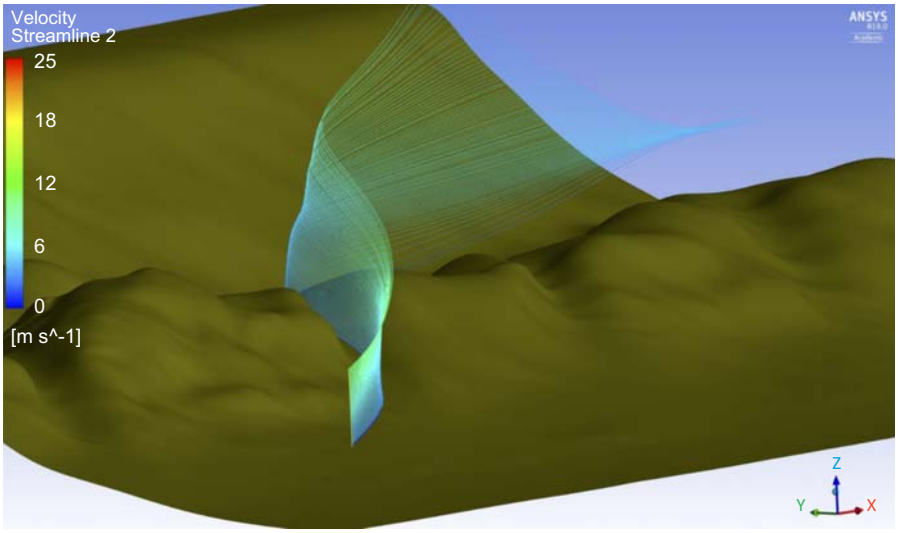

Figure 3: Computational Flow Dynamics (CFD) wind flow modelling during oblique onshore incident wind conditions. The excavated foredune notches result in flow steering from the beach through the notches to the backdune.

Recent publications

Nguyen, D, Hilton, M, and Wakes, S (2022a). Wind flow dynamics and sand deposition behind excavated foredune notches on developed coasts. *Earth Surface Processes & Landforms 47*. doi: 10.1002/esp.5341

Nguyen, D, Hilton, M, and Wakes, S (2022b). Aeolian sand transport thresholds in excavated foredune notches. *Earth Surface Processes & Landforms* 47, 553-568. doi: 10.1002/esp.5271

Nguyen, D, Hilton, M, Wakes, S, and Simons-Smith, T (2021). Incident wind angle and topographic steering through excavated foredune notches. *Geomorphology* 392, 107982. doi: 10.1016/j.geomorph.2021.107982

Nguyen, D (2022). *Wind flow dynamics and sand transport through excavated foredune notches* (PhD Thesis). University of Otago. http://hdl.handle.net/10523/12831

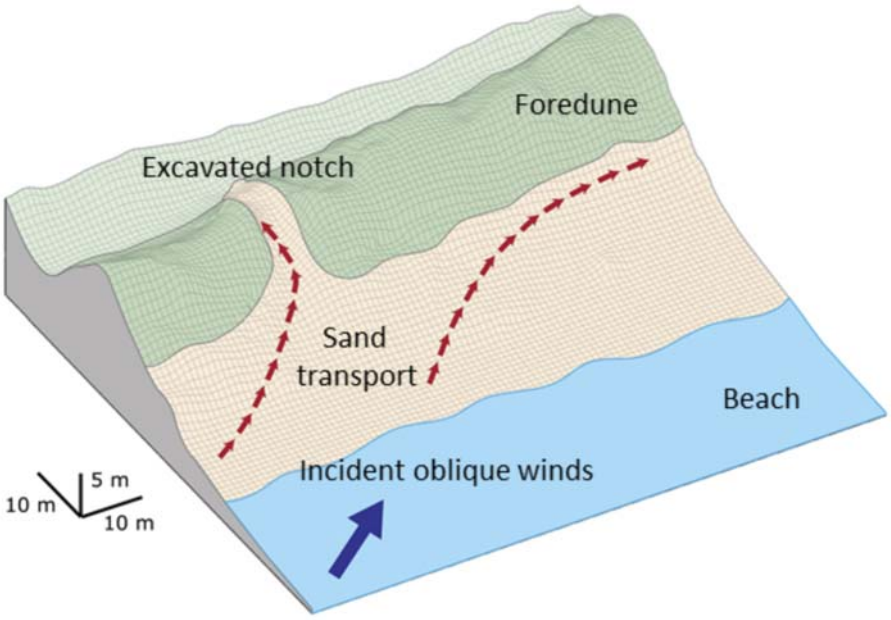

Figure 4: Conceptual model of aeolian sand transport through an excavated notch and along a section of intact foredune during highly oblique onshore winds (Nguyen et al., 2022a,b).

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NZCS 2022 Scholarship award winners

Alasdair Hall, Massey University Student Research MSc Scholarship

Post-earthquake reestablishment and indicators of body condition of the New Zealand fur seal in Kaikōura

The primary aim of Alasdair's project is to update understandings of the abundance and body condition of New Zealand fur seal/kekeno around Kaikōura. This population has not been comprehensively assessed since before the November 2016 earthquake, an event that drastically altered their habitat, and also led to a large-scale reconstruction effort on State Highway 1 (SH1), which runs in close proximity to many of the colonies.

As well as assessing relatively long-standing colonies like Ōhau Point, where Alasdair will be able to compare his results with previous studies, he will also be providing abundance estimates and body condition indicators for pups in newer breeding areas that have not previously been recorded.

Understanding population abundance and body condition trends will be important for upcoming management decisions, such as the review of the Kaikōura (Te Tai ō Marokura) Marine Management Act.

The other focal research question relates to the impacts of SH1 on the Kaikōura fur seal population. Much of their breeding and haul-out habitat is close to this major transport infrastructure, and previous research has shown that road mortality is the major cause of death for pups aged between 50 days and weaning. However, SH1 has changed significantly since this last study was completed, so Alasdair is seeking to understand how the road impacts the population now, and attempting to determine the spatial and temporal factors that may lead to fur seals getting onto the road.

Benjamin Jones, University of Auckland Student Research PhD Scholarship

Investigating coastal archaeological vulnerability in Aotearoa

Ben's PhD focuses on understanding how future sea-level rise driven erosion will impact coastal archaeological sites at the local, regional and national scale. Coastal erosion is a key threat to the preservation of archaeological sites, either exposing sites to future destruction and/or destroying already exposed sites.

Some 37.3% of archaeological sites recorded are within 500 m of the coast, and understanding the impact and the scale of the problem is important, both from a scientific and cultural perspective, because these sites hold evidence of Aotearoa's tangible and intangible history. By combining archaeology and geomorphology, and in collaboration with local hapū (Patuharakeke), part of Ben's research involves characterising and radiometrically dating eroding coastal landforms that hold at-risk archaeological material, located at Poupouwhenua/Bream Bay in Northland/Te Tai Tokerau.

Understanding the risk to coastal archaeological sites in Aotearoa is something important to Ben as he has formed a connection with Aotearoa through its history. For many years Ben worked as a professional archaeologist in Aotearoa. The takeaway from this role for him was the engagement with iwi and hapū who have an ancestral connection to archaeological sites. The best encapsulation of this is the proverb 'Kia whakatōmuri te haere whakamua': 'I walk backwards into the future with my eyes fixed on my past'. Iwi, hapū and local communities are faced with potentially losing these important places and sites due to sea-level rise driven by climate change.

Advancing our understanding of the coastal zone and the risks to assets in the coastal zone, including archaeological sites, provides a forum to communicate such risks to coastal managers, scientists and to the public at large.

Ben's PhD project contributes to the Coastal research programme within the Resilience to Nature's Challenges (RNC) National Science Challenge | Kia manawaroa Ngā Ākina o Te Ao Tūroa. His research is under the supervision of Associate Professor Mark Dickson, Dr Emma Ryan, Dr Murray Ford, and Dr Daniel Hikuroa.

Coastal News weblinks in the printed newsletter

One of the most noticeable trends in *Coastal News* over the years has been the rise in the use of web addresses – and their complexity. Obviously, these are an invaluable source of further information for readers, but in the printed version of the newsletter we can't include active links as we do in the pdf version. We realise that manually copying long strings of seemingly random characters can be frustrating for readers, so for each issue we now produce a pdf file of live links – this can be found on the NZCS website at www.coastalsociety.org.nz/publications.

To make things even easier, you can access the pdf file by using the QR code to the right. The file contains every link published in each newsletter, organised by the pages where they appear, and all are active (clickable) links.

News you might have missed

Continuing our semi-regular 'News you might have missed' segment, we offer some more weird, wonderful and obscure news items that might have passed you by…

An ocean farm and forest

The BBC describes how a British businessman has put together a plan to create the world's largest seaweed farm – the size of Croatia no less – to remove a billion tonnes of carbon from the atmosphere each year. Read how this would supposedly work at www.bbc.com/news/science-environment-63200589. Moving from farm to forest, the *Guardian* reports that the world's largest seagrass forest has recently been discovered by a somewhat unlikely method – strapping cameras to sharks. Find out how (and why) at www.theguardian.com/environment/2022/nov/05/scientists-discover-worlds-largest-seagrass-forest-by-strapping-cameras-to-sharks

Life and death

Starting with new life, Phys.Org reviews a recent study that highlighted a notable side effect of the Tongan volcano – a rapid and massive phytoplankton bloom. It wasn't just the size of the bloom that was remarkable (around 40 times that of the island of O'ahu, Hawai'i), but the speed with which it developed – just 48 hours after the eruption. For more, see https://phys.org/news/2022-10-tonga-volcano-eruption-life-rapid.html. From life to death, new research on the Hikurangi subduction zone draws an unexpected connection between the remains of ancient dead marine organisms and the likelihood of earthquakes in the region. It's all down to movement and friction between the Pacific and Australian plates – but how does dead marine life fit in? Find out at www.sciencealert.com/dead-creatures-buried-in-the-ocean-could-influence-earthquakes-scientists-say.

Aquatic behavior

Some of the more unusual research reported recently has found that sea sponges and octopuses both have an unusual habit. In the case of sea sponges, it is sneezing, although apparently for a beneficial reason (see www.theguardian.com/environment/2022/aug/10/achoo-sea-sponges-sneeze-to-clear-their-pores-marine-experts-say for more). Octopuses, however, have a far more antisocial habit, in that they deliberately propel objects at each other. This behaviour has been observed as part of an Australian study, with both a report and video available at www.theguardian.com/science/2022/nov/09/octopuses-throw-objects-at-one-another-researchers-observe. Moving on to communication, a scientist has identified 53 sea creatures previously thought to be silent can actually communicate – but we weren't listening. For more, see www.bbc.com/news/science-environment-63380157.

Deep dive

Finally, if you're in the mood for a mystery, there's one sitting some 3 km below the surface of the Atlantic Ocean – perfectly-aligned pits that form a straight line across the seabed, whose source remains a mystery. For a fanciful selection of theories (from the unlikely to the bizarre), see the article at www.dailymail.co.uk/sciencetech/article-11053289/What-mysterious-holes-punched-1-7-miles-surface-Atlantic-Ocean.html

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News from the regions

Northland

Laura Shaft, Regional Representative

Storm-water litter audit

A project designed to estimate how much litter is reaching the Te Tai Tokerau coastal environment through stormwater drains has estimated that over six million items are released from the Whangārei stormwater network every year – the vast majority being plastics. A further 1.3 million items were estimated to be released from the Kerikeri stormwater network and 1 million from the Dargaville stormwater network each year.

The project was part of a multi-agency response led by NRC and involved the region's three district councils, Northland District Health Board, and local businesses. It involved installing and auditing the contents of 51 litter traps that were fitted in stormwater grates throughout the region at a variety of places, such as schools, playgrounds and car parks.

These litter traps captured a staggering 21,000 items of litter, with plastic accounting for 71.1% of all items. Litter and plastic are one of the biggest pollutants of our oceans.

NRC and students from Taipā Area School undertook an audit of a litter trap installed in the school's grounds (Photo: NRC).

CoastCare

Over this year's planting season 17,400 dune plants have been planted at 20 sites around Northland through the CoastCare programme, which involves over thirty CoastCare groups and many schools, marae and hapū. A large proportion of these plants are the specialised dune binders spinifex and pingao, which are grown from seed collected by CoastCare volunteers and staff, propagated in a specialised nursery, and returned to the area from which they were collected. Planting is just part of the picture though: weed and pest control, management of access and education are all essential components of the dune restoration work.

Fencing and planting working bee on Ruakākā dunes, south of Whangārei with local residents, Bream Bay Coastal Care, Northland Regional Council and DOC (Photo: NRC).

Auckland

Lara Clarke, Matthew McNeil, Andrew Allison and Eddie Beetham, Regional Representatives

NZ SeaRise: exploring the science behind the maps

The NZCS Auckland branch met in person on 10 August to hear Dr Rob Bell and Dr Richard Levy discuss recently released research by the NZ SeaRise programme on relative sea-level rise (RSLR) projections and the influence of vertical land movement (VLM) around the New Zealand coast and what it means for New Zealand. The process of monitoring VLM, data interpretation and use were discussed, and some impacts and implications of RSLR considered and queried by the engaged audience. Over 60 members and friends met in person for the first time in nearly two years and the enthusiasm people felt toward in-person events was palpable. A great prelude to the NZCS Waiheke conference in November!

Dr Rob Bell presenting at the NZCS SeaRise event in Auckland (Photo: E Beetham).

The event was recorded and is available on the NZCS website at: www.coastalsociety.org.nz

Waikato

Jamie Boyle and Joshua Sargent, Regional Representatives

Shoreline Management Pathways

Thames-Coromandel District Council have formally adopted the Shoreline Management Pathways (SMPs), bringing together three plus years work alongside the community to help adapt to the effects of climate change.

The Council's Executive Leadership Team also adopted the Implementation Plan, which will look to kick start key tasks associated with the SMPs including (but not limited to): developing prioritisation methods, exploring funding opportunities, flood scheme reviews, protection design, updating geospatial hazards information, developing STATS (signals, triggers, and thresholds) monitoring methods, plan change investigations, forward planning of coastal restoration priority areas, and continued collaboration with iwi.

For more, see www.tcdc.govt.nz/Your-Council/News-and-Media/News-and-Public-Notices/News-Articles/Council-swift-to-adopt-Shoreline-Management-pathways

Bay of Plenty

Jonathan Clarke, Josie Crawshaw and Scott Murray, Regional Representatives

Tauranga waterfront development

A significant development has been approved in the Tauranga City Council LTP to redesign and reinvigorate the downtown hub of the

Tauranga CBD. A waterfront plan has been developed for the edge of Tauranga Harbour, with goals to reconnect and amplify the city centre's connection to the harbour through the transformation of the waterfront into a premier recreational destination.

The plan includes a waterfront parkland incorporating a mix of recreational, community and commercial activities that celebrate the water's edge as a focal point. There are goals to reconnect people to the waterfront, developing ecological improvements to the seawall and nearshore environment, and utilisation of water-sensitive urban design.

For more, see the Tauranga Moana Waterfront Plan at www.tauranga.govt.nz/our-future/enabling-growth/tauranga-moana-waterfront-plan

Tauranga Harbour Great White Shark research

A new project is set to begin this summer, bringing together local iwi, marine ecologists, fisheries scientists and shark experts to research Great White Sharks in the Tauranga Harbour and wider Bay of Plenty region. The collaboration comes after a notable increase in the frequency of interactions between humans and white sharks over the past few years. The project is being led by the University of Waikato with hapū from the northern Tauranga Harbour, Te Whānau a Tauwhao and Ngāti Te Wai.

For more, see www.waikato.ac.nz/news-opinion/media/2022/research-into-great-white-sharks-in-bay-of-plenty-set-to-begin

Wellington

Ryan Abrey and Verity Taylor, Regional Representatives

NIWA Science fair

NZCS sponsored a prize for the Wellington NIWA Science fair, which had a number of applicable projects that displayed the NZCS values. There was however one which stood out titled 'Wonderful World of Weed' by Hana Kleyn, Rosie Dunn and Sophie Wall from Evans Bay Intermediate School. This project explored the many uses of seaweed, how it is preventing ocean acification, and how it helps the economy. They did a fantastic job of presenting, researching and proposing great uses for seaweed. Well done to them and all the presentations this year.

Hana Kleyn, Rosie Dunn and Sophie Wall at the NIWA Fair (Photo: Amanda Hood, Evans Bay Intermediate School).

Inspiring the next generation

Wayne Juno, from Homes Consulting, shared a post on LinkedIn introducing his daughter to the ways that those in construction can help the animals whose habitat they borrow in their work. They joined Gabriela Koneski and Nina Tropina on a quiet, wet Saturday to talk penguins, dolphins, noise reduction and water treatment. From their safe zone they had the beautiful backdrop of Brian Perry Civil's pair of barge-based hundred tonners starting work on Holmes Australia & New Zealand/CentrePort Ltd's resilience upgrades. His daughter's school project is well served with information, and what an inspiration for a young girl to hear from such knowledgeable women who are achieving great things in engineering.

Knowledge sharing in action in Wellington (Photo: Wayne Juno)

Impromptu regional catchup

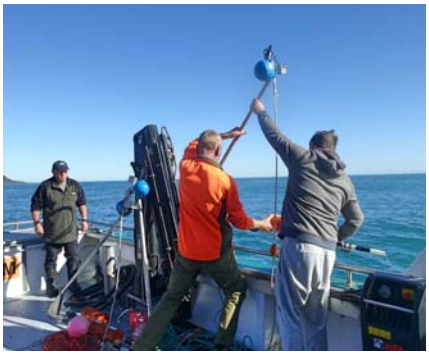
The Wellington Region had an impromptu drinks event to take advantage of those converging on the capital for the 'Aotearoa Climate Adaptation Network Hui'. We met at Coene's and had a good evening catching up with what was going on in the region, as well as being able to connect with a young professional from Winstone Aggregates who was down from Auckland. We are looking forward to more events now that things are finally returning to normal.

West Coast

Contributions from Don Neale (Regional Representative) and Paulette Birchfield (WCRC)

Hautai Marine Reserve

In August, DOC completed a survey of the Hautai Marine Reserve in southern South Westland, one of New Zealand's most remote marine reserves. The work combined depth sounding, drop camera and baited underwater video to map and describe the seabed in and around the reserve, information that will help for future monitoring and management of the reserve.



Don Neale and Greig Funnell set a baited underwater video at the Hautai Marine Reserve, while skipper Dallas McHardie looks on (Photo: DOC).

Te Tai o Poutini Plan

The proposed Te Tai o Poutini Plan was notified and open for submissions over the past couple of months. This is a combined 'One Plan' for the three District Councils of the West Coast-Te Tai o Poutini (Buller, Grey and Westland). The plan includes sections on natural hazards and the coastal environment that will be of interest to NZCS members.

Bull kelp die-off

Marine reserve monitoring on the West Coast has included photopoints that have shown

a massive die-off of bull kelp beds along the Coast Road area between Greymouth and Westport (and possibly beyond). The die-off is probably due in part to the 2022 summer/autumn heatwave, as well as earlier heatwaves and ex-Cyclone Fehi in 2018. Collaborative work between DOC, University of Canterbury and NIWA is aiming to progress research and monitoring of these climate impacts on West Coast kelps. The kelp die-off has been reported by RNZ and other media: www.rnz.co.nz/audio/player?audio_id=2018863699 (starts at 12:50, 6 min duration), and www.stuff.co.nz/environment/climatenews/130216288/marine-heatwaves-likely-cause-of-kelp-die-off-in-popular-reserve

Whitebait regulation changes

Whitebait regulation changes were a feature of this year's whitebait fishing season. The regulation changes made in 2021 help to provide more consistency between the rules for the West Coast and the rest of New Zealand. Most notably, the fishing season was shortened nationally to 1 September – 30 October.

Storm surge damage

The impacts of wave damage from storm surge was again felt by residents in Cobden from a storm event on 13 June 2022. Domett Esplanade was left strewn with debris and damaged fences from strong winds and high seas. The cause was a low-pressure weather system where waves surged high enough to overtop at the north end of the Cobden sea wall. Seawater overtopped at Domett Esplanade and North Beach Road, with properties damaged and the road closed at Domett Esplanade and surrounding streets. The West Coast Regional Council and Grey District Council are currently looking at what long-term options for protection from coastal inundation are available for affected properties in the lower-lying areas of Cobden.

Canterbury

Justin Cope and Deepani Seneviratna, Regional Representatives

Adaptation planning with Christchurch communities underway

The Christchurch City Council's collaborative adaptation planning process with communities is now underway. The Whakaraupō-Lyttelton Harbour and Koukourārata-Port Levy communities will be the first to plan for how they can adapt to coastal hazards caused by sea-level rise. A Coastal Panel (a diverse group of community and rūnanga representatives from across Whakaraupō with some city-wide representation) has now been established. The Panel will provide informed recommendations to Council on adaptation options on behalf and with the support of the wider community.

Kelp bed at Punakaiki Marine Reserve, March (L) and September (R) 2022 (Photos: WCRC).

An initial phase of community engagement will run from through to December 6. A series of community events will be run with the aim to hear from a wide range of residents so we're on what they value about the area and what is most important to them. The information gathered will be used by the Coastal Panel to determine a short-list of adaptation options which the community will then be able to give feedback on next year.

More information on the Coastal Hazards Adaptation Planning programme can be found on the Christchurch City Council's website https://ccc.govt.nz/environment/coast/adapting-to-coastal-hazards/our-coastal-hazards-adaptation-planning-programme

Banks Peninsula subtidal habitats and ecosystems mapping

Following successful multi-beam echo sounding hydrographic surveys of the Te Pātaka o Rākaihautkū/Banks Peninsula seabed reported in *Coastal News 77*, the University of Otago has been engaged as a 'Science Partner' in the programme. They will add to the hydrographic and ground truthing data through delivering additional fieldwork, map creation and coordinating with other agencies, organisations and volunteers in the partnership to deliver work programmes.

Land Information New Zealand and Environment Canterbury, in partnership with Department of Conservation and Onuku and Wairewa rūnanga, undertook multibeam mapping of approximately 53,000 ha of seabed around Te Pātaka o Rākaihautkū/Banks Peninsula in late 2021 to update maritime charts for safe vessel navigation and to help significantly in developing the understanding of marine ecosystems and subtidal habitats around Te Pātaka o Rākaihautkū.

Stormy winter creates issues for low-lying coastal properties

Winter storms have finally overwhelmed the last lines of coastal flood defence along several kilometres of South Canterbury coastline. Chronic long-term erosion of the mixed sand-gravel coastline north of Timaru has finally overwhelmed privately owned coastal stopbanks constructed in the 1980s, resulting in even moderately-sized coastal storms now regularly inundating 30-35 ha of productive farmland. Several significant freshwater coastal wetlands are also at risk from the ongoing erosion and constant saltwater intrusion. Environment Canterbury and other local agencies are working with property owners on the immediate problem.

Coast north of Opihi River (top); Seadown Coast, south of Opihi river mouth (bottom) (Photos: Chris Fauth, Environment Canterbury).

However, with around 16 km of coastal stopbanking either currently vulnerable or likely to be exposed to direct wave attack and erosion within the next 10-20 years, this part of the coastline is now at the sharp end of the stick when it comes to coastal adaptation planning for Canterbury.

Otago

Sorrel O'Connell-Milne, Regional Representative

ORC coastal science update

In the coastal space the kelp forest monitoring programme development is underway. The significant ecological marine spatial mapping work has been completed, and the ORC science team are now looking to ground truth some of the spatial mapping work.

Southland

Bryony Miller, Regional Representative

Bluff Harbour rock dredging

Under an existing coastal permit, South Port NZ Ltd started rock dredging in the Bluff Harbour channel in August 2022. The rock dredging was completed by Heron Construction Company Ltd to remove fractured or fragmented rock that remained in the Port harbour entrance channel from previous dredging campaigns. The purpose of this campaign was to remove any fractured or broken rock in preparation for the drilling and blasting campaign proposed under the capital dredging/Kia Whakaū resource consent application (which has a target depth of 9.7 m chart datum (CD)).

This project commenced on 21 August and was completed on 15 October 2022 and South Port is very pleased to announce that this dredging campaign has exceeded expectations and has achieved 9.5 m CD in the harbour entrance channel.

Subsequently the resource consent for capital dredging/Kia Whakaū was granted in September and South Port will now contract a trailer hopper suction dredge (THSD) to deepen the berth pockets (10.2 m CD) and swinging basin (9.7 m CD) while also completing the deepening of the entrance channel to 9.7 m CD. This work is expected to be completed by September 2023 and the additional depth/draft will allow for larger cargo volumes and/or vessels to transit through the Port.

Due to the success of this rock dredging component the drilling and blasting activity that was required as part of the Kia Whakaū project is now unlikely to be required under the consent. This is a very exciting development for the Port and will have the potential to significantly reduce the cost of project Kia Whakaū going forward.

Heron construction rock dredging in Bluff Harbour, September 2022 (Photo: Tammi Topi, South Drone).

NZCS guides, publication archives & downloads

The NZCS website houses a complete archive of the Society's publications, including back issues of *Coastal News*; 'hot topic' reprints of significant articles from previous issues; newsletter author and article indexes; a guide to writing articles for NZCS publications; and copies of NZCS Special publications. All these can be accessed at www.coastalsociety.org.nz under the 'Media>Publications' tab on the main menu.

Fifth NZCS Special publication published

In 2016, the NZCS launched its second special publication ('*Adapting to the consequences of climate change: Engaging with communities*'), which looked at how New Zealand was preparing for sea-level rise and the associated effects of climate change. Fast forward six years, and the newly published fifth special publication ('*Coastal Adaptation: Adapting to coastal change and hazard risk in Aotearoa New Zealand*') continues this theme by focusing on the complex challenge of moving the country towards adaptation to coastal change and hazard risks.

Work on the publication began at the end of 2021, and its completion has been due in no small part to the time and effort of the many people involved – the 71 content contributors, 19 reviewers, four editors, and the numerous others who were 'shoulder tapped' for specific help and tasks.

With a print run of 600, the book will be distributed to NZCS members; councils; selected government agencies and libraries; and selected science, environmental, consultant and community organisations. Pdf copies will also be available for wider distribution on the NZCS website and, for international readers, on the Auckland University figshare site.

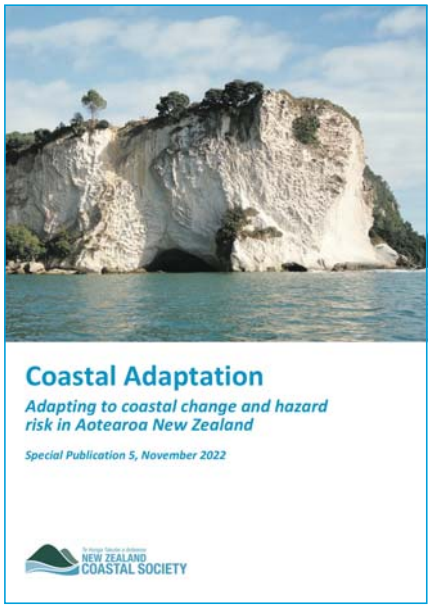
The new publication was launched at the 2022 NZCS Conference (initially in electronic format, with a hardcopy version to follow in December). It is the most substantial special publication to date at 102 pages – three times the size of its 2016 predecessor. However, be assured – along with the quantity comes quality, with a wide variety of contributions representing a range of interdisciplinary experts and researchers, tapping in to a rich vein of knowledge, expertise and experience.

The book is divided into five sections, each with a particular focus:

Section 1, 'Setting the scene', examines the country's current planning system, transformational coastal adaptation governance, and the need for changes to regulations, funding arrangements, policies, and infrastructure investments.

Section 2, 'Planning and policy frameworks', covers the necessity of understanding that the policy and planning framework is key to progressing toward an integrated approach to coastal hazard management.

Section 3, 'Engagement, collaboration and partnership', puts the focus on ways to enhance effective engagement by looking at the role of Te Ao Māori and coastal marae, ways in which we can elevate our engagement to make it more meaningful, and discusses the role of organisations in this process.

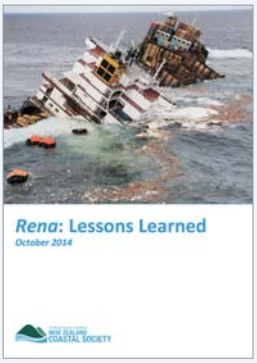


Section 4, 'Advances in coastal science', acknowledges that there are still many unknowns in the science and presents a variety of opinion and examples on how to utilise the best available information in decision making.

Section 5, 'Adapting to coastal change in urban and built environments', considers the built environment and the importance of appropriate tools for adapting to coastal change and evolving hazard risks in Aotearoa New Zealand.

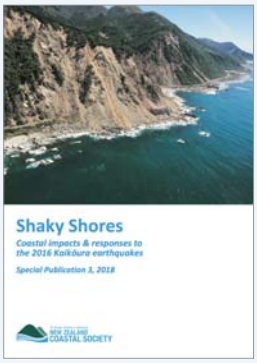
Other titles in the NZCS Special Publication series

Missed out on one of the previous special publications? They are all available for download in pdf format from the NZCS website (www.coastalsociety.org.nz) or the University of Auckland's figshare site (https://auckland.figshare.com/coastalsociety).

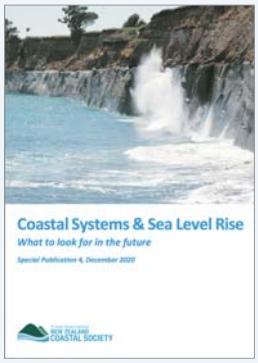


Rena: *Lessons learnt* (2014)

Adapting to the consequences of climate change: Engaging with communities (2016)



Shaky Shores – Coastal impacts & responses to the 2016 Kaikōura earthquakes (2018)



Coastal Systems & Sea Level Rise: What to look for in the future (2020)

About the authors

Geoff Cooper has a background in global policy having worked for the United Nations, the US Treasury and the Federal Reserve. Before becoming GM Strategy at Te Waihanga, Geoff worked as a Chief Economist at Auckland Council and at PwC.

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Contributing to *Coastal News*

We welcome contributions for forthcoming issues of *Coastal News*. Please contact the Editor, Charles Hendtlass, at cellwairmonk@gmail.com if you'd like to submit an article, contribute a news item, have content suggestions or a photo to share, or to give some feedback on the newsletter.

The submission deadline for the next issue is 7 February 2023.

A Contributor's Guide is available for download from the Society's website at www.coastalsociety.org.nz (under the 'Publications' tab). This provides information on the style and format requirements when writing for NZCS publications. An index of articles previously published is also available for download.

Kupu takutai: geographical coastal terms poster

If you are reading the printed version of the newsletter, you will have found a copy of the second NZCS Kupu Takutai (Coastal Terms) poster. Te Hunga Takutai o Aotearoa (New Zealand Coastal Society) has produced this poster to encourage the use of te reo Māori in your mahi and everyday life, and we encourage you to share and display it (for extra copies, see the link below).

If you are reading the online version of the newsletter, a copy of the poster is reproduced below and a full-sized copy can be downloaded from: www.coastalsociety.org.nz/media/view/publications/kupu-takutai (a copy of the first poster is also available at this link).

We acknowledge there may be additional alternative te reo Māori translations for some of the coastal terms used in this poster and many kupu have a deeper meaning. For example tātahi is beach from the inland perspective looking out to sea. Some alternative kupu for beach are tuaone, one, tahamoana (seaside) and uta (beach from the sea perspective heading to the shore).