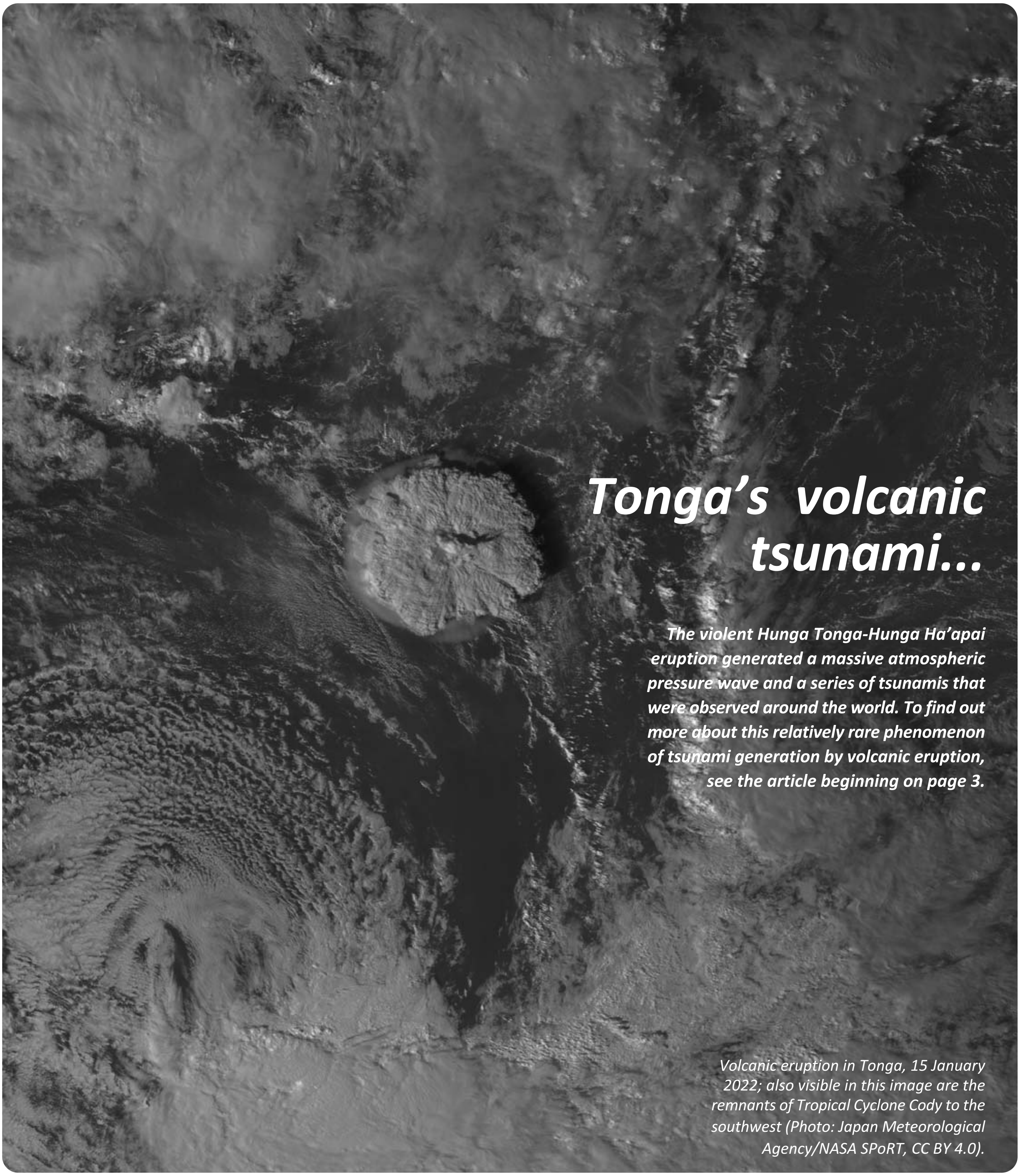
Te Hunga Takutai o Aotearoa
NEW ZEALAND COASTAL SOCIETY

Coastal News

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

Issue 77 • March 2022



Tonga's volcanic tsunami...

The violent Hunga Tonga-Hunga Ha'apai eruption generated a massive atmospheric pressure wave and a series of tsunamis that were observed around the world. To find out more about this relatively rare phenomenon of tsunami generation by volcanic eruption, see the article beginning on page 3.

Volcanic eruption in Tonga, 15 January 2022; also visible in this image are the remnants of Tropical Cyclone Cody to the southwest (Photo: Japan Meteorological Agency/NASA SPoRT, CC BY 4.0).

ISSN 1172-6938

Te Hunga Takutai o Aotearoa
NEW ZEALAND COASTAL SOCIETY

CONTENTS

Contents numbers and blue web links in this pdf are active (clickable).

Word from the Chair

Our previous issue was released in November 2021. Since then we have experienced a stunning long, hot summer, presenting multiple opportunities to cool off at your favourite coastal spot. Sadly, however, this summer also saw a record number of drownings, many of which occurred on beaches. It certainly got us thinking about how we, as coastal professionals, can help people stay safe whilst enjoying all that our beautiful beaches have to offer. We would welcome any ideas from members on how NZCS can help raise public awareness about how to interact with our beaches in a safe way.

You will no doubt have heard that with the Omicron outbreak, the Australasian Coasts and Ports conference will be held entirely online. The organising committee have done an amazing job flexing as COVID has had its ups and downs, and we'd like to share an extra special thanks to all involved with organising the conference for their dedication and perseverance. NZCS will be making an announcement at the conference that we think you all will be interested in – so watch this space!

Since the last issue we have welcomed Bryony Miller to the executive committee. Bryony hails from Invercargill and works as a coastal and marine ecologist. She has hit the ground running on the committee and brings a wealth of enthusiasm and ideas to the role. It's great to have you join the team Bryony!

Jose Borrero has stepped down from the committee after ten years. Over that time, Jose played a big role in advancing NZCS in terms of technology by getting us set up on social media, an overhaul of the website, as well as organising the Raglan conference in 2010. We would like to extend a huge thanks to Jose for his time and efforts on the committee.

This issue traverses a wide range of topics such as the January Tongan eruption and resultant tsunami, which, while devastating for the affected communities, presented an exciting research opportunity and some TV time for some NZCS members. These all help to raise the public profile and societal benefits of our members' essential work in the field of coastal hazard management.

There is also an interesting study on the variety of microplastics littering Northland's coastline, an article on marine biodiversity offsetting and compensation offering a council perspective, a paper on innovative storm surge modelling, plus a whole array of interesting news from the regions.

We hope you enjoy the read!

The Hunga Tonga-Hunga Ha’apai volcano and tsunami

Jose Borrero[1,2], Emily Lane[3], Colin Whitaker[4]

Introduction

On January 15th at approximately 5:15 pm local time (0415 UTC), several weeks of heightened activity at the Hunga Tonga-Hunga Ha’apai volcano, 65 km northwest of Tongatapu (Figure 1), culminated in a violent eruption generating a massive atmospheric pressure wave and a series of tsunamis that were observed around the world. Since tsunami generation by volcanic eruptions is a relatively rare phenomenon, this event was remarkable due to the global impact of the generated waves.

On Tongatapu, tsunami waves caused catastrophic damage to the western part of the island with runup heights greater than 13 m in the Ha’atafu area (Figures 1 and 2). In the capital of Nuku’alofa media reports showed videos of waves crashing over sea walls and flooding houses, suggesting tsunami runup heights on the order of 3-5 m.

The tsunami was observed and recorded on New Zealand’s newly installed array of DART tsunameters (Borrero, 2020) located along the Tonga-Kermadec Trench subduction zone and in the Coral Sea to the west, as well as on coastal tide gauges and the GeoNet tsunami network (Figure 1).

Volcanic tsunamis

Tsunami generation from volcanic events is very complex and can involve many different processes, including evacuation of water by explosive eruptions, flank collapse (submarine or sub-aerial landslides), pyroclastic density currents entering the water (highly mobile flows of volcanic material and gas), caldera collapse and atmospheric pressure waves radiating out from the volcanic explosion.

The first four of these mechanisms can create very large and destructive tsunami waves in the near field. However, due to their relative point source origin and the dispersive nature of the waves they generate (Hayward et al., 2022), the wave energy attenuates comparatively rapidly, which renders them mostly benign in the far field (greater than a few hundred kilometres away). The latter mechanism (atmospheric pressure waves), however, has been known to have created measurable, but generally non-destructive tsunami waves at great distances from the erupting volcano. The most well-known example of this was the 1883 eruption of Krakatau in Indonesia, which created a highly destructive tsunami in the near field (> 40 m and causing >36,000 deaths) as well as a pressure generated tsunami that was recorded on tide gauges around the world. Other researchers (Lowe and de Lange, 2000) provide evidence to support the notion that the AD 200 eruption of Taupo would have also caused a global meteorologically generated volcanic tsunami.

In general, however, volcanic tsunamis are generally not considered to be a significant far-field tsunami hazard since only the largest eruptions generate pressure waves capable of producing tsunamis with non-negligible amplitudes in the far field. Furthermore, so few events have occurred that researchers in this area have very little understanding of the likely recurrence of these events. The Tonga eruption itself is the largest eruption in the Pacific in recorded history and is thought by some to be a 1 in 10,000-year event. The specifics of the tsunamis generated from this event are discussed in more detail below.

Effects in New Zealand

On the evening of January 15th, the east coast of New Zealand was just beginning to feel the effects of ex-tropical cyclone Cody, which was forecast to pass just east of East Cape on January 16th. On what was quite

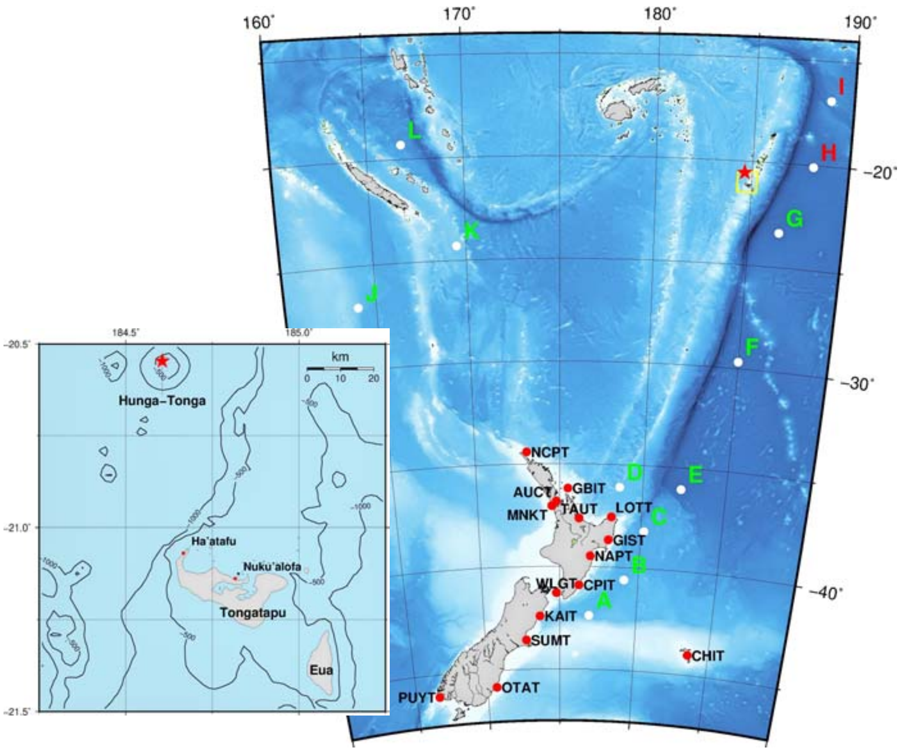


Figure 1: Location of the Hunga-Tonga volcano in the southwestern Pacific (red star), New Zealand DART stations (white dots), and GeoNet tsunami monitoring stations (red dots). DART stations in green recorded the tsunami, while stations in red were offline. Inset (yellow box) shows the location of Hunga-Tonga relative to Tongatapu and locations mentioned in the text.

(1) eCoast Marine Consulting and Research, Raglan; (2) University of Southern California Tsunami Research Center, Los Angeles, CA, USA; (3) National Institute of Water and Atmospheric Research, Christchurch; (4) Department of Civil and Environmental Engineering, University of Auckland, Auckland.

Figure 2: Tsunami damage in Ha'atafu (Photo: Moana Paea, Ha'atafu Beach Resort).

literally a 'dark and stormy' night, duty officers at New Zealand's National Emergency Management Agency were alerted to the intensification of the ongoing eruption in Tonga. Shortly thereafter NZ DART G was triggered by a tsunami wave signal and the Tsunami Experts Panel was convened to advise on the potential effects and impacts on New Zealand. Although the Panel was aware of the waves recorded on DART station G, they were hampered by a lack of quantitative information on the eruption itself. Given what was known about volcanically generated tsunami in general and the information at hand, the Panel supported NEMA's issuance of a 'Beach and Marine Threat' warning for 'strong and unusual currents and unpredictable surges at the shore' for the northeast coast of New Zealand. This warning was issued at 8:14 pm on January 15th and was in effect until 4 am on the 16th.

The most seriously affected area in New Zealand was the Northland Region, where the marina at Tutukaka was severely damaged by strong currents generated as the tsunami surge was forced through the narrow breakwater entrance. The resulting high-velocity jet was strong enough to break floating piers, including the refuelling dock, and cause boats to drift freely leading to collisions and ultimately several sunken boats (Figure 3). Also, in Northland there were reports of damage from strong currents in Whangaroa Harbour and several campsites were evacuated, although there were no reports of inundation exceeding the level of the high tide.

Water level recorders and tide gauges around the country picked up the tsunami signal (Figure 4), with some sites showing very unusual effects. The largest overall tsunami height was recorded at Great Barrier Island (GBIT) with a maximum peak to trough height of nearly 2 m occurring at approximately 1 am NZ time, some 4-5 hours after first arrival. At Wellington (WLGT) the typical resonant behaviour of Wellington Harbour was observed starting with the first arrival of the tsunami around 9 pm on the 15th. However, there was an unusual resurgence of the signal between 9 am and 2 pm the following day (20 to 25 hrs in Figure 4) with amplitudes more than double what they were earlier in the record. The Gisborne (GIST) record also showed a resurgence in tsunami energy around that time, but the largest surges were recorded earlier in the record from midnight to 3 am NZ time (11-13 hours on Figure 4). The decreases and then resurgences of tsunami energy at some of these gauges might be due to dispersive wave trains shifting in and out of phase with the local harbours and bays.

The north side of Banks Peninsula was also affected by the tsunami with a low-lying campground in Pigeon Bay being partially inundated by a tsunami surge that arrived at high tide around 4:30 am on Sunday 16th January. Le Bons Bay and Okains Bay also saw considerable erosion caused by surges traveling up their rivers and surges in Port Levy were also too strong for small craft to safely enter the water. These surges continued for several days with Cyclone Cody continuing to pump infragravity wave energy into the system set up by the tsunami.

Other far-field effects

Besides New Zealand, unusually large and persistent tsunami waves were observed on the other side of the Pacific. In Ventura Harbour California, at approximately 11 am local time Saturday (15 hours after the main eruption), a harbour patrol vessel tied to a dock was swamped and sunk as strong currents pulled on the moored vessel ultimately capsizing it. Surges persisted through the day and around 7 pm a large section of a floating dock with boats still attached broke free and collided with another vessel (*VC Star*, 16 January 2022).

Strong surges also affected coastal towns in Peru and were reportedly responsible for two drownings there after a surge hit a truck

Figure 3: Sunken boat at Tutukaka (Photo: Alec Wild, NIWA).

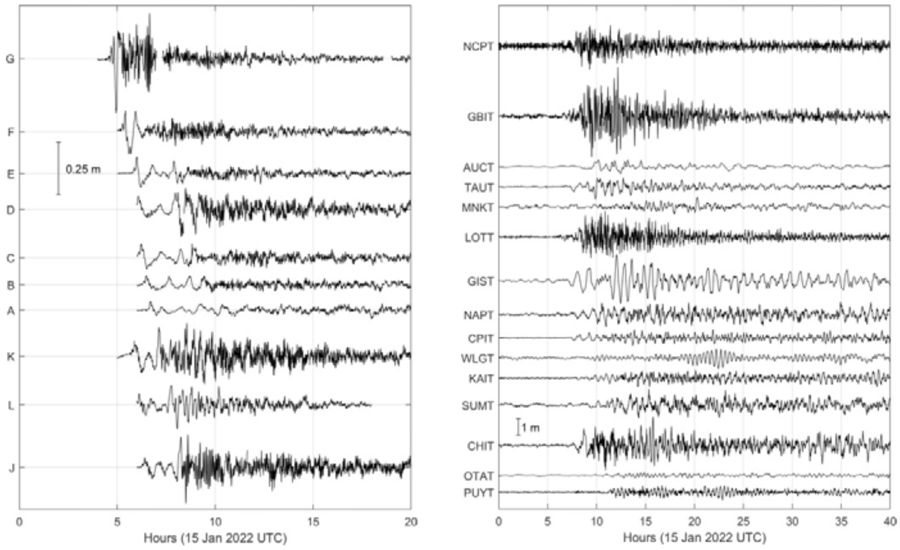


Figure 4: Records from the New Zealand DART stations (left) and GeoNet tsunami monitoring stations (right) (plots courtesy Dougal Greer, eCoast).

parked on a beach, dragging it and its occupants into the ocean (*NZ Herald*, 17 Jan 2022). The atmospheric pressure disturbance even caused measurable seiching in the Caribbean and Mediterranean Seas, although not large enough to cause problems.

Tsunami source mechanism(s) of the Hunga Tonga-Hunga Ha'apai volcanic eruption

The tsunamis caused by the Hunga-Tonga eruptions were likely caused by multiple distinct source mechanisms. According to eyewitnesses, the first tsunami waves affecting western Tongatapu arrived before the 'big bang' of the main eruption. These may have been caused by a flank collapse triggered by earlier eruptions. Later waves could have been caused by submarine caldera collapse and/or pyroclastic density currents from the collapse of the eruption column. Turbidity currents from the pyroclastic density currents may also have severed the domestic and international submarine telecommunications cables (Matangi Tonga, 2022; Speidel, 2022). More information on these sources will be available once bathymetric surveys of the affected areas are conducted later in the year, however the precise details may never be known.

Besides the waves directly caused by the eruption processes, aspects of the tsunami were enhanced or directly generated by the atmospheric pressure disturbance caused by the explosive main eruption (see Sommerville, et al. 2022). In the near field this manifested as a pressure drop of approximately 20 hPa, which radiated outwards while accelerating up to the speed of sound. In the far field (>300 km) the pressure disturbance became a dipole with a leading peak and trailing trough, which circulated around the earth multiple times travelling at the speed of sound. As this pressure disturbance moved over the ocean, it caused a deformation of the sea surface, creating a progressive long wave. When a pressure disturbance moves at speeds close to the phase speed of the water wave it is generating, an effect known as 'Proudman resonance' occurs, which results in a significant amplification of the water wave height. Ultimately, the impacts of the Hunga Tonga-Hunga Ha'apai eruption in the far field appears to be a result of the moving pressure disturbance generating tsunami waves over the ocean basins with amplification due to the Proudman effect occurring over the deeper areas. This resulted in multiple secondary tsunamis being generated over oceanic trenches as the pressure pulse circled the globe, significantly increasing the duration of the overall tsunami.

Conclusions

The eruption of Hunga Tonga-Hunga Ha'apai was an unprecedented event with no known historical analogue in the Pacific and only one other comparable event in modern history. As such, the waves generated by the event caught the tsunami warning community off guard. The resultant tsunami was generated by a complex series of events including direct wave generation (likely by a combination of pyroclastic density currents, submarine landslides and caldera collapse) as well as waves generated by the pressure pulse from the volcanic explosion propagating over the ocean.

The tsunami from this event, as well as the near- and far-field generation of tsunamis by volcanic eruptions in general, are active areas of research. The knowledge generated from the study of these topics will ultimately help to update predictive approaches currently used effectively for earthquake-generated tsunamis, allowing these to be used for the more complex source mechanisms associated with volcanic eruptions.

References

Borrero, J (2020). Tsunami-detecting DART buoys deployed offshore New Zealand. *Coastal News*, Issue 71, March 2020.

Hayward, MW, et al. (2022). Multilayer modelling of waves generated by explosive subaqueous volcanism. *Natural Hazards and Earth System Sciences*, 22(2), 617-637. https://doi.org/10.5194/nhess-22-617-2022

Lowe, D and de Lange, W (2000). Volcano-meteorological tsunamis, the c. AD 200 Taupo eruption (New Zealand) and the possibility of a global tsunami. *The Holocene* 10.3 (2000) pp 401-407.

Matangi Tonga (2022). *Torn apart, missing 110 km domestic fibre optic cable may take year to replace*. https://matangitonga.to/2022/03/01/torn-apart-missing-fibre-optic-cable

New Zealand Herald (17 January, 2022). https://www.nzherald.co.nz/world/tonga-eruption-tsunami-two-people-in-peru-drown-as-surge-hits/MX2R5NZQXI6ZU4DNNVSSRJ3ZKY

Sommerville, et al. (2022). *Why the Tonga tsunami arrived much earlier and much larger than expected.* https://riskfrontiers.com/insights/why-the-tonga-tsunami-arrived-much-earlier-and-much-larger-than-expected

Speidel, U (2022). *When volcanoes go bang, submarine cables do what?* https://blog.apnic.net/2022/03/01/when-volcanoes-go-bang-submarine-cables-do-what

Ventura County Star (16 January, 2022). https://www.vcstar.com/story/news/2022/01/16/ventura-harbor-patrol-boat-capsizes-damage-tsunami-tonga-pacific-ocean/6550000001

Coastal litter monitoring in Northland

Nick Bamford, Northland Regional Council

Marine litter originates from multiple sources and causes a wide range of environmental, economic, safety, health, and cultural impacts. The slow rate of degradation of most marine litter items, mainly plastics, is leading to a steady increase in marine litter found at sea and shorelines globally. The following describes programmes and projects the Northland Regional Council (council) contributes to and its partners in the coastal litter monitoring space in Northland (see weblink 1).

In the absence of robust and regular litter data collection, council adopted the use of Litter Intelligence (see weblink 2) to help fill this regional and national void. Since 2019, council has undertaken quarterly surveys at our Hātea awa site in the heart of Whangārei city. On average, the litter density was 1330 items per 1000 m^2. The plastics percentage (per survey) fluctuates between 67% to 93%. Consistently, plastic and foamed plastic accounted for the most common items found during our Hātea surveys. Council also undertook litter surveys at 16 popular recreational bathing beaches in Northland over summer 2020/2021. The average litter density was 31 items per 1,000 m^2 and the plastic percentage of litter items was 66%. This summer, 16 beaches have again been surveyed to assess trends in the quantity and type of litter found over time.

Stormwater plastic project

To estimate how much plastic and litter is reaching our rivers and estuaries each year, council have teamed up with NorthTec, Whitebait Connection, Whangārei District Council, Far North District Council, Kaipara District Council and Northland District Health Board to install litter traps in stormwater grates across the region. The traps have been installed at a variety of locations across the region, including playgrounds, car parks, supermarkets, fast food premises and industrial sites. The contents are audited every three months to identify high risk land uses and to estimate how much plastic gets washed into the sea.

In the latest audit a total of 7204 items were captured in the 51 litter traps in just three months. Cigarette butts were the most frequently captured item, with 2200 cigarette butts captured (31% of all items), followed by fragments of soft plastic (1577 items). Overall, the dominant type of litter was plastic (72%).

The results also show big differences between locations. For example, 1075 items were captured at a transport/logistics site in Whangārei, while a residential street in Dargaville had just six pieces of litter.

Microplastic contamination in Te Tai Tokerau-Northland (Aotearoa-New Zealand) beach sediments

Council worked alongside Aotearoa Impacts and Mitigation of Microplastics (AIM^2, see weblink 3) and Scion. AIM^2 has three research objectives relating to microplastics (MP): (1) understanding the distribution of MP in NZ environments; (2) identifying associated risks and impacts to animals, people and ecosystems; and (3) identifying solutions ranging from microbial mitigation of existing pollution, to prevention of new pollution through outreach and education. In total, 11 sites (nine open coast, one estuarine and one dune lake) were selected based on geographic spread, prevailing wind, ocean currents and recreational use (Figure 1). Sediment samples were collected in summer 2019/20 and winter 2020.

Results from the microplastic contamination in Te Tai Tokerau-Northland beach sediments report (see weblink 4) showed that there was a varying degree of particle abundance at different Northland sites (Figure 2). MP abundance varied among locations within the beach and freshwater sites. Higher MP concentrations were seen at beach sites like Mangawhai and Sandy Bay, while lower concentrations were obtained from Lake Taharoa (Kai Iwi Lakes) and the estuarine site at Onerahi (Whangārei Harbour). When compared to the MP concentration recorded at Auckland beaches (6 MP/kg dry weight or 459 particles/m^2) investigated by Bridson et al., (2020), the overall mean particle concentration of Northland sites (3 MP/kg dry weight or 229 particles/m^2) was found to be significantly lower compared to that of the Auckland beaches.

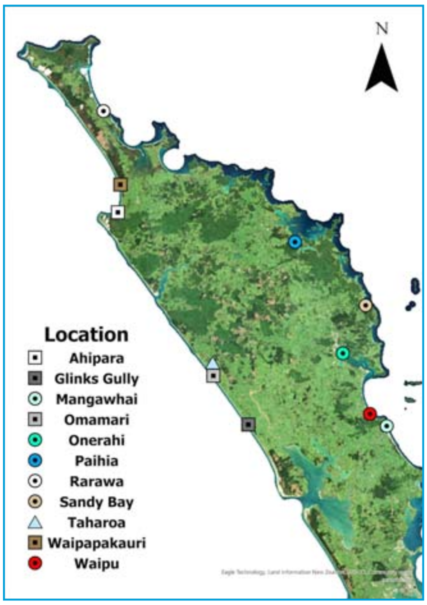


Figure 1: Northland sample locations for microplastics in sediments.

Microplastic in shellfish

Shellfish samples were collected from Houhora Heads (*Paphies australis*), Mangawhai (*Austrovenus stutchburyi* and *Macomona liliana*), Onerahi (*Austrovenus stutchburyi*), and Te Haumi (*Austrovenus stutchburyi*) (see Figure 3).

All these locations are within significant ecological areas (SEAs) (defined by assemblages of epifauna, birds, substrate, etc.). Specimens were sent to ESR, Christchurch, for MP analysis. This study also sits under the AIM^2 umbrella.

Microplastic particles were identified in all individual shellfish so far examined. The predominant morphotypes were fibres and fragments and the average number of particles per individual varied within site. A wide variety of polymer types were also seen, ranging from nylon to polyester. Results from the Mangawhai and Te Haumi cockle specimens show the abundance of MPs, separated by morphology (Figure 4).

2021 Microplastics expedition

Blue Cradle (see weblink 5), AIM^2 and researchers from six NZ institutions are working to determine the current state of MP pollution in New Zealand's marine,

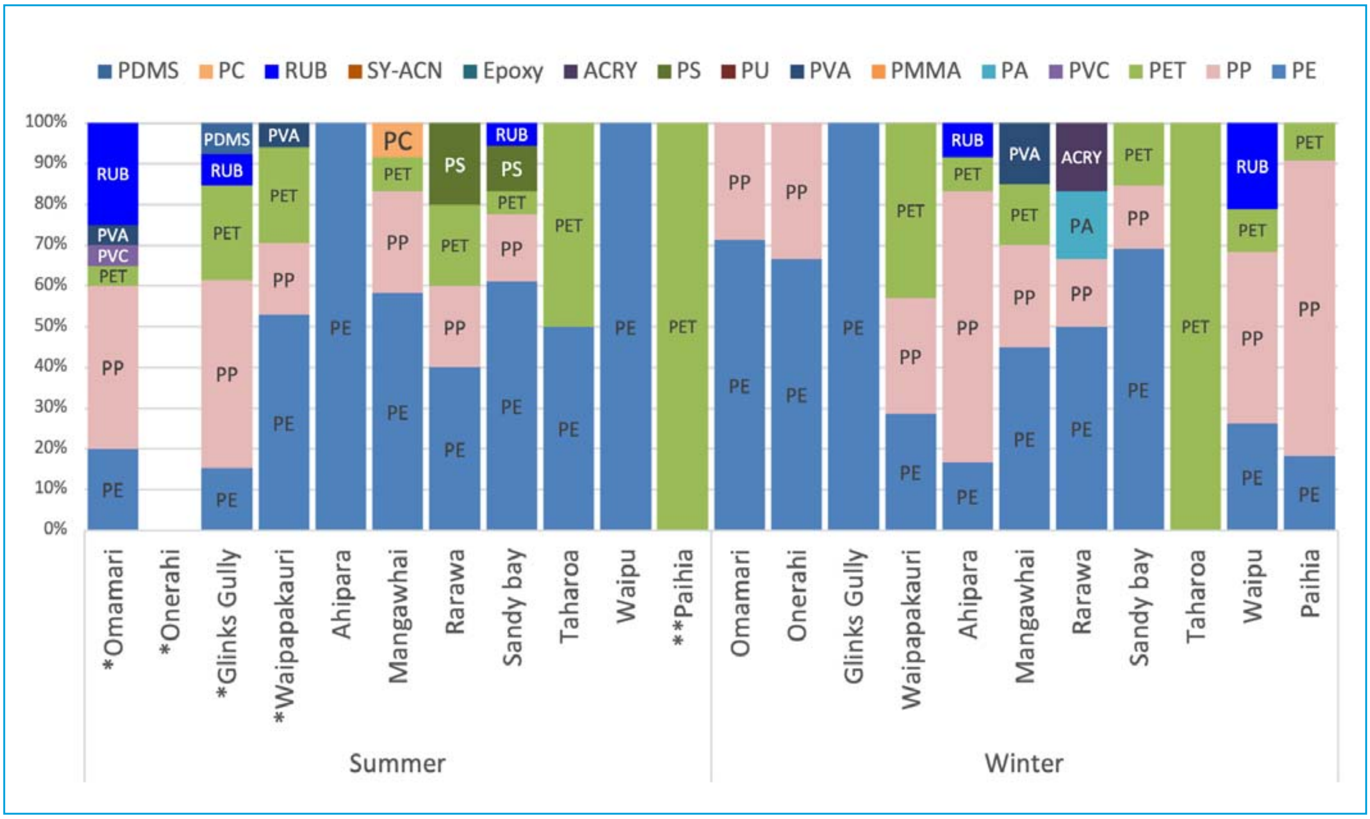


Figure 2: Relative abundance (%) of polymer type of large microplastic particle (LMPP) identified at the sampling sites in summer and winter. An average of three samples were conducted for each site, unless indicated where 5 or 6** were done. Polymer type: Polymers: RUB = Rubber; PVA = Polyvinyl acetate; PP = Polypropylene; PE = Polyethylene; PET = Polyethylene terephthalate; PVC = Polyvinyl chloride; PA = Polyamide; PC = Polycarbonate; PS = Polystyrene; PDMS = Polydimethylsiloxane; ACRY = Acrylic.*

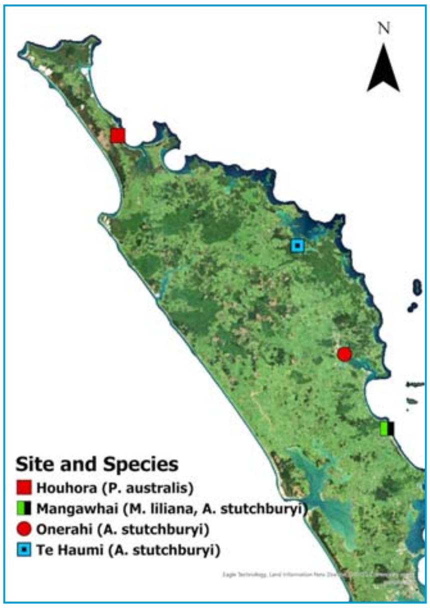


Figure 3: Sites and species locations of collected shellfish specimens.

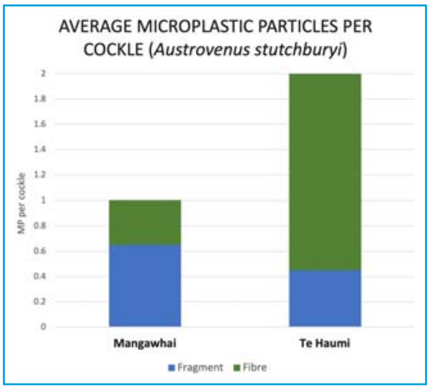


Figure 4: Average MP particles per cockle and predominant morphotypes.

freshwater, and terrestrial environments. In June 2021 near and offshore manta net trawls were undertaken to collect data on microplastics in the Hauraki Gulf, Bay of Islands and Whangārei. Results from this expedition are still pending.

Weblinks

1. Northland coastal litter monitoring: www.nrc.govt.nz/environment/coast/coastal-litter-monitoring-in-northland
2. Litter Intelligence: https://litterintelligence.org
3. Impacts and mitigation of microplastics: www.esr.cri.nz/our-research/research-projects/aotearoa-impacts-and-mitigation-of-microplastics-aim
4. Microplastic contamination in Te Tai Tokerau-Northland (Aotearoa-New Zealand) beach sediments: www.nrc.govt.nz/media/akbnnzjn/microplastic-contamination-in-te-tai-tokerau-northland-aotearoa-new-zealand-beach-sediments-2021.pdf
5. Blue Cradle: https://bluecradle.org/2021-microplastics-marine-biosecurity-expeditions

NZCS archive & downloads

The NZCS website houses an extensive archive of the Society's publications, including back issues of *Coastal News* (from issue 1, 1996 to date) and 'hot topic' reprints of significant articles from previous issues; newsletter author and article indexes (updated yearly); an author's guide to writing articles for NZCS publications; and copies of the four NZCS Special publications (published 2014-2020). All these can be accessed at www.coastalsociety.org.nz under the 'Media>Publications' tab on the main menu.

Biodiversity offsetting and compensation in the marine environment

Further reflections from a regional council officer's perspective

Jamie Steer[1] and Megan Oliver[2]

We read with interest Tommaso Alestra and Jacqui Bell's article on biodiversity offsetting and compensation in the marine environment in the November issue of *Coastal News* (see box for article link). Alestra and Bell touched on a number of important points relevant to the increasing pressure of development on coastal marine ecosystems in New Zealand. We have three reflections we'd like to add to theirs from a regional council officer's perspective.

In a nutshell, these are: (1) a paucity of dedicated technical guidance is hampering efforts to understand and coordinate impact management in the coastal marine environment; (2) many of the interim measures being used to redress adverse effects are unproven and may not meet their stated objectives; (3) when contemplating the management of adverse effects on marine ecosystems, greater emphasis should be placed on the avoidance of those effects by applicants and decision makers.

Paucity of guidance

There is currently little direct guidance to support the management of adverse effects on biodiversity in the coastal marine environment in New Zealand. National-level guidance does, however, exist to support implementation of good practice impact management in general. This includes the New Zealand Government's 2015 guidance on the use of biodiversity offsetting, Local Government New Zealand's 2018 guidance on the use of offsetting and compensation, and the Environment Institute of Australia and New Zealand's revised 2018 guidance on ecological impact assessment in terrestrial and freshwater environments.

The overarching direction, and many of the principles identified, in these documents is very helpful for managing effects on coastal marine ecosystems. Nevertheless, as Alestra and Bell rightly note, they do not identify impact management issues that are unique to the coastal marine environment, they provide no examples or case studies from coastal marine ecosystems, and they offer no guidance on limits or constraints specific to those ecosystems. The need for such information is becoming increasingly apparent.

Over the past few years large-scale consent applications involving effects on coastal marine ecosystems in regions such as Auckland and Wellington have had to progress in the absence of any targeted technical direction. Experts involved in these consents have had to rely on international case studies and bespoke methods generated under significant time pressure. Opportunities to potentially coordinate and optimise outcomes at a regional level have been lost. All of this has significantly increased the chances of these projects resulting in poor outcomes in the marine environment.

We have to be careful about 'innovation'

Alestra and Bell note that many of the practices for redressing adverse effects in the coastal marine environment remain undeveloped. This is especially notable when considering that equivalent measures may be relatively well developed in other domains (for example, the terrestrial environment). For the reasons identified by Alestra and Bell, and others, developments in marine impact management practice simply have not kept pace and are now badly lagging.

Recent experience in this area indicates that this slowness is not for a lack of options or imagination when it comes to potential practical effects management measures. Alestra and Bell note just some of the increasing number of possibilities, from living seawalls to seaweed restoration. But there is a problem: the vast majority of these measures are unproven. Most of them have been imported from recent applications overseas where their efficacy may also be questionable. Long-term data on the

This article is published in response to an earlier article by Tommaso Alestra and Jacqui Bell ('Biodiversity offsetting and compensation in the marine environment'), published in *Coastal News* 76, November 2021, page 7. Download a copy of this article at: www.coastalsociety.org.nz/assets/Uploads/files/CN-76-2021-11.pdf#page=7

Decorator crab scrambling over red algae (Adamsiella) *beds in Wellington Harbour (Photo: NIWA Peter Marriot, NIWA).*

(1) Senior Biodiversity Advisor, Greater Wellington
(2) Senior Environmental Scientist, Greater Wellington

reliability of most 'innovative' measures is hard to come by; generally non-existent.

Coupled with this uncertainty is the fact that many of these new techniques do not offset for effects in the necessary 'like-for-like' manner. They may provide benefits, but many of those benefits are to species and ecosystems not directly impacted by the development – hence why many of them can be considered only 'compensation', the lowest step in the effects management hierarchy. Alestra and Bell explain, for instance, how this comprehensive default to compensation was the case for the various measures planned to be used to redress adverse effects in relation to a coastal marine project they have recently assisted with.

It is important here to be clear: the compensation measures to be implemented – creation of mussel habitat, living seawalls, artificial tidal pools, etc. – will result, by definition, in a net loss of biodiversity value *even if they succeed*. Their perceived success, therefore, is a matter only of whether they are subsequently determined to comply with consent conditions, not whether the coastal marine environment gains or loses per se. The latter is locked in and will happen regardless. Those concerned with the effects of development on coastal ecosystems – and the contribution of compensation measures to alleviating them – should thus temper any nascent enthusiasm with such new measures.

Many of these 'innovative' techniques might more accurately be described as 'exploratory' – closer perhaps to research than application. In such circumstances decision makers might consider limiting the extent to which such novel approaches can be considered as part of a consenting decision (or consider them only where a backup option is provided in the event of failure). In Australia, for example, the contribution of 'other compensatory actions' implemented under the Environment Protection and Biodiversity Conservation Act 1999 – including research projects to inform future management initiatives – are capped at 10% of the overall offset package. This may help to ensure that uncertain and barely-tested approaches do not become the norm in impact management.

Avoidance of adverse effects remains the most important step

Alestra and Bell correctly note that, ultimately, avoidance remains the most important step in the effects management hierarchy. Much of the resource consenting conversation is had at the offset and compensate steps though (that is, at the opposite end of the hierarchy). This is particularly concerning in the marine environment as there is strong national direction, not just to apply the effects management hierarchy, but to avoid effects on many ecosystems, habitats and species entirely.

New Zealand Coastal Policy Statement (2010) Policy 11 directs the protection of indigenous biodiversity through the avoidance of adverse effects of activities on a wide range of indigenous taxa, ecosystems, habitats and community types. It further requires the avoidance of *significant* adverse effects, and the avoidance, remediation or mitigation of *other effects* on a range of further habitats and ecosystems. This direction is critical to the fulfilment of the objectives of the Aotearoa New Zealand Biodiversity Strategy 2020. Goal 10.4.2, for example, seeks to ensure no loss of the extent or condition of marine and coastal habitats which have been identified, mapped and designated as having high biodiversity value by 2030.

This national direction is invariably reflected in regional coastal plan policies and rules. Activities within recognised coastal sites of significance, in particular, are generally non-complying activities, meaning that an applicant must establish that the adverse effects of their activity on the environment will be minor, or that the activity will not be contrary to the objectives of the relevant plan or proposed plan. Applications for resource consent involving significant adverse effects on such ecosystems should necessarily contain a detailed options analysis to determine the case for proposing the activity in that location in the first instance.

Finally, there are limits to offsetting, and indeed to compensation as well. In the Wellington region, for example, these limits are stated in Schedules G2 and G3 of the proposed Natural Resources Plan for the Wellington Region. Applications to offset or compensate must not result in residual adverse effects following implementation. Consideration of offsetting is inappropriate where there is no appropriate site, knowledge, proven methods, expertise or mechanism available to design and implement that offset. When such limits cannot be met, applicants must instead revert to the mitigation, remediation or outright avoidance of adverse effects. It is incumbent on applicants, and especially the marine ecologists advising them, to rigorously test their applications – and their associated impact management measures – against these principles.

Future direction

The need for more technical guidance on impact management in the coastal marine environment has been previously identified by local government and others. Recognising this, we are currently working with a group of council officers and others to secure funding for new guidance in this area. The focus is intended to be on identifying and quantifying the value of practical measures (for example, installation of new habitat on seawalls, creation of rocky reef structures) that can be contemplated to meet mitigation, offsetting or compensation requirements, and on specifying how such measures could be assessed as part of a consenting decision. We hope to be able to share this work with the New Zealand Coastal Society in due course.

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 300 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).

Using data driven approaches to make short-term predictions of storm surge around New Zealand's coast

Sébastien Delaux[1], Naomi Puketapu-Waite[1], Jorge Perez[1], Carine Costa[1], Javier Tausia[2], Ana Rueda[2], Paula Camus[2], Fernando Mendez[2], Karin Bryan[3], Remy Zyngfogel[4]

Storm surge is a critical component of coastal flooding during extreme storms, particularly when coupled with abnormally high tides (see Figure 1). Numerical dynamical models of sufficient accuracy for real-time civil defence applications can be unwieldy and cost-prohibitive because of New Zealand's complex coastal environment, compounded by low resolution weather predictions.

Although theoretically the most accurate, in practice these models lack knowledge of fringing vegetation, bathymetry and seabed roughness, and local variations in wind/pressure fields, and these uncertainties in dynamical models overwhelm any advantages. Non-linear and linear data-based prediction models are revolutionising prediction in coastal science enabling low cost prediction (see, for example, the free wave and surge predictions provided on the Coast and Ocean Hub at https://coastalhub.science).

Here we show some preliminary results of models built by training data-driven prediction models on historic storm surge timeseries. These prediction models reduce the complexity in atmospheric inputs to optimise performance, and once trained can provide superior localised predictions.

For our training dataset, we use a combination of the water level from the Moana Project Hindcast (https://doi.org/10.5281/zenodo.5895264), which has high spatial resolution, publicly-available water level observations collected by Regional Councils and Port Authorities around New Zealand (see Figure 2), and the National Centers for Environmental Prediction (NCEP) atmospheric reanalyses (wind and surface pressure).

The data-driven prediction models are trained on the observations (providing accurate predictions at these sites), and on the Moana hindcast (providing regionally-resolved predictions). Where both coincide, comparisons show that the Moana hindcast reproduces water level well (Figure 2 shows some examples).

Figure 1: Flooding in Raglan, January 2018 (Photo: Stephen Hunt).

The wind fields, atmospheric pressure at mean sea level (SLP), and the gradient of SLP are used to build the predictor. In order to capture both spatial and temporal patterns efficiently, the data are reduced by selecting consecutive time frames of a regional or local subset averaged over 6h, 12h and 24h time intervals with the last frame matching with the prediction time (different approaches were trialled).

The EOF technique (commonly used in climate studies) breaks gridded data down into its dominant spatial patterns where a smaller subset of those patterns explains most of the variance; these shapes can be used as a basis for predictions and the lesser ones can be discarded. An example of the two most important EOFs of SLP are shown in Figure 3, panel b.

Once the predictor dataset has been prepared, then the prediction is created by using a regression model, where the weights are evaluated by training the model on a portion of the water level dataset (or hindcast), reserving the rest for validation. The metric that the model is optimised for (also called a cost function, for example, mean-square error) can make a difference on the way it performs. Some metrics are focused more on replicating typical conditions and some more on variability or extremes. We used a number of different

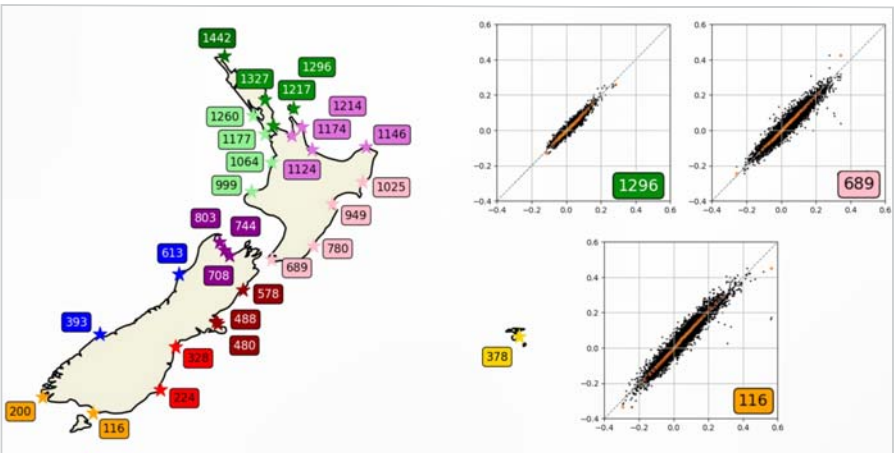


Figure 2: Validation of the Moana Hindcast with tide gauge observations.

(1) MetOcean; (2) University of Cantabria (Spain); (3) University of Waikato; (4) Calypso Science

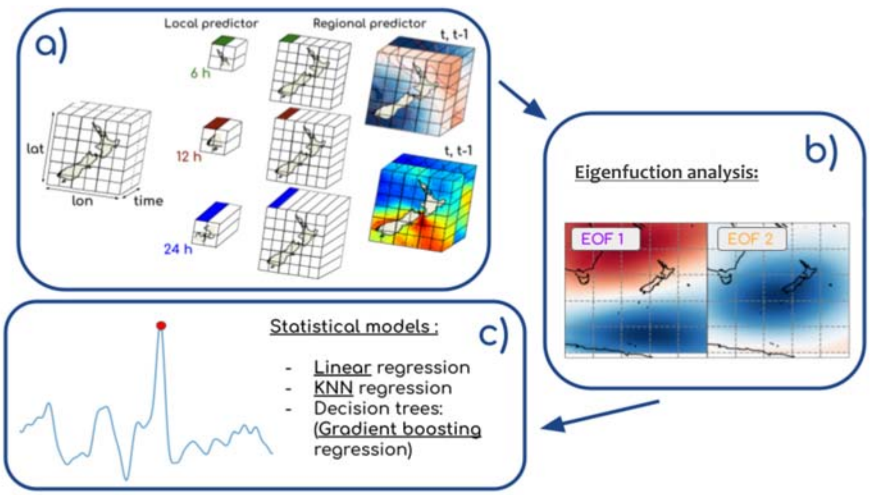


Figure 3: Preparing atmospheric predictors.

styles of regression models (linear, k-nearest neighbours (k-NN), decision trees) with different methods of preparing the predictor datasets. In linear models, for example,

$$Y(t) = a_1X(t) + a_2X(t-1) + a_3X(t-2),$$

all the training data are used (all X) to evaluate the weights (a_1, a_2, a_3); in k-NN models, only sequences of X(t), X(t-1), X(t-2) that are similar are used to evaluate the weights. In decision trees, the input data is classified into increasingly refined subcategories until the subcategory provides an optimal match to the validation datapoint.

The performance of the forecasting system using the linear regression model and different predictor preparation methods is shown in Figure 4, where blue represents a better forecast, evaluated against observation points shown in Figure 2. In general, using 24-hour averaging with a time lapse of three days, and including winds and SLP gradients, provides a better forecast across the network.

These results provide a robust foundation and benchmark to build and assess the convolutional neural network (CNN) models that are being developed at present. Unlike the linear approaches, which rely on EOF analysis to extract patterns out of the gridded data, CNN can learn an optimal way to extract those directly when being trained to predict the storm surge.

Early prototypes show performance comparable with that of the best linear model, however, a single CNN can generate storm surge predictions for all locations along the coast of New Zealand at once; the current linear models are trained at every single coastline location. Exploring the full extent of the performance of neural networks will deliver solutions to this problem and will be one of the main focuses of the second phase of this project.

Ongoing work is also focused on testing performance on cyclone events. These are difficult because these are not well resolved by the large spatial resolution of the atmospheric data used to develop the prediction models. To overcome this problem without increasing the need for dynamical modelling, we are trialling a vortex representation, which constructs idealised pressure and wind circulation at high resolution around known cyclone tracks. Figure 5 shows an example of synthetic wind fields around cyclone Gita, accompanied by the predicted SLPs.

The project finishes in September 2021, and the untrained modelling system will be made available on GitHub and on the TAIAO data platform (https://taiao.ai/) to allow for open implementation at different sites, and the trained modelling system will be incorporated into MetService's forecasting services.

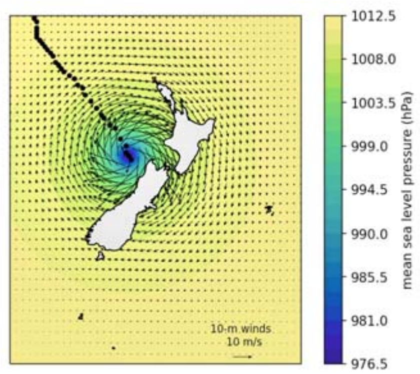


Figure 5: Synthetic atmospheric conditions around cyclone track Gita.

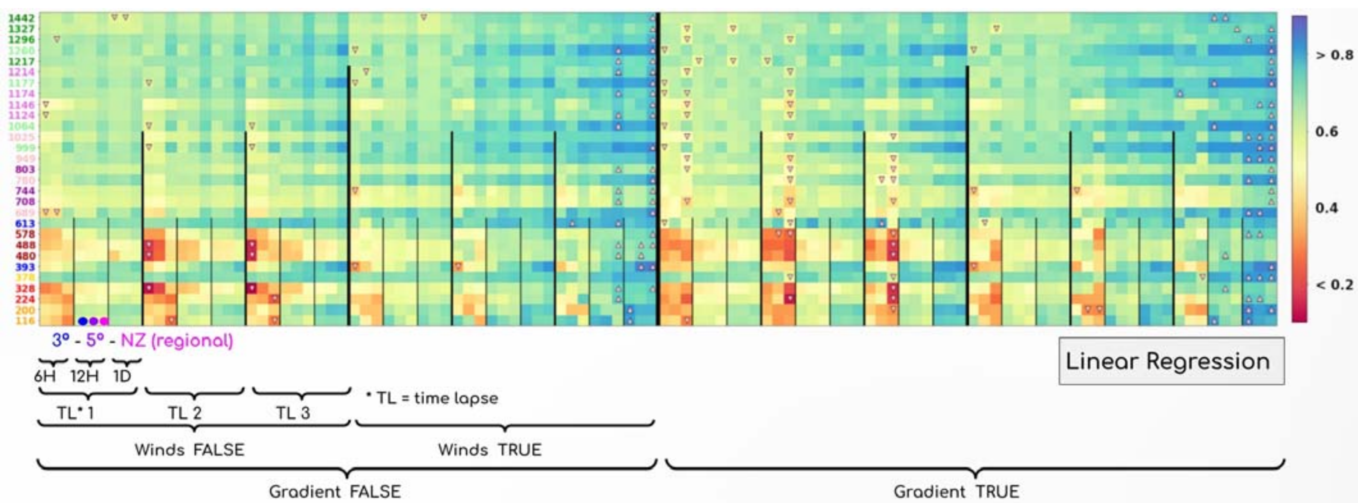


Figure 4: Comparison of optimal performance using the linear regression models. The colour scale is correlation between prediction and observation.

NZCS Student Awards closing soon

The New Zealand Coastal Society prides itself in giving out multiple awards designed to recognise both professional and student achievement and merit in the study or advocacy of issues related to the betterment of New Zealand's coastal resources.

Current and predicted pressures pose significant challenges for managers and planners seeking to provide sustainable futures for coastal environments and communities. The New Zealand Coastal Society (NZCS) was created as a means to promote and advance knowledge and understanding of the coastal zone. This includes fostering coastal research and capacity building that has the potential to contribute towards the aims of the Society.

If you have questions, please contact us at: nzcoastalsociety@gmail.com.

Student Research Scholarship

Applications close 1st May 2022

The society offers two scholarships annually to students conducting research that has the potential to contribute towards the aims of the society: NZ$5000 to support PhD research, and NZ$2500 to support Masters research. Applications close 5 pm on 1st May. Free attendance to the annual NZCS conference and dinner will also be awarded (an additional value of $700).

Māori & Pacific Island Research Scholarship

Applications close 1st May 2022

The Society is offering one PhD or Masters Research scholarship, which is open to anyone of Māori or Pacific Island descent OR with a research topic with Māori and Pacific Island focus within the coastal environment. An example could be the application of traditional Māori or Pacific Island coastal management techniques to modern day coastal planning. The purpose of this scholarship is also to promote diversity amongst coastal practitioners. The value of the award is NZ $5,000 to support PhD research or NZ $2,500 to support Masters research. Applications close 5 pm on 1st May. Free attendance to the annual NZCS conference and dinner will also be awarded (an additional value of $700).

In addition, award winners are profiled in each year's November issue of *Coastal News*, with a short biography and an outline of their research proposals.

For more information and links to the application forms, go to: www.coastalsociety.org.nz/awards

NZCS Management Committee

Co-Chairs
Mark Ivamy & Amy Robinson
mark.ivamy@boprc.govt.nz
amy.robinson@waikatoregion.govt.nz

Deputy Chair
Colin Whittaker
c.whittaker@auckland.ac.nz

Treasurers
Mike Allis & Ryan Abrey
michael.allis@niwa.co.nz
ryan.abrey@stantec.com

University & Education Coordinator
Colin Whittaker
c.whittaker@auckland.ac.nz

Website & Social Media Coordinators
Renee Coutts & Belen Rada Mora
nzcoastalsociety@gmail.com

***Coastal News* & Special Publications Coordinators**
Don Neale and Ana Serrano
dneale@doc.govt.nz Ana.Serrano@boprc.govt.nz

Special Projects Coordinator
Mike Allis
michael.allis@niwa.co.nz

National Regional Coordinators
Connon Andrews & Ryan Abrey
connon.andrews@beca.com
ryan.abrey@stantec.com

Central Government Representatives
Ryan Abrey & Connon Andrews
ryan.abrey@stantec.com
connon.andrews@beca.com

Awards & Scholarship Coordinators
Bryony Miller & Tom FitzGerald
bryony.miller@e3scientific.co.nz
tom@coastalmanagementcollective.com

Professional Development Coordinator
Sam Morgan
samm@4sight.co.nz

Administration, Membership & Communications Coordinators
Renee Coutts & Belen Rada Mora
nzcoastalsociety@gmail.com

***Coastal News* Editor**
Charles Hendtlass
cellwairmonk@gmail.com

For member profiles, see: https://www.coastalsociety.org.nz/about-us/management-comittee

News from the regions

Northland

Laura Shaft, Regional Representative

Coastal Adaptation Programme: Whakarāpopototanga

Northland councils are developing a work programme to address climate change risk to coastal communities. The programme will set out guidance for ways councils, communities, tangata whenua and key stakeholders can co-develop community adaptation plans.

The preferred best-practice engagement and decision-making approach to be used in the coastal adaptation programme is dynamic adaptive pathways planning, described in the 2017 Ministry for the Environment 'Coastal Hazards and Climate Change Guidance for Local Government'.

This process enables communities to be intimately involved in developing adaptation plans for their own communities through a structured process that uses community panels to collaboratively determine adaptive pathways using risk assessment, engineering designs, options assessment, and prioritisation processes.

The result will be a flexible, long-term adaptation plan for each community, signed-off by a governance body and the relevant communities and councils. While this approach will be appropriate for larger communities, we also work with smaller communities to develop and implement community-led adaptation plans at the local or hapū scale.

Funding for pilot community engagement projects has been allocated in the 2021-31 Long Term Plans for all Northland councils (priority actions 29 and 30 of the draft Strategy).

The Climate Change Adaptation Te Taitokerau (CATT) working group has developed the draft 'Coastal Adaptation Programme – Coastal Community Adaptation Profiles' to support the pilot community engagement projects.

This report is the third in a series of technical chapters contributing to the Te Taitokerau Climate Adaptation Strategy (the Strategy). In the previous chapter 'Climate risk overview', the risks posed by coastal hazards were identified as a key gap in council responses to date, presenting an opportunity to develop community adaptation responses to the projected impacts of climate change.

A priority action recommended in the Strategy is the Coastal Adaptation Programme, a 10-year programme of adaptation planning with coastal communities across the region.

The Coastal adaptation profiles technical report helps develop this future adaptation planning work programme by describing the range of coastal risks, and community needs and opportunities, in different coastal communities across the region.

The intent of the report is to provide data on the different levels of risk projected for different communities, guidance on appropriate adaptation planning approaches that might be appropriate for different communities, and community attributes to consider when planning adaptation.

Auckland

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

Shoreline Adaptation Plans

Auckland Council's Shoreline Adaptation Plans (SAPs) are in full swing with the second pilot, Beachlands and East, underway. SAPs look at how council-owned land and assets on the coast can be adapted to the impacts of coastal hazards and climate change over the next 100 years.

Recognising the environmental and landscape value of the shoreline, SAPs also work to promote the preservation and restoration of the coastal environment for future generations.

The SAP process was piloted in north Auckland along the Whangaparaoa Peninsula in 2021, and the pilot report will be publicly available following its adoption in early 2022. Beachlands and East covers Auckland's south-eastern coastal areas, stretching between Pine Harbour in the Beachlands area down to the Auckland Council boundary near Matingarahi, and is slated for completion in mid-2022. A regional risk assessment, which will help determine the order of the future SAP areas, is currently in development.

Hawke's Bay

José Beyá, Regional Representative

Clifton to Tangoio 2120 Coastal Hazards Strategy (update from issue 75)

Additional workshops with community panels have been held to further refine details of the concept design proposed by Councils.

The managed retreat assessment has been carried out by Tonkin and Taylor and a workshop with the community panels took place in June 2021.

Marine Customary Areas application

In December 2021, the High Court issued its preliminary decision re Ngati Pahauwera* finding in favour of four applicants for Protected Customary Rights (PCRs) and Customary Marine Titles (CMTs) under the Marine and Coastal Area (Takutai Moana) Act. A second High Court hearing was to be scheduled for mid-2022 to confirm details of those orders.

However, in February 2022, each of the four applicants subsequently filed their own appeal against the High Court's first decision, so those will now be subject to Court of Appeal proceedings (timings are currently unknown).

Meanwhile, several other applications for PCRs and CMTs spanning remaining parts of the Hawke's Bay coastline are yet to be timetabled for hearings before the High Court.

* see: https://www.courtsofnz.govt.nz/assets/5-The-Courts/high-court/high-court-lists/marine-and-coastal-area-takutai-moana-act-2011-applications-for-recognition-orders/20211222-Re-Ngati-Pahauwera.pdf

Enhanced monitoring programme

The Hawke's Bay Regional Council approved additional funding for coastal monitoring in the 2021-2031 Long Term plan. This will build better information for future design.

The first step will be to install wave buoys to improve knowledge in the nearshore wave climate. MetOcean was recently awarded a contract to deliver this service for this year. The first location will be in front of Westshore, Napier.

Wellington

Ryan Abrey and Verity Taylor, Regional Representatives

Electric ferry enters service
(update from issue 76)

Wellington's pioneering electric ferry, *Ika Rere*, made its first passenger sailing across the capital's harbour from Queen's Wharf to Day's Bay on March 1. After a week of passenger services, the ferry was taken out of the water for a clean and minor remedial work, with sailings resuming from 21 March. *Ika Rere* is the first fully electric, high-speed passenger ferry in the Southern Hemisphere. Designed and built in New Zealand, the 19 m carbon fibre-constructed catamaran for East by West Ferries carries up to 132 passengers at a service speed of 20 knots.

Ika Rere is a slender-hulled carbon fibre composite catamaran, with a highly efficient electrical distribution system and advanced battery management system, that is charged with the same charging standard used by electric cars and trucks around New Zealand. For the operator, this translates into a vessel with zero operating emissions, future proofed for technological developments, with a strong ROI over the lifetime of the vessel, and a far improved passenger experience over conventional aluminium/diesel ferries.

The ferry has been designed and built to complete one return run of 25 km before charging at the dockside at a rate of 1 MW for 15 minutes, while passengers disembark and board. For the first year of operation, she will be charged from a 300 kW charger at its overnight berth.

An on-board reminder of what makes the Ika Rere *different (Photo: Simon Hoyle, Southlight Studio).*

West Coast

Don Neale, Regional Representative

Flooding issues

Civil Defence and others have been dealing with flooding issues in Westport and Buller during February. No specific updates are available from this important work, but the flooding caused by recent storms has raised a wide range of issues for future coastal and river management in the area.

Intertidal monitoring

The Department of Conservation has been working with the University of Canterbury to do intertidal monitoring of the Hautai Marine Reserve. Three University scientists and two mana whenua rangers spent three days camping at the reserve to complete transects at four sites, combined with eDNA water sampling and photopoint monitoring. This is some of the first biological monitoring to be done at one of New Zealand's most remote mainland marine reserves, which was established in 2014.

Wellington's electric ferry Ika Rere *sailing off Queens wharf, watched by an appreciative audience (Photo: Simon Hoyle, Southlight Studio).*

New role

NZCS Committee member and West Coast Regional Coordinator Don Neale has moved into a new role as the Department of Conservation's West Coast Marine Reserves Ranger. His is one of several new marine ranger roles being established around New Zealand to put a greater focus on some of New Zealand's most significant marine protected areas.

Canterbury

Contributions from Justin Cope (Canterbury Coordinator) and Ruby Clark (CCC Adaptation Planning Advisor)

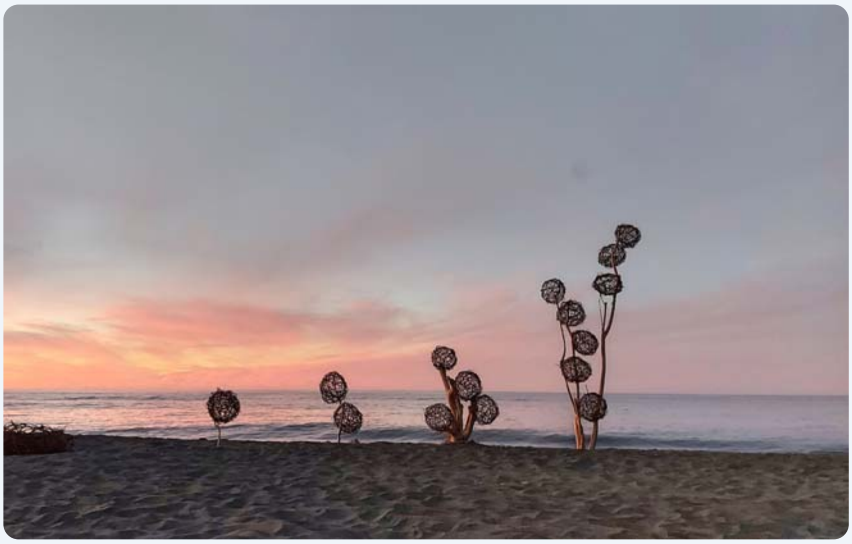
Kaikōura coastal hazard assessment

The Kaikōura District is the latest district in Canterbury to be getting an updated coastal hazard assessment. A lot changed in the coastal hazard landscape in Kaikōura following the 2016 earthquake, and the assessment will significantly improve our knowledge of how the present-day coastal erosion and inundation hazard has changed following the recent tectonic activity and what that means under future projected sea level rise scenarios. Jacobs are undertaking the assessment for Environment Canterbury and the Kaikōura District Council and it will be released mid-2022.

Banks Peninsula seabed mapping

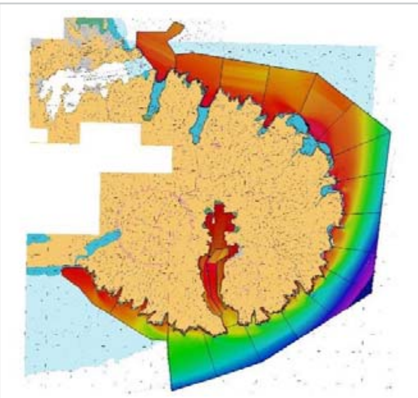
The multi-beam echosounder data collection phase of a hydrographic survey of Te Pātaka o Rākaihautū/Banks Peninsula seabed was completed in December 2021.

Land Information New Zealand contracted Discovery Marine Ltd to undertake multibeam mapping of approximately 41,100 ha of seabed around Te Pātaka o Rākaihautū/Banks Peninsula to update maritime charts for safe vessel navigation. Environment Canterbury and the Department of Conservation, in partnership with Onuku and Wairewa rūnanga, secured funding to maximise the opportunity afforded by the LINZ work to extend the area of seabed mapped by an additional 12,000 ha. This additional area extends the mapping so the entire peninsula, including areas



Hokitika's 20th annual Driftwood and Sand beach sculpture festival managed to go on despite the Covid-19 restrictions. Somewhat ironically, the Public Choice winner was a sculpture titled 'Exponential Growth', by local artist Anne Daniel. The Coast's dynamic environment was highlighted by the destruction of most sculptures within a week after the event by the encroachment of tropical fronts well south into the Tasman Sea.

shallower than 10 m deep, is included. This work will help significantly develop the understanding of marine ecosystems around Te Pātaka o Rākaihautū and will improve rūnanga, community and agency knowledge and management of subtidal habitats and ecosystems around the Peninsula.



Bathymetry coverage area of the Te Pātaka o Rākaihautū /Banks Peninsula seabed

The next phase of the programme to be undertaken during 2022 will be to validate the multibeam data in terms of the mapping of sea bed habitats by ground truthing – sediment grabs, diving, and camera/video drops.

Adaptation planning with Christchurch communities

In late 2020 the Christchurch City Council endorsed the establishment of a Coastal Hazards Adaptation Planning programme to undertake adaptation planning with low-lying coastal and inland communities across the Christchurch District that will be impacted by sea level rise through coastal inundation, coastal erosion, and rising groundwater. The district is significantly exposed to coastal hazards with approximately 25,000 properties and $1B in public infrastructure exposed to coastal hazards over the next 120 years. The programme has been rolled out in phases:

Phase One (initiation): Now completed, this phase involved updating our Coastal Hazards Assessment (Tonkin + Taylor) and developing a Risk and Vulnerability Assessment in collaboration with the University of Canterbury. A key step in this phase was the establishment of the Coastal Hazards Working Group, which is comprised of elected members from Christchurch City Council and Environment Canterbury, alongside Papatipu Rūnanga representatives from Te Rūnanga o Ngāi Tahu.

Phase Two (city-wide engagement): Beginning October 2021, this phase aimed to initiate a city-wide conversation about coastal hazards. Adaptation planning will occur in tranches, which requires the development of a process that will ensure equitable outcomes across the district and over time. To help achieve this, proposed policy principles, engagement process, decision-making process, roles and responsibilities were set out in a Coastal Adaptation Framework. Feedback was sought on this document alongside an Issues and Options paper for the aligned Coastal Hazards District Plan Change (https://ccc.govt.nz/the-council/plans-strategies-policies-and-bylaws/plans/christchurch-district-plan/changes-to-the-district-plan/planchange/plan-change-12), and the updated Coastal Hazards Assessment.

A key focus throughout the programme has been ensuring information is available in a range of accessible formats. An example of how this has been achieved are the short, yet informative, Coastal Hazard Assessment videos (see https://ccc.govt.nz/environment/coast/coastalhazards/videos) which help to concretise information through the use of familiar locations, props, visual explanations of key concepts, and utilisation of relatable language (such as referring to 30 cm as opposed to 0.3 m). A particular effort was also made to engage youth, acknowledging the inter-generational implications of coastal hazards and adaptation planning outcomes. Feedback gained in youth-specific workshops enabled the development of youth-specific collateral, summarised consultation documents, and engagement formats based in youth-centric locations such as schools and universities that helped facilitate greater engagement from young people.

Phase three (collaborative adaptation planning with communities in the Whakaraupō Lyttelton Harbour Adaptation Area): Yet to commence, this phase will involve the establishment of a Coastal Panel (a diverse group of community and rūnanga representatives from across Whakaraupō with some city-wide representation) that will provide informed recommendations to Council on behalf and with the support of the wider community. Expressions of interest for the Coastal Panel membership have been sought.

The Coastal Panel will be supported by a Specialist and Technical Advisory Group, experts in their fields that are able to provide information, advice and guidance to support decision making. Phase Three is due to begin in 2022.

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-sea-level-rise).

Southland

Bryony Miller, Regional Representative

Student research at SIT

Student research is underway at the Southern Institute of Technology, with students working with a variety of organisations to research coastal species: a study supported by the Ornithological Society of New Zealand surveying water birds (including coastal and migratory birds) at Pleasure Bay Lagoon, transpondering hoiho chicks on Whenua Hou/Codfish Island with the Yellow-eyed Penguin Trust, and conducting kanakana surveys with NIWA in the Waiau Catchment.

South Port dredging works

The South Port capital dredging works is initiating the baseline monitoring in Bluff Harbour this month, which will include subtidal seagrass delineation and sediment analysis, local turbidity calibrations, and rocky reef mātaitai assessments. These baseline surveys will be utilised to provide a BACI monitoring assessment of the works. South Port have also recently completed 12 months of marine mammal acoustic monitoring at three locations in the harbour. This data delineates marine mammals within the vicinity, the length of time they are present, and what species are present.

This data will be used to further inform the capital dredging project and the marine fauna observers who will be present during the works.

NZCS Regional Representatives

Northland	**Laura Shaft** lauras@nrc.govt.nz
Auckland	**Lara Clarke** l.clarke@gns.cri.nz *(currently on parental leave)*
	Matthew McNeil Matthew.McNeil@aucklandcouncil.govt.nz
	Andrew Allison andrew.allison@niwa.co.nz
	Eddie Beetham EBeetham@tonkintaylor.co.nz
Waikato	**Jamie Boyle** jamie.boyle@tcdc.govt.nz
	Joshua Sargent js535@students.waikato.ac.nz
Bay of Plenty	**Jonathan Clarke** JClarke@tonkintaylor.co.nz
	Josie Crawshaw Josie.crawshaw@boprc.govt.nz
	Scott Murray SMurray@tonkintaylor.co.nz
Manawatu-Wanganui	**Claire Murray** Claire.Murray2@ghd.com
Hawke's Bay	**José Beyá** Jose.Beya@hbrc.govt.nz
Gisborne	**Murry Cave** Murry.Cave@gdc.govt.nz
Taranaki	**Thomas McElroy** thomas.mcelroy@trc.govt.nz
Wellington	**Ryan Abrey** ryan.abrey@stantec.com
	Verity Taylor VTaylor@tonkintaylor.co.nz
Upper South Island	**Lisa Marquardt** lisa.marquardt@mfe.govt.nz *(currently on parental leave)*
West Coast	**Don Neale** dneale@doc.govt.nz
Canterbury	**Justin Cope** justin.cope@ecan.govt.nz
	Deepani Seneviratna Deepani.Seneviratna@ecan.govt.nz
Otago	**Sorrel O'Connell-Milne** sorrel@e3scientific.co.nz
Southland	**Bryony Miller** bryony.miller@e3scientific.co.nz

News you might have missed

Coastal News Editor

Long web addresses in print media are often unavoidable, but not exactly user friendly – they can't be clicked and transposing them to a browser can lead to both frustration and error. To make the process a little easier, we now provide a pdf file of (clickable) links for each issue. For access details, see the box on page 19.

One of the side effects of living in 'interesting times' is that intriguing, quirky or good news stories can be overlooked due to the sheer volume of negative news. This is equally true of the coastal world, so continuing our semi-regular 'News you might have missed' segment, here are some stories that might have passed you by...

What to do with seaweed

Photo: Pixabay

Seaweed has featured in a number of stories recently, including three highlighting some unexpected uses. A BBC article has posed an intriguing question – can giant kelp help the aviation industry curb its greenhouse gas emissions? While the obvious connection is using kelp to lock carbon away, there is also potential for it to be used as a carbon neutral biofuel. For the full story see www.bbc.com/future/article/20211119-can-flying-ever-be-carbon-neutral

Another unexpected use for seaweed is in the treatment of slipped discs. A trial is underway of a seaweed-derived gel that, when injected into damaged discs, hardens, thereby reducing pain and promoting the growth of new tissue. For more, see www.dailymail.co.uk/health/article-10255667/How-seaweed-jab-beat-agony-slipped-disc.html

The third new use for seaweed is in the building trade, and this one has a local flavour. A University of Canterbury student has developed a plasterboard incorporating seaweed as a replacement for the artificial materials currently used.

While still in the prototype stage, further work is being undertaken to gauge its commercialisation potential, as reported at www.stuff.co.nz/environment/climate-news/127561461/using-carbonabsorbing-seaweed-to-help-our-homes-go-green

Before leaving seaweed, two other articles are worth checking out. The first looks at work underway to reverse the loss of Tasmania's giant kelp, which has declined some 95% over the past 15 years due to climate change impacts. This article can be found at www.theguardian.com/australia-news/2022/mar/13/really-worth-a-crack-bringing-tasmanias-giant-kelp-forests-back-from-the-brink.

The final article looks at an Indian startup company that has developed a 'sea combine harvester', an automated catamaran that simultaneously harvests and replants seaweed in the ocean. For the full story, see https://edition.cnn.com/2022/01/05/business/india-sea6-energy-seaweed-harvester-spc-intl/index.html

Litter communities

Photo: Pixabay

The problem of ocean litter is well known and widely reported (including in this issue of *Coastal News*), but recent studies of the Giant Pacific Garbage Patch throws up a new twist. A study has shown that the 79,000 tonne, 1.5 million square kilometre accumulation of plastic debris is not only harbouring coastal plant and animal species, but it seems they are forming communities and thriving. For two accounts, see www.dailymail.co.uk/sciencetech/article-10263711/Animals-plants-living-Great-Pacific-Garbage-Patch.html and www.stuff.co.nz/environment/300475151/great-pacific-garbage-patch-now-an-immense-floating-plastic-habitat

On a related topic, it would seem that octopuses are increasingly using human-generated litter for shelter instead of sea shells. The study, conducted in Brazil, captured images of 24 octopus species making use of metal cans, plastic and glass bottles, and other debris as shelter. The article, with a good selection of the images taken, can be found at www.dailymail.co.uk/sciencetech/article-10611505/Octopuses-using-human-litter-shelter-shocking-images-reveal.html

Aquatic songs and coral reefs

Photo: Pixabay

The underwater world is a surprisingly noisy place – it is estimated that around 126 marine mammals, 100 invertebrates and some 1000 fish species emit some sort of noise, but researchers believe there are many more waiting to be identified. 'Song' libraries of fish, frog and other marines species have been created (for example, FishSounds (https://fishsounds.net/index.js) and FrogID (www.frogid.net.au/)), but there is now a proposal to combine and expand these into a super library called the Global Library of Underwater Biological Sounds (aka 'Glubs'). For more, see www.theguardian.com/environment/2022/feb/17/underwater-sound-library-to-reveal-language-of-the-deep-aoe

Meanwhile, in Indonesia, fish songs are being used to monitor the health status of a restored coral reef. The reef was severely damaged by blast fishing, but now fish and other marine life are returning and apparently making quite a bit of noise about it. The reef soundscape is now close to that of an undamaged reef, so the restoration project is considered to be a success. To read the full story, see www.theguardian.com/environment/2021/dec/08/whoops-and-grunts-bizarre-fish-songs-raise-hopes-for-coral-reef-recover

Sticking with reefs, a Nobel prize-winning stock market theory – of all things – is being used to help save threatened coral reefs. 'Modern portfolio theory', which is a mathematical framework that helps risk-averse investors maximise returns, is being used by researchers at Australia's University of Queensland to identify coral reefs around the world most likely to survive climate change, and which would then be able to repopulate other not-so-fortunate examples.

If it seems a bit far fetched, the full story is available at www.theguardian.com/environment/2021/nov/28/stock-markets-modern-portfolio-theory-mpt-used-to-pick-coral-reefs-arks-conservation-survive-climate-crisis

If using economic theories to save coral reefs seems a bit unusual, how about gathering coral spawn by moonlight? It's not as new age as it sounds though, but is part of an Australian Institute of Marine Science project to help breed heat-tolerant corals.

While these particular corals are 'kept in captivity', replicating natural spawning signals is all part of the ongoing process – for the full story, see www.theguardian.com/environment/2021/nov/26/great-barrier-reef-how-a-spectacular-coral-spawning-event-is-helping-to-breed-heat-tolerant-corals

Odd news update

In two billion year old breaking news, scientists in Scotland have uncovered the role plankton played in mountain formation. It's all down to the remains of primitive lifeforms acting as a lubricant allowing rock slabs to pile up and – eventually – form mountains. For a fuller explanation, see www.theguardian.com/environment/2021/dec/05/hot-news-from-two-billion-years-ago-plankton-actually-moved-mountains

And finally, both unexpected and odd, London's Thames River – declared 'biologically dead' in 1957 – is now home to venomous sharks, along with seahorses, eels, seals and other species. While positive, it's not all good news according to a recent health survey. For more on this, see https://edition.cnn.com/travel/article/venomous-sharks-london-scli-intl-gbr-scn/index.html

NZCS Special Publication update

Activity on the fifth in the series of NZCS special publications has now moved to the next stage, with the contents finalised, and authors beginning work on their contributions. With the working title 'Coastal Adaptation – adapting to coastal change and hazard risk in Aotearoa New Zealand', the publication will highlight expert perspectives and practical experience to help Aotearoa New Zealand move toward an integrated approach to coastal hazard management. Including submissions and commentary from multiple perspectives (e.g. researchers, Māori, communities, planners, policymakers, and resource managers), it will be generally aimed at readers who are knowledgeable and interested, but not necessarily expert, in the subject of coastal adaptation.

The contents list (which may be subject to minor changes) covers the following topics:

1 Introduction

- What is coastal adaptation?
- Imperative to adapt
- What does success look like?

2 Planning & Policy

- The context
- Economic tools
- Legacy development
- Triggers

3 Engagement

- With Māori
- With the community

4 Matauranga & Science

- Matauranga and Science connections
- Processes
- Ecosystems

5 Built Environment

- Infrastructure
- Engineering science and risk
- Shoreline management plans

6 Conclusions.

Publication is planned for early November, in both print format (which will be distributed to NZCS members, organisations, libraries and local government agencies) and, later, an electronic version that will be freely available on the NZCS website.

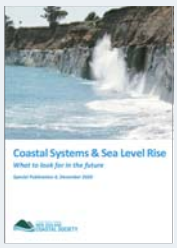
If you have any queries or comments on the new publication, please contact Don Neale, NZCS Publications Coordinator, at: dneale@doc.govt.nz

If you haven't seen any of the previous special publications shown below, they can be downloaded from the NZCS webite at www.coastalsociety.org.nz (listed under the 'Publications' tab).

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)

Coastal News weblinks

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 an active link as we do in the pdf version. We realise that long, complex and non-clickable web addresses can be frustrating (and counterproductive) for readers, so beginning with issue 74 we have been adding a pdf file of all the newsletter links to the NZCS website (www.coastalsociety.org.nz/publications) – so one click will work, rather than readers having to manually copy long strings of seemingly random characters.

To make things even easier, you can access the pdf file 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.

Disclaimer

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 June 2022.

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.

The New Zealand Coastal Society would like to acknowledge our corporate members for their support:

4SIGHT CONSULTING

Tonkin+Taylor

NIWA Taihoro Nukurangi

Bioresearches A Babbage Company

May + Partners

Environment Canterbury Regional Council Kaunihera Taiao ki Waitaha

Taranaki Regional Council

wsp

ENGEO

OCEL CONSULTANTS NZ LIMITED

Beca

GEOFABRICS

NZDS

DML DISCOVERY MARINE LTD

awa

New Zealand Coastal Society

www.coastalsociety.org.nz

www.instagram.com/nzcoastalsociety

www.facebook.com/NZCoastalSociety

nzcoastalsociety@gmail.com

Abel Tasman National Park coast
(Photo by David Philipp from Pixabay, https://pixabay.com)