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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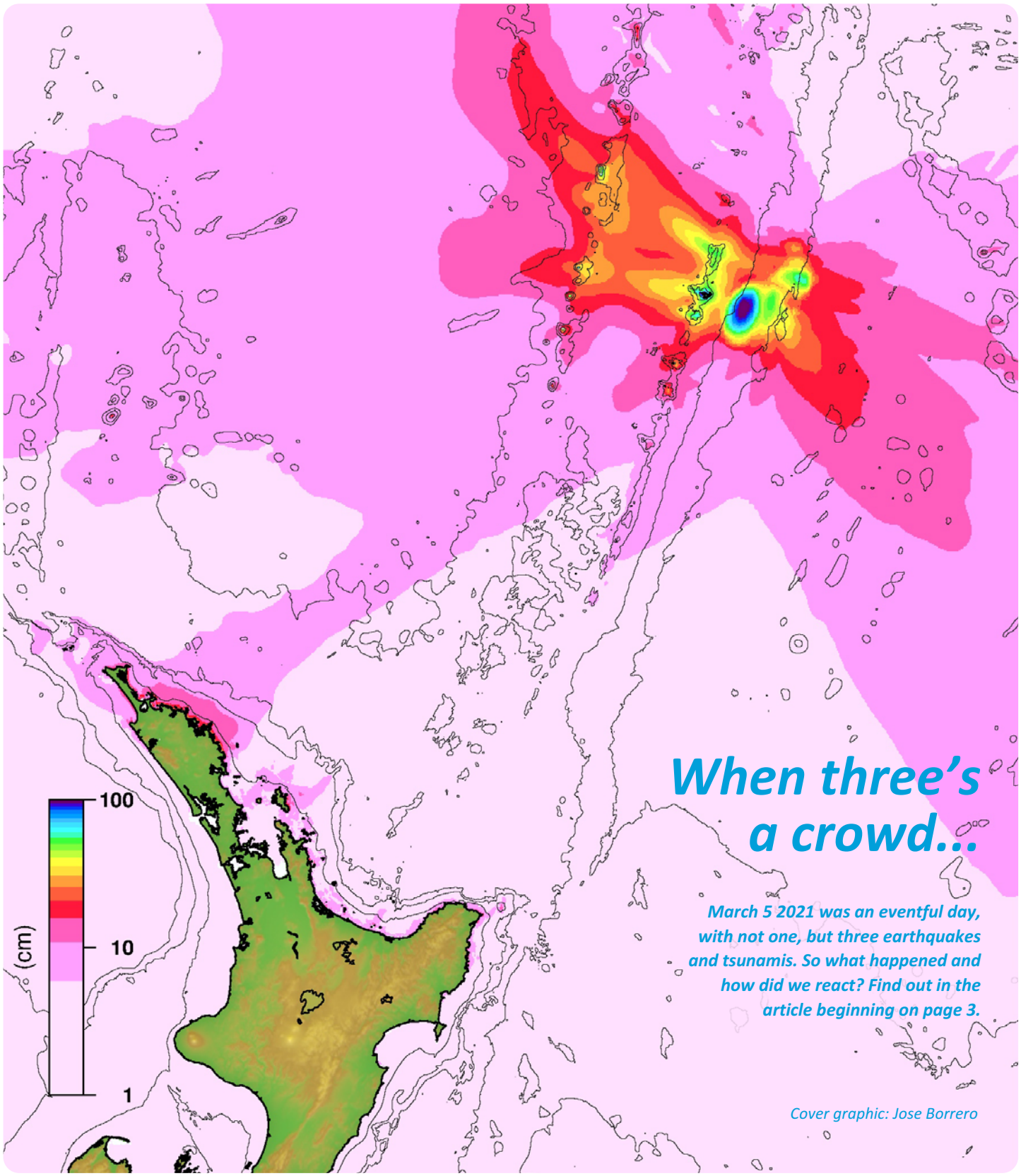

When three's a crowd...

March 5 2021 was an eventful day, with not one, but three earthquakes and tsunamis. So what happened and how did we react? Find out in the article beginning on page 3.

Cover graphic: Jose Borrero

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Word from the Chair

Kia ora katou tatoa

It has been a fantastic start to the year! We've had the pleasure of formally awarding Rob Bell his life membership during a lunch presentation with Rob's colleagues at NIWA Hamilton. A new tradition we have started is to present our life members with a special taonga – a pounamu toki carved by Ngati Waewae. We have taken the time to visit our other life members – John Duder, John Lumsden, Terry Hume and Terry Healy (whānau) – to present their taonga and thank them for their ongoing contributions to the Society. It has been an honour for the executive committee to present these gifts to our very own life member taonga.

Going back in time to November 2020, we were really pleased with the success of our hybrid webinar conference event. As you will know, COVID-19 got in the way of our plans to hold the conference on Waiheke Island. However, the local organising committee (led by Terry Hume) implemented 'Plan B', which comprised:

- the Eric Verstappen Young Professionals gathering
- a series of four streamed talks from Giovanni Coco, Karin Bryan, Mark Dickson and Richard Levy relating to our recent Special publication *Coastal Systems & Sea Level Rise*
- face-to-face social networking events in Christchurch, Wellington, Tauranga, Raglan and Auckland.

The virtual attendance and in-person social events were well attended and we are delighted to have pulled it off in a time of such uncertainty. Thank you to all our sponsors and all of you that attended, who made the event such a great success.

On the back of this, the Society is busy organising a range of webinars and regional events to be rolled out across the year. We encourage you to consider these opportunities to share your mahi. The Society is also organising the Australasian Coasts and Ports Conference, which we host in New Zealand every six years in conjunction with our partners the Engineers Australia National Committee on Coastal and Ocean Engineering, and PIANC Australia and New Zealand. This year the conference will be held at Te Pae in Christchurch from 30 November to 3 December. We look forward to seeing you there and welcoming our Australian colleagues for what is always a fantastic, informative event.

In this issue we cover a range of interesting topics. It is particularly exciting to be able to provide a report on the March tsunami trifecta – with thanks to Jose Borrero and Murry Cave for pulling this article together at such short notice. Other articles traverse a history of shoreline change in Northland, the resilience of coastal ecosystems in relation to sea level rise, land based aquaculture, and modelling tsunamis generated by volcanic activity. We would like to take this opportunity to say a huge thank you to all of the contributors to this issue – we are grateful for the time you spend preparing these articles – you make the *Coastal News* the fabulous publication that it is, and we could not do it without your support.

Noho ora mai (look after yourself)

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 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).

Three tsunamis (and earthquakes) ... in one day

Jose Borrero[1] and Murry Cave[2]

March 5 2021 was a busy day for New Zealand's emergency management and tsunami response community. It all began at approximately 2:30 am on Friday March 5 2021 (New Zealand Daylight Time-NZDT) when a magnitude 7.3 earthquake located some 175 km northeast of Gisborne shook people awake across the North Island. The relatively strong and long-lasting shaking felt by residents in Gisborne and along the East Cape alerted many to the possibility of an ensuing tsunami prompting numerous people to spontaneously evacuate coastal areas.

This was particularly the case for the coastal settlements north of Gisborne city where the Tolaga Bay, Tokomaru Bay, Te Araroa and Hick's Bay communities self-evacuated to higher ground. In Gisborne city, self-evacuation was more sporadic, but areas prone to shake amplification such as Sponge Bay did evacuate. Muriwai also evacuated to Muriwai school and in the absence of a local coordinator, a Council staff member who lived in the area informally took over local coordination. The Gisborne Emergency Co-ordination Centre (ECC) mobilised and was operational by 2:45 am and continued until 2:45 pm.

Video taken by Claudia Maaki of Tokomaru Bay showed a pronounced bore at Tokomaru from the 8.1 Kermadec event. The Te Araroa web cam was accessed by the ECC to assess tsunami and strong wave seiche was observed along the Te Araroa beach front.

Post event information gathering was initiated but found no evidence of tsunami at Tokomaru Bay above the normal high tide mark. At Hick's Bay deeper water seaweeds were found thrown up at the high tide mark.

The tsunami monitoring response for the first event began immediately after the earthquake thanks to the 24/7 operations at New Zealand's National Geohazards Monitoring Centre (NGMC). Additionally, several members of New Zealand's Tsunami Experts Panel (TEP) were awakened by the shaking and quickly began responding to the event. Determining whether or not a large tsunami was generated by this earthquake was of critical importance due to the fact that the region offshore of New Zealand's East Cape is known to produce earthquakes capable of generating tsunami much larger than the magnitude alone would suggest (discussed in more detail below). As such, the teams worked for several hours after the earthquake monitoring coastal tide gauges for any signs of a large tsunami.

With no indication that a large wave was generated, response activities were winding down when, at 6:40 am, a second earthquake struck on the Tonga-Kermadec Trench, the enigmatic subduction zone that runs from Wellington to Samoa. However, this earthquake was located 1100 km north of Gisborne and with a magnitude (M_W) of only 7.4 it was immediately clear that it did not pose a significant tsunami threat to New Zealand. Nevertheless, members of the NGMC and TEP convened another series of conference calls to discuss the event and provide information to New Zealand's National Emergency Management Agency (NEMA) who are in charge of providing official tsunami warning information to the public.

As discussions related to the second event continued, the third and largest earthquake occurred in nearly same location as the second. With a magnitude of 8.1, this earthquake presented more of a concern for New Zealand, as historical predecessors such as the 15 January 1976 earthquake which occurred in nearly the same location, caused strong currents and damage to boats and docks in Tutukaka Harbour, a well-known tsunami 'hot spot' on the New Zealand coast (Borrero and O'Neill, 2019).

With the first arrival of tsunami waves from the third earthquake not due in New Zealand for at least two hours, the focus of the assessments quickly shifted. Rapid assessment tools suggested that tsunami heights would exceed 30 cm, the threshold for a 'beach and marine' threat, for all of the North Island and the west coast of the South Island.

Later assessments increased the threat level to the lowest of the 'marine and land' threat levels along the Northland coast near Tutukaka, Great Barrier Island and the northern and eastern sections of East Cape. These advisory levels proved to be accurate as surges in that size range were observed in those areas, including dramatic video posted on social media of a tsunami bore propagating in to Tokomaru Bay (see Figure 1) and of the strong currents rushing in and out of Tutukaka Harbour. Monitoring of this event continued through the day and, by 3:30 pm, it was apparent that the peak of the tsunami activity had passed and the advisories were lifted. The overlapping tsunami signals from the three tsunamis were clearly recorded on tide gauges in New Zealand as shown in Figure 2.

Figure 1: A tsunami bore, generated by the third earthquake, entering Tokomaru Bay at 11:27 am. Image sourced from the internet.

Event	Time (NZDT)	Mag. (M_W)	Long. (deg W)	Lat. (deg S)	Depth (km)
1	0227	7.3	180.556	37.563	20.8
2	0641	7.4	177.834	29.665	53.1
3	0828	8.1	177.282	29.735	26.5

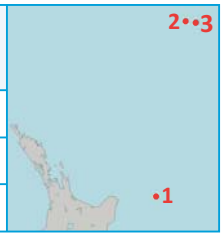

Table 1: Details of the three significant earthquakes near New Zealand on 5 March 2021 (Source: USGS).

(1) eCoast Marine Consulting and Research, Raglan, New Zealand; (2) Gisborne District Council, New Zealand

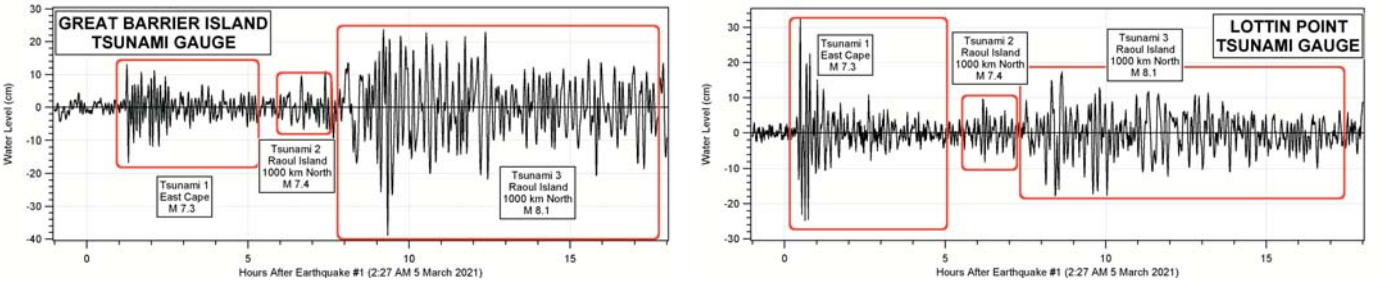

Figure 2: The three overlapping tsunami signals as seen on the Great Barrier Island and Lottin Point sea level gauges.

Discussion

With a magnitude of 7.3, the first earthquake was on the small end of the spectrum for producing highly destructive tsunami – even in the nearfield. However, as noted above, the East Cape region is known to produce tsunamis much larger than would be expected based on earthquake magnitude alone.

These so called 'tsunami earthquakes' (Kanamori, 1972) generate larger tsunami due to their relatively slow earthquake rupture, which is more efficient at transferring seismic energy into wave energy, as well as greater deformation of the sea bed related to the presence of mechanically weaker material.

Indeed, on March 25 1947 a magnitude ~7 earthquake offshore of Gisborne generated a tsunami with runup heights in excess of 10 m at sites along the open coast north of Poverty Bay. This event was followed a few months later (17 May) by a slightly smaller earthquake that also generated an anomalously large tsunami with runup heights of up to 6 m along the coast from Gisborne to Tolaga Bay (Eiby, 1982).

However, the M 7.3 event on March 5 2021 did not exhibit any characteristics of a tsunami earthquake. Instead, the focal mechanism suggests that it was an intraplate event which occurred on a steeply dipping fault in the over-riding Australasian tectonic plate on the western side of the subduction zone. The sense of motion of the earthquake was mostly strike-slip with a slightly oblique component that provided sufficient vertical motion to generate a small tsunami.

In contrast, the 6:41 am and 8:28 am events were classic interplate subduction zone earthquakes, meaning that they ruptured on the plate boundary itself and they had a pure thrust mechanism where the overriding plate moves upwards relative to the subducting plate. While these types of earthquakes are the classic tsunami generators, the ultimate size of the tsunami was muted by two factors: the relatively small magnitude of the event and the fact that the greatest amount of dislocation occurred some 100 km down the fault plane itself at a depth of ~30 km in to the earth, thereby reducing the amount of seafloor deformation and the amplitude of the subsequent tsunami.

The tsunamis generated by these earthquakes were recorded on New Zealand's newly installed DART buoy array (Fry et al., 2020; Borrero, 2020). Six DART sensors were operational during the events and recorded the tsunami. The data were used in real time by the Tsunami Experts Panel to assess the tsunami threat and have since been used to calibrate numerical models of the event (Gusman, 2021).

An example of this modelling is shown in Figures 3 and 4 where Borrero (2021) used

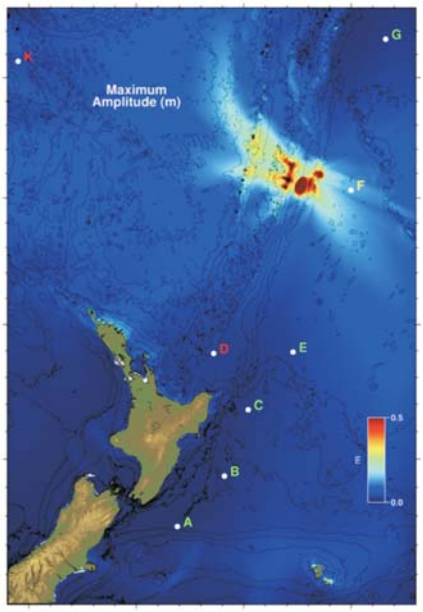

Figure 3: Maximum computed tsunami amplitude from the 8:28 am, M_W 8.1 earthquake and locations of New Zealand's DART sensors.

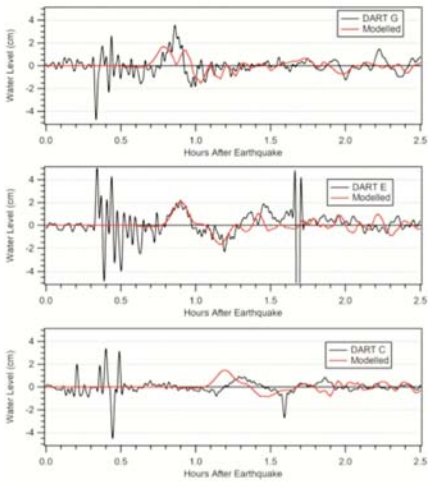

Figure 4: A comparison of modelled to measured tsunami water levels at DART stations C, E and G. Dart data provided by Aditya Gusman, GNS Science.

the USGS fault solution to initialise a hydrodynamic model. The model output shows a particularly good fit to the measured data at Site E, a good fit for timing and total wave energy at Site G and accurate amplitude with early arrival at Site C. Unfortunately DART F, located closest to the rupture zone, was offline during the event. However, the presence of multiple sensors gave the overall system the redundancy needed to be useful.

Conclusion

The early morning earthquakes of March 5th 2021 were – quite literally – a wakeup call for New Zealand's disaster management community. The long and strong shaking of the first event prompted people to self-evacuate and to act without an official warning, behaviour that is important to save lives. This was followed by two earthquakes a few hours later located approximately 1000 km north of New Zealand. These events each generated a tsunami, however neither was big enough to generate a damaging tsunami in New Zealand. Nevertheless the events tested New Zealand's emergency and disaster

response capabilities and the experience gained and lessons learned will serve to improve these systems in future events.

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80 years of shoreline change in Northland

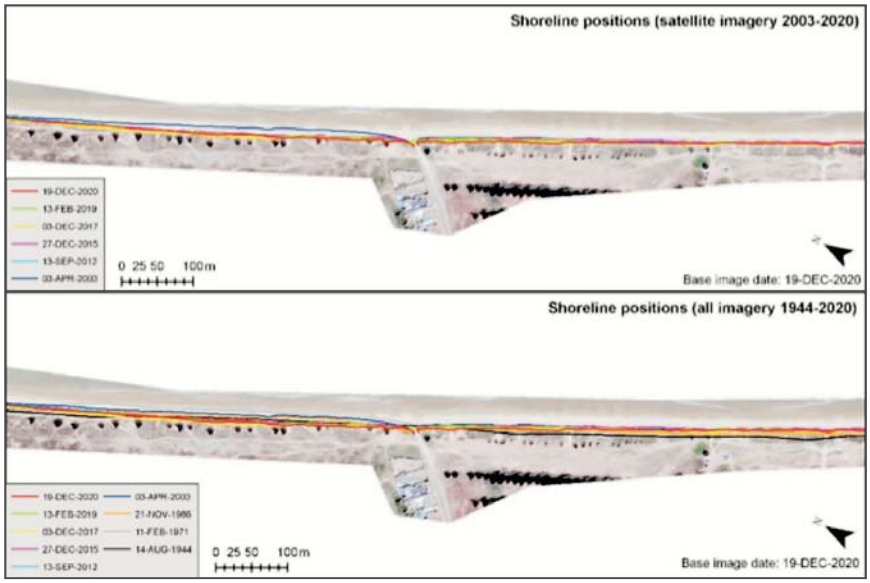
Emma Ryan, Mark Dickson and Murray Ford

A team of researchers at the University of Auckland have georeferenced and digitised ~3000 km of shoreline historical imagery from the Crown aerial archive since the 1930s – covering every unconsolidated shoreline in the Northland region. This research, which is supported by Northland Regional Council, and forms part of the 5-year Coastal Programme within the Resilience to Nature's Challenges National Science Challenge (RNC), is the first step in an ambitious project that aims to capture historical shoreline data across Aotearoa New Zealand in a consistent manner. A national assessment of coastal erosion has not been conducted since the benchmark work of Gibb in 1978 and is long overdue.

In addition to historical Northland shoreline data, a detailed shoreline analysis since 2005 was undertaken for eight selected beaches of interest to Northland Regional Council, using high resolution commercial imagery obtained from the Maxar constellation of satellites. Together, the historical and more recent higher resolution shoreline analyses reveal net shoreline change (erosion and accretion) rates and patterns. The research team is currently analysing these changes to explore spatial and temporal patterns and identify Northland coastal erosion hotspots.

Initial analyses reveal some areas of coast that have had phases of erosion and accretion over several decades, and other areas that have been remarkably stable, despite interdecadal climatic fluctuations and observed sea-level rise over the past century.

If you have questions about the research or are interested in collaboration, please contact Emma Ryan, e.ryan@auckland.ac.nz



Example of shoreline change at southern Tokerau Beach, Northland.

Congratulations to NZCS member Dr Shari Gallop

Shari, a Senior Lecturer at the University of Waikato, is the recipient of the New Zealand 2020 L'Oréal/UNESCO For Women in Science fellowship for her research on the science of restoring estuaries and how they will stand up to climate change. The fellowship programme recognises the achievements of exceptional early-career women scientists in Australia and New Zealand, and only five awards are made annually. For the first time, the programme is dedicated to scientists investigating climate change and Shari is the sole recipient from New Zealand to be awarded this year's fellowship, and the first-ever from the University of Waikato. Shari has been awarded $25,000 to help her groundbreaking studies into estuary restoration. A short profile of Shari was published in *Coastal News* 68 (March 2019).

Enhancing the resilience of coastal ecosystems to relative sea-level change

Shane Orchard [1,2]

Coastal margins are exposed to rising sea levels that present major challenges for managing natural resources and hazards under climate change. The Canterbury earthquakes provided a rare example of seismic displacement that generated rapid sea-level change in a coastal system typical of many worldwide. This created a unique opportunity to observe the actual effects of relative sea-level rise that arose from movement of the land in relation to the sea.

This article provides an overview of two studies that investigated the nature and consequences of shoreline position change connected to these events. Similarly, this is an important aspect of adaptation to sea-level rise under climate change. The first of these studies addressed the larger-scale picture with a focus on the estuary of the Heathcote and Avon Rivers/Ihutai as a natural feature and ecosystem that is the subject of protection under current policy and law. Key themes were the quantification of vertical displacement, shoreline position changes, and spatio-temporal variability in the observed patterns of change. Drivers of these changes were further characterised to identify the specific mechanisms by which 'coastal squeeze' effects may occur (Orchard et al., 2020a). The results showed that historical approaches to natural hazard management had substantial negative impacts on outcomes for natural environments in a real hazard event, and also identified ways to avoid them through innovative planning and design (see Box 1).

A follow-up study delved further into the consequences for riparian wetlands and the considerable ecosystem services they provide (Orchard et al., 2020b). A central theme was again the exploration of specific mechanisms of change, this time at the scale of individual wetlands and the saltmarsh system as a whole. The fortuitous availability of pre-earthquake vegetation data and concurrent ground-level data enabled the design of a robust impact assessment to quantify earthquake effects and identify anthropogenic factors that influenced the pattern of loss or gain.

Surprising results included reduced surface elevations in all wetlands eight years after the major February 2011 earthquake, despite having experienced widely varying seismic displacement effects including some examples of uplift. The lack of evidence for vertical accretion in the recovering marsh ecosystems raises questions around their self-repair capacity under conditions of sea-level change, since the accumulation of sediments by these ecosystem being frequently regarded as an attribute that could potentially keep pace with sea-level rise (Morris et al., 2002). In this case, some marshes were simply overwhelmed by the magnitude of initial sea-level changes, and these far exceed the rates of changes likely to be experienced with incremental climate change. However, the widespread nature of the elevation loss in less extreme situations also highlights the potential for relatively small hydrological changes to trigger unexpected effects. In this case it is possible that the cycles of vegetation die-off and replacement inherent in zonation changes across the shore profile have been sufficiently frequent to exacerbate erosion effects in marshes that remain intact, although the breakdown of carbon-rich marsh platforms was also observed. Looking ahead, additional insights are likely to be gained by following the eventual stabilisation of these dynamics, or otherwise, while active management techniques such as sediment nourishment and replanting might also have a role to play.

These findings illustrate some of the complexities and also opportunities for managing risks to coastal vegetation types which are vulnerable to climate change. Conclusions from the study included four key principles for building the resilience of coastal ecosystems to sea-level rise (see Box 2).

Examples of king tide conditions in the lower Avon Otakaro catchment following the Canterbury earthquakes. The upper intertidal range has moved into adjacent urban areas including existing roads and large areas of the residential 'red zone' (Photos: S Orchard).

Box 1: Three resilience-building principles for low-lying coastal ecosystems under conditions of climate change

(1) Enable nature-based climate solutions by protecting and restoring coastal ecosystems and ecosystem services that directly contribute to climate change adaptation (e.g., carbon sequestration, wave attenuation, sediment capture), as well as others (e.g., wildlife habitat, water filtration) that are also essential to retain.

(2) Include both built and natural environments in the design of adaptation initiatives such as managed retreat.

(3) Avoid legacy effects of activities such as land-filling, which dramatically alter the 'rewildability'of low-lying landscapes as hydrological conditions change.

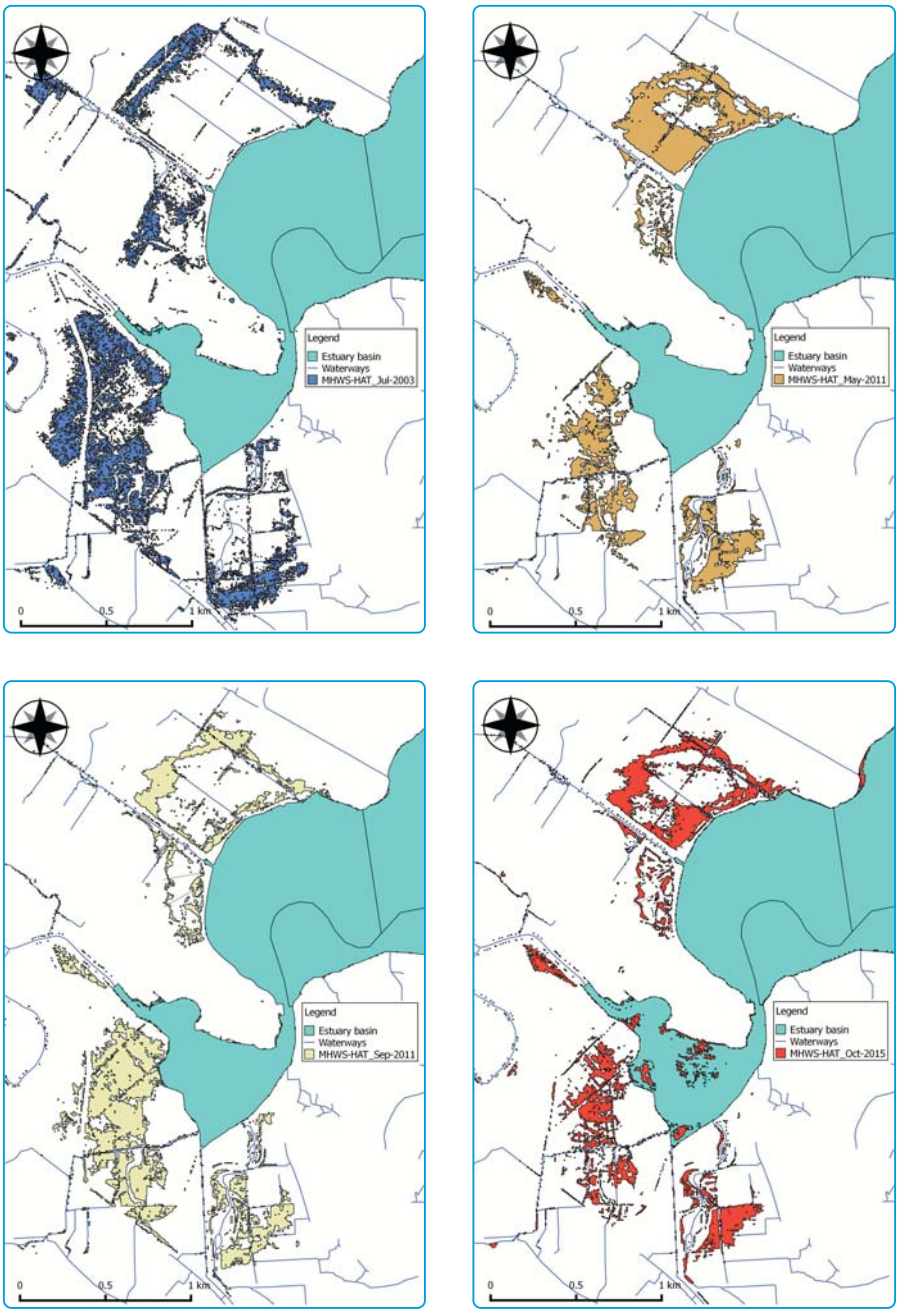
(1) School of Biological Sciences & (2) School of Earth and Environment, University of Canterbury, New Zealand

Addressing uncertain futures using a scenario-modelling approach

The above studies explored the impacts of hydrological changes in low-lying coastal environments that are vulnerable to sea-level rise. The principles identified through quantifying the actual impacts of the earthquake effects can provide useful insights for other situations such as eustatic sea-level rise, even though the specific trajectories of change and locations concerned will undoubtedly be different in each case. The methodological underpinnings of this approach are grounded in the theory of scenario-modelling, which provides a means of linking contemporary observations with future climate effects. This approach avoids making predictions of the future and instead relates a given observable or modelled scenario to a plausible future state (Bardsley & Sweeney, 2010). In many ways, this approach is designed to identify and illustrate what we may not want to occur, so that we may take steps to ensure that it does not actually occur under future climate change.

When used in the context of climate studies, scenario-modelling enables the de-coupling of spatial and temporal predictions. This results in a distinctly different approach to that of probabilistic assessments that typically incorporate both aspects in the estimation of predicted vulnerability or risk (Peterson et al., 2003). Scenario modelling provides an alternative view by first inviting consideration of the impacts that could occur in a given situation (e.g., 1 m sea-level rise) and addressing the timeline over which such effects could occur as a separate exercise in view of those results. In this way, scenario-models support a transparent approach to awareness-raising (e.g., construction of 'worst case' scenarios), which is an essential aspect of building momentum and buy-in for societal action on climate change. These societal aspects are crucial in the face of uncertainty and related inertia associated with the unknown timing of future events. Scenario-modelling can also be useful to test the public's appetite for risk by painting a picture of things that might be lost. For example, if you knew that a large proportion of New Zealand's blue carbon ecosystems comprised of mangroves, saltmarsh and sea grass could be eliminated under a 1 m sea-level scenario in the absence of nature-based adaptation measures, would you actually care?

Both of the above studies incorporate scenario-modelling aspects in drawing analogies between a contemporary extreme event and future climate change. The results highlight the need for an improved focus on nature-based solutions in the design of natural hazard responses in a peri-urban setting with strong similarities to many others



Example of complex changes in the Ferrymead area revealed by comparable LiDAR datasets showing the upper intertidal area between Mean High Water Springs (MHWS) and Highest Astronomical Tides (HAT). Initial uplift (May 2011 panel) resulted in contraction of this zone in the south, but gains in Charlesworth wetlands to the north.

Box 2: Four risk factors for the conservation of low-lying coastal ecosystems

(1) encroachment of anthropogenic land uses

(2) connectivity losses between areas of suitable elevation

(3) disproportionate effect of larger wetlands and their vulnerabilities

(4) need to establish new protected areas to address the future movement of ecosystems under sea-level rise.

nationwide. They also identify an important role for disaster recovery contexts (both large and small) as opportunities for achieving real progress on adaptation to climate change.

Acknowledgements

The Ngāi Tahu Research Centre, NIWA, Environment Canterbury, Coastal Restoration Trust, and Brian Mason Scientific & Technical Trust are acknowledged for supporting the above work. Thanks also to staff and students at the University of Canterbury, and to the co-authors on the papers mentioned.

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NZCS Webinar – Series 2.0

Since our first series was such a success, we are doing it again with a second series. So, if you have an interesting topic you would like to present to the wider NZ Coastal Society membership, please submit your topic proposal and a short abstract (around 200 words) to nzcoastalsociety@gmail.com.

Presentation details:

- The topic, abstract and a presenter bio will be pre-circulated
- Consists of a 15-20 minute live presentation, with an extra 5 to 10 minutes added for questions and discussion
- The presentation platform and any technical support will be provided by NZCS and Engineering New Zealand
- The abstract and presentations will be recorded and made available on the NZCS Media drive post presentation.

Previous webinars (available on the NZCS website at www.coastalsociety.org.nz/media/webinars) include:

- Human impact on shallow marine environments in Aotearoa (Marta Ribo)
- Measuring turbulent ocean mixing in the tidally driven energetic flows of Cook Strait (Arnaud Valcarcel)
- Satellite derived intertidal bathymetry, study case: Tauranga Harbour (Wagner Costa)
- Richard Levy, Karin Bryan, Giovanni Coco and Mark Dickson discuss their articles in the NZCS publication *Coastal Systems & Sea Level Rise* (presented as part of the virtual NZCS 2020 Annual Conference)
- Composite modelling: Experiments and CFD combined for better design insights on coastal structures (Pablo Higuera)
- Storm surge and wave climate projections (2020-2100) for Aotearoa New Zealand (Giovanni Coco, Joao Albuquerque, Laura Cagigal)
- Baseline investigation of microplastic pollution in sediment and bivalves in the Tauranga Harbour (Tauranga Moana) and eastern coastline in the Bay of Plenty (Anita Lewis)
- Evaluation of the implementation gap in coastal risk management (Laura Robichaux)
- Kaituna re-diversion project
- Analysis of extreme storm-tide and skew-surge events around the coastline of New Zealand (Scott Stephens)
- Aerial drones and their application within coastal zones for data collection (Ryan Abrey)
- Sea level rise planning (Bruce Glavovic).

Advertising in *Coastal News*

Coastal News is published three times a year (in both print and electronic formats) and is distributed to the Society's 300 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. If you are interested in placing an advertisement, download the *NZCS Advertiser's Guide* from www.coastalsociety.org.nz/view/publications or email the NZCS Administrator at nzcoastalsociety@gmail.com for further details (please note that advertising space may not always be available in any specific issue, and that advertisements should be in keeping with NZCS aims and values).

New NZCS Life Member Award recipient

Andrew Swales

It is our pleasure to announce that Dr Rob Bell was recently awarded NZ Coastal Society Life Membership. This award recognises the outstanding contribution Rob has made to the objectives of the NZCS and to the sustainable management of New Zealand's coastal environment over the last four decades. Rob's contribution spans engineering and science of climate change, coastal hazard/risk, and coastal oceanography. Over the last decade or so, he has played a pivotal role in informing policy development and planning at the national scale. Here we summarise Rob's career and contributions to coastal management in New Zealand.

Rob has 39 years' experience as a research engineer and consultant working in government research agencies including the Ministry of Works and Development, Department of Scientific and Industrial Research (DSIR), and NIWA since its inception in 1992. Rob has been an active member of NZCS since its formation in 1992. Presently, Rob is a Principal Scientist and NIWA Programme Leader (Climate Impacts and Adaptation), championing the area of hazard risks, sea-level rise, climate adaptation and adaptive planning and design. Rob is also a chartered engineer whose contributions to the profession include:

- Member of the University of Canterbury Advisory Board for the Department of Civil Engineering and Natural Resources Engineering (2006–2015);
- Developed/presented short-courses on coastal hazards and climate change for engineers and planners (for IPENZ/ Engineering NZ and NZ Planning Institute); and
- Land Information NZ Standards Committee – appraising and approval of NZ Vertical Datum (2016, 2009).

Rob's science and consulting has greatly contributed to coastal management in New Zealand across a broad range of subject areas, including wastewater outfall design, tides, sea-level rise and coastal hazards.

Rob has authored/co-authored 106 science publications, 140 consulting reports and more than 150 presentations at national and international conferences, public meetings, seminars and workshops. Science outputs related to coastal oceanography, hazards/risk and adaptation include papers published in the *Journal of Geophysical Research – Oceans*; *Environmental Research Letters*; *Pure and Applied Geophysics*; *Estuarine, Coastal and Shelf Science*; *Sustainability*; and the *NZ Journal of Marine & Freshwater Research*. Rob is presently a research leader in the MBIE Endeavour NZSeaRise Programme (2018-2022) looking at the impacts and risks of sea level rise; a leader of the 'Resilience to Nature's Challenges' National Science Challenge (Enabling Coastal Adaptation objective 2019-present); and a member of the National Science Challenge management group.

Over the last decade, Rob has significantly contributed to evidence-based coastal policy and planning. Highlights include the MfE Expert Panel for the National Climate Change Risk Assessment (2019); contributions to the NZCPS 2010 hazards policies; and lead author of the *MfE Guidance manual – climate change* (2017). MfE tasked Rob with the nationwide roll-out of the guidance manual in 2018, which included 21 one-day workshops and evening public presentations at 12 locations. This marathon effort was acknowledged last year by the Climate Minister, James Shaw. Also in the coastal hazards realm, other contributions include: Briefing to the New Zealand government select committee (2018 Economic Development, Science and Innovation) on drivers of rising economic impact of extreme

In February our new co-Chairs Amy Robinson and Mark Ivamy, along with members of the executive committee, had the honour of awarding Rob Bell Life Membership of the NZCS. Also at the ceremony were Ruth Bell, members of the NIWA Coastal Group, and some of Rob's colleagues. A formal presentation will be made at the 2021 Coasts and Ports conference in November in Christchurch.

weather events; New Zealand representative at the 2010 IPCC workshop on SLR and ice - sheet instabilities; National-scale assessment for the Parliamentary Commissioner for the Environment (2015) on the value of coastal assets expected to be exposed to SLR; and presentation of expert evidence for the Environment Court in relation to coastal hazards and climate change. Rob is a member of the New Zealand Tsunami Experts Panel, responding to Pacific tsunami alerts, and worked with the Ministry of Civil Defence in the aftermath of the 2004 Boxing Day tsunami to improve New Zealand's tsunami early warning system.

Rob's achievements have been recognised in recent years by significant awards including:

- Prime Minister's Science Prize (with NZ Sea Rise and Antarctic Ice Research team) – 2019
- NZ Science (CRIs): Lifetime Achievement Award – 2019
- NIWA Lifetime Achievement and Science Communication Excellence Awards – 2019
- Fellow of Engineering NZ – 2019
- Stuff Climate Change Power List – 2019
- NZCS Terry Healy Coastal Project of the Year (MfE Coastal Hazards & Climate Change Guidance) – 2018
- NZCS Terry Healy Coastal Project of the Year (Hawkes Bay Coastal Strategy) – 2017
- NIWA Excellence Awards – Applied Science – 2015.

Rob has generously given his time to support the activities of the NZCS. This has included assisting with the organisation of several conferences, including Australasian Coasts and Ports conferences, editing conference proceedings, and presentations at numerous regional events and NZCS conferences. Notable is the lead that Rob took in collating papers and editing the proceedings for the 10th Australasian Conference on Coastal & Ocean Engineering held in Auckland in 1991. Discussions at this conference led directly to the establishment of the NZCS in 1992. Rob is passionate about supporting the development of the 'next wave' of coastal professionals, which has involved interactive panel discussions and regular attendance at NZCS Young Professionals Breakfasts.

Rob departs NIWA in April after this productive and impactful career. It is no exaggeration to say that several generations of scientists have benefitted from his knowledge and generous and kind mentorship. I know that Rob will be sorely missed by his NIWA colleagues in the Coastal and Estuarine Physical Processes Group and beyond. Rob, your NZCS Lifetime Members award is well deserved – I'm sure NZCS members join with me in congratulating you – it is an honour to have you join the ranks of the NZCS Lifetime Members.

Postscript: Life Membership of the NZCS is reserved for a few individuals who have, through their work, made an outstanding contribution to the Society and the New Zealand coastal and marine area. Rob is the fifth member to receive Lifetime membership since the Society was formed in 1992. The previous recipients are: John Duder (2006), John Lumsden (2007), Terry Healy (2010), and Terry Hume (2012).

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Land-based aquaculture in southern New Zealand – the Ocean Beach vision

Bryony Miller, e3Scientific

While wild fisheries worldwide continue to strive for sustainability, aquaculture ventures are developing, evolving and adapting to the ongoing need for fresh, affordable and environmentally responsible produce. The southern waters of New Zealand, such as Foveaux Strait, are well known for their productivity based on temperate and dynamic conditions. Because of this, a regionally and nationally significant new aquaculture venture is now under development in Bluff, the southernmost point of mainland New Zealand.

The 56-hectare site was once home to New Zealand's largest freezing works. Ocean Beach, as the site is aptly named, is being regenerated from a series of abandoned industrial buildings, to an aquaculture centre of excellence. Their vision 'to be New Zealand's foremost land-based aquaculture centre of excellence' is no small concept. In this favourable location, however, it appears to be an achievable goal.

The site was purchased in 2018 and included a disestablished pāua farm operation which has since been reignited with significant investment in the facility and associated sea water infrastructure. A local team, including some of the former farm team members are focussed on breeding and growing New Zealand's finest farmed pāua, sustainably bred and nurtured within the cool clean waters of Foveaux Strait. The pāua are bred from adult stock taken from Stewart Island, included in the Total Allowable Commercial Catch (TACC).

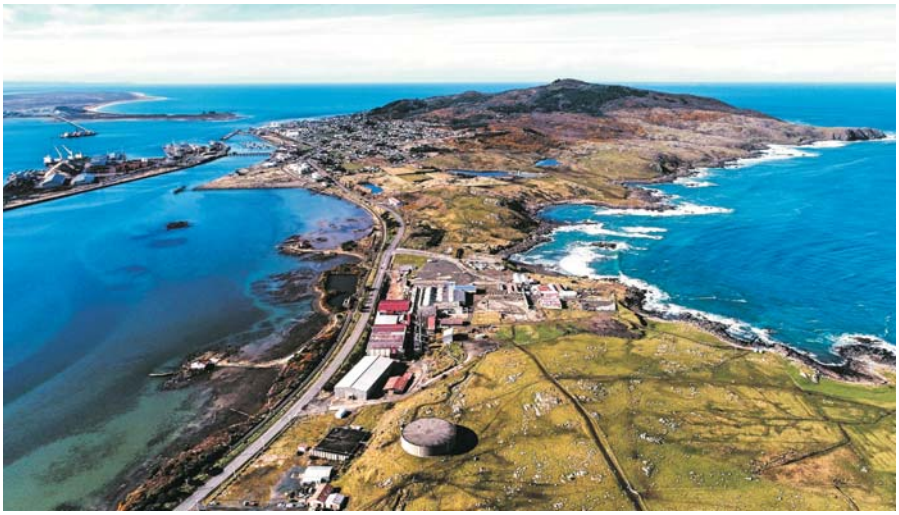
A five-year memorandum of understanding with Auckland University of Technology (AUT) covers education, research projects, staff and student exchange programmes, internships, post-doctoral research fellowships, and funding applications. It also includes development of other species, such as salmon, oysters, seaweed, and forms of macro and micro algae. AUT students have already added their expertise to the operation through pāua feed trials and have signalled their intent to establish satellite labs on the site to provide a place for PhD students to gain hands on experience in the field of aquaculture. The Ocean Beach and AUT teams have also started discussions with the Southern Institute of Technology (SIT) about including aquaculture in their provided courses to help provide local expertise to the site.

Current Coastal Permits allow 13,000 m^3 of seawater to be utilised daily, which is pumped from the shore of Foveaux Strait on the southern side of the plant and discharged to the same side approximately 100 metres south of the intake. There is also the infrastructure to pump and discharge into the Bluff Harbour. Sand and seaweed are filtered out of the discharge, which is cleaner than the intake and is monitored by Watercare and Environment Southland.

Ocean Beach are now working with local planners from Bonisch and marine ecologists from e3Scientific to achieve an overarching Coastal Permit that allows for tenants to 'clip' into the existing system and infrastructure and get started relatively quickly without needing to invest the significant sums normally required to establish an aquaculture operation. The proposed Coastal Permit would also allow for a much wider range of species to be farmed on site and would cover a significantly larger discharge volume, although the water quality would remain consistent. Potential aquaculture ventures include both marine and freshwater and the coastal permit aims to allow for a wide suite of species from seahorses to sponges, and galaxiids to groper.

Ocean Beach is still developing and currently seeking expressions of interest from businesses interested in leasing aquaculture space on the site. There are a handful of sophisticated aquaculture players such as Sanfords, who are in the early stages of establishing a purpose-built recirculating aquaculture system (RAS), potentially the largest in New Zealand, on site.

The aim is to provide a real catalyst for regional growth, creating significant employment opportunities and doing so in a manner that takes pressure off the local environment rather than adding to it. AUT marine biologist Professor Andrea Alfaro, who leads the science advice at Ocean Beach, states that "Virtually every wild fish species is under pressure or undergoing significant change from acidification of the oceans caused by global warming. However, Bluff provides cold and clean water – the temperature varies between 8 and 13 degrees Celsius – that is ideal to avoid the stresses of ocean warming". The research conducted at Ocean Beach will have the potential to help breed resilient shellfish, fish, algae and seaweed and optimise their growth to help ensure a sustainable future.



Ocean Beach (foreground), Bluff and Bluff Harbour (Photo: Ocean Beach).

Modelling tsunami generation by volcanic eruptions

Colin Whittaker, Emily Lane, Yaxiong Shen, Natalia Lipiejko, Lily Battershill, Matty Hayward, William Power and James White

A summary of recent progress on the Marsden Project 'Volcanoes can make waves too: A new understanding of tsunamis generated by volcanic eruptions'.

This project seeks to investigate how different volcanic eruptive processes generate tsunamis. A combination of laboratory experiments and numerical modelling was used to determine the wave-making potential of underwater eruptions (discrete and sustained) and pyroclastic density currents (extremely fast, often hot, flows made of a mixture of gas and volcanic ash and debris) entering the ocean (see Figure 1).

Laboratory experiments modelling discrete underwater eruptions have demonstrated that, for a given eruption strength, there is an optimal depth that will maximise the size of the waves generated. Figure 2(c) shows the dome, transition and finger regimes that are visible at the surface during an eruption. The maximum wave height occurs during the transition regime.

Moving from discrete to continuous eruptions, there is also an eruption length after which waves will no longer increase in size for a longer eruption. Recent experiments have started to illuminate the role of gas condensation in eruptions using steam rather than compressed air.

Numerical modelling of underwater eruptions has focussed on the best way of representing the eruption processes and their interactions with water. Following simulations of dam-break flows and underwater explosions, which tested the applicability of different modelling approximations, a multi-layer non-hydrostatic model was applied to undertake preliminary modelling of the waves that could be generated by a moderate eruption in Lake Taupō (see Figure 3).

Laboratory experiments have started to investigate tsunami generation by pyroclastic density currents (PDCs). One of the mechanisms that could be responsible for the high mobility of PDCs is gas-induced fluidisation. As such, the PDC is modelled as a fluidised flow of glass beads running down a porous plate into a small wave flume.

The measurements from these experiments enable characterisation of the PDC velocity profile before and following its impact into the water, and the spatial and temporal free surface evolution of the generated waves. Figures 2(a) and (b) show the leading wave generated by the PDC entering the water (which propagates ahead of the PDC itself) and the underwater flow of the PDC afterwards.

The numerical modelling of these PDCs has investigated the effect of the slope boundary condition on the PDC velocity profile, which in turn affects its impact into the water. This impact can be categorised depending on the collapse of the air cavity formed by the impact, and the steepness of the generated wave front (Figure 2(d)). Work is ongoing in both experimental and numerical modelling to characterise the far-field properties of the generated waves.

By using these parallel techniques to better understand these underlying processes, this project aims to improve our ability to model volcanic tsunamis and to quantify the hazard they pose to Aotearoa New Zealand.

For more information on this project, contact c.whittaker@auckland.ac.nz

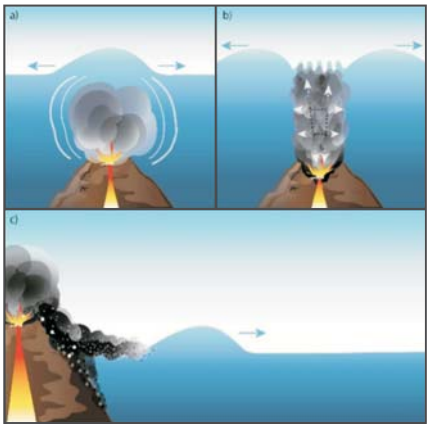


Figure: 1 Schematic diagram of volcanoes generating tsunamis (a) discrete explosions; (b) eruption columns; and (c) pyroclastic density currents.

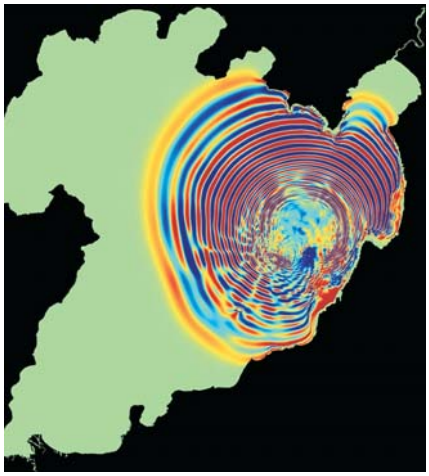


Figure 3: Snapshot of wave amplitudes from a simulation of waves generated by a possible volcanic eruption within Lake Taupō, where the maximum amplitudes were approximately 2 m.

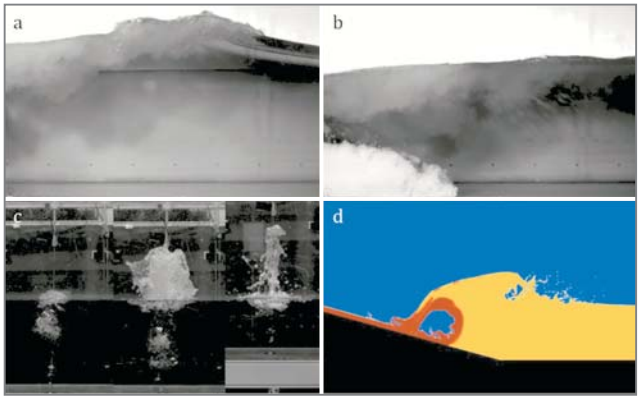


Figure 2: Results from laboratory experiments and numerical modelling: (a) Leading wave generated by PDC entry into water; (b) PDC propagating underwater following the wave; (c) Fountain regimes generated by an underwater eruption; (d) Numerical model of PDC entry into water.

NZCS conference review 2020

COVID-19 forced cancellation of the NZCS 2020 annual conference planned for Waiheke Island in November, but allowed us to try a new format to offset any risk of some or all regions going into lockdown. Our event also served to launch and showcase the NZCS Special Publication on the effects of sea level rise on coastal systems.

Conference format

The conference ran over one day and comprised networking events and a webinar:

- The Eric Verstappen Young Professionals Networking (EVYPN) event held in Auckland, Raglan, and Christchurch saw face-to-face gatherings over a lunch for students and young professionals. In Tauranga, this event was replaced by the Eric Verstappen Panel Discussion where panellists led a discussion on 'How to navigate a coastal career'.
- The webinar on the 'Effects of sea level rise on coastal systems' was viewed by gatherings at Auckland, Tauranga, Raglan, Wellington and Christchurch as well as a wider audience online. It provided the platform for four of the authors (Associate Professor Richard Levy, Professor Karin Bryan, Associate Professor Giovanni Coco and Associate Professor Mark Dickson) to speak to their papers in the Special Publication and answer questions. The talks were recorded and made available online via the NZCS website (see link at www.coastalsociety.org.nz/media/webinars). Physical copies of the Special Publication were distributed at the event (it is also available to download at www.coastalsociety.org.nz/media/view/publications).
- Regional networking gatherings (RNG) at Auckland, Tauranga, Raglan, Wellington, and Christchurch provided the opportunity to mix, mingle and connect with colleagues over post-webinar food and drinks.

Conference success

The event was a great success overall. The blend of online webinar and face-to-face gatherings in the regions worked really well. Organisers received a lot of positive feedback and attendees enjoyed the opportunity to connect again. A big success was the high number of registrants. The EVYPN and RNG networking events were attended by 74 and 182 participants respectively. The webinar connected with an audience of about 393 registrants, which is three times our normal conference attendance. This demonstrated how online streaming makes events accessible to a much wider community, and helps NZCS communication and outreach. It suggested that in future some parts of our conference (e.g., the keynotes) could be shared more widely by streaming.

Event organisation

This year we were able to make registration free to all attendees because of generous support and sponsorship.

Venues were provided for no charge by Beca (Auckland), Engineering New Zealand (Wellington) and WSP (Christchurch). Monetary sponsorship was provided by NIWA, GNS, e-Coast, DOC and Boffa Miskell. Engineering New Zealand provided excellent support by way of a conference website, handling registrations, running the Webinar via their Adobe Connect platform, and by running a SurveyMonkey online survey to seek registrant feedback. NZCS ran a parallel website with supporting information.

The event also owed its success to the 12 months of work put in behind the scenes by the organising committee who were well down the track with organising the conference at Waiheke before COVID-19 forced the need to devise a quite different event. Those who contributed include: Paul Klinac, Colin Whitaker, Connon Andrews, Lara Clarke, Ana Serrano, Tom Fitzgerald, Amy Robertson, Ryan Abrey, Eddie Beetham, Matt McNeil, and Craig Davis.

Looking forward to Waiheke 2022

We plan to revisit the Waiheke option for the NZCS conference in November 2022 following Coasts & Ports 2021 in Christchurch this year.

Dr Terry Hume
NZCS 2020 Conference Convenor

Above – Where we were supposed to be! However, while we didn't make it to Waiheke in 2020, we will be there in 2022. Below – photos taken from around the country of the replacement virtual event.

Meet your new Regional Representatives

Andrew Allison (Auckland)

Andrew Allison is joining Lara and Matthew as an NZCS Auckland regional representative for 2021. He is a coastal adaptation scientist and modeller at NIWA specialising in the interactions between natural and engineered systems. His research is focused on developing models and tools to improve decision making in coastal human-environment systems in response to sea level rise, climate change, and land use change. In 2020 he completed a PhD in Geography, during which he developed and implemented a new methodology for multidisciplinary complex systems modelling to investigate publically identified concerns about New Zealand's estuarine systems. Andrew is experienced in agent-based and system dynamics modelling, having developed ecological, economic, geomorphic, multi-hazard, social and political models, as well as whole-system models simulating the interactions between these systems.

Claire Murray (Manawatu-Wanganui)

Claire is taking on the previously vacant Manawatu-Wanganui representative's role. Her background is in civil engineering, but during her masters degree she had the opportunity to take on a thesis project in oceanography. Following her masters, she spent six years working in coastal engineering consulting in Canada. Claire has been involved with a range of coastal projects including coastal protection, marinas, impact assessment, flooding and erosion hazards, and climate change adaptation. She is now a Water Engineer at GHD in Palmerston North, but is still hoping to stay connected to the coastal community and hear about what's happening around New Zealand.

Ryan Morrison (Waikato)

Ryan is a Resource Officer in the Coasts and Inland Waters Team at Waikato Regional Council based in Hamilton. This role includes processing consents and undertaking consent compliance monitoring throughout the Waikato Region. Ryan has been working in this role for just over two years. He has been at Waikato Regional Council for just over eight years and previously worked in roles in infrastructure consenting and compliance, dairy farm compliance, and asset management. Ryan studied a Bachelor of Environmental Planning at the University of Waikato, graduating in 2012. Interests outside of work include fishing and diving, mostly on the Coromandel Peninsula.

Verity Taylor (Wellington)

Verity is a Civil Engineer at Tonkin and Taylor (T+T) based in Wellington. She joined T+T in January 2020 after completing her studies of Civil and Environmental Engineering at the University of Queensland. She has always been passionate about the ocean and the coastlines and during her final year of studies she completed a thesis based on coastal shoreline evolution. At T+T she has been able to continue to develop her interest and knowledge of the coastal environment and the surrounding processes, working primarily on coastal projects. Her engineering interests include coastal hazard risk assessments, coastal engineering design, shoreline and asset management, human impact to the coastal zone, and adaptation to climate change. Personally, she loves getting into the great outdoors, whether that is hiking in the mountains or going to the beach, and is a competitive rower.

Andrew Allison

Claire Murray

Ryan Morrison

Verity Taylor

For a complete list of regional represetatives and their contact details, see page 19.

News you might have missed...

With the world still anything but normal, you might not have caught up with some of the coastal related stories recently in the news.

Two local stories bring a positive spin – a recent dive on the *Rena* wreck site finds a thriving kelp forest (www.stuff.co.nz/environment/300184165/rena-shipwreck-divers-discover-reef-roiling-with-life-nine-years-after-sinking) and the Kaituna Cut is showing signs of life again (www.nzherald.co.nz/video/local-focus-kaituna-cut-on-the-mend/34IRSLLD4NT2TDPRMAHF4I3QPU/). Turning to rivers, a RNZ article and video looks at recent NSC (Sustainable Seas) research results into just how far river waters reach into the sea, and it can be a surprisingly long way (www.rnz.co.nz/national/programmes/ourchangingworld/audio/2018775191/all-at-sea-the-surprising-reach-of-river-waters).

Elsewhere, but still with a New Zealand connection, a recent study has shown that some Pacific islands are beating sea level rise by growing, thanks to sediment produced by the surrounding coral reefs (www.stuff.co.nz/science/123559259/the-pacific-islands-which-are-growing-despite-sea-level-rise). Staying with islands, the BBC recently featured an article on Germany's Halligen islands – how will these inhabited islands, flooded by the North Sea up to 50 times a year, cope with rising sea levels? (www.bbc.com/future/article/20210216-the-islands-that-protect-germany-from-the-north-sea). Plus, a recent study has reached a surprising conclusion – it would seem that icebergs don't melt in the way we always thought they did. Find out why at www.sciencedaily.com/releases/2021/02/210216133415.htm.

And finally, for light relief, how about some genuine New Zealand glow-in-the-dark sharks? (www.bbc.com/news/world-asia-56256808).

News from the regions

Northland

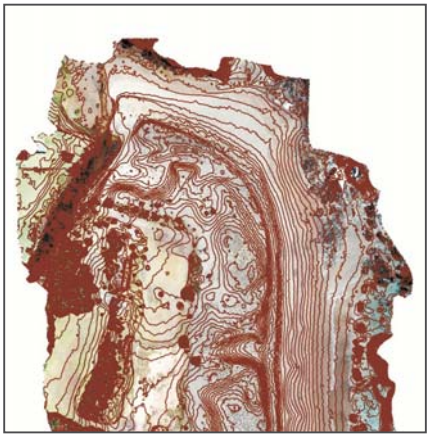
Laura Shaft, Regional Representative

The Coastal Restoration Trust of New Zealand has developed community-based guidelines for assessing the state of coastal dune systems, including surveying the status of vegetation cover and dune morphology, and monitoring of the performance of restoration programmes, which are available online at: https://monitoring.coastalrestorationtrust.org.nz

A number of transects were set up in Northland during the development of this project and over the summer Northland Regional Council (NRC) staff re-measured these to identify changes in the vegetation cover over time, the proportion of native vegetation cover, and the presence of pest plants. The transect data can be viewed and compared to the previous survey results at: https://monitoring.coastalrestorationtrust.org.nz/survey-data/northland

CoastCare groups, iwi, schools and land-owners have been involved with this work to increase understanding of zonation and the effects of dune restoration work such as fencing, weed control and planting.

In addition, a drone was flown (where weather conditions permitted) to obtain high resolution contemporary images. These can be used to assess changes in vegetation cover and dune health over time. The drone images can also be processed to create a digital elevation model, that gives us information about the dune shape and can be used to track erosion and accretion over time.



Drone image, showing 0.25m contours, derived from the elevation values (NRC).

Dune transect monitoring with year 13 science students (Photo: NRC).

Auckland

Lara Clarke, Matthew McNeil and Andrew Allison, Regional Representatives

Sediment transport processes in the southern Firth of Thames

Jordi Tablada's MSc thesis, *Suspended sediment transport processes on a wave-exposed tidal flat in the southern Firth of Thames,* was recently published under an open-access license and is available at: http://hdl.handle.net/2292/53470

The study showcases an analysis of field data collected by NIWA scientists from an instrumented transect in the southern Firth of Thames spanning from the fringe of the mangrove forest, across the intertidal mudflats into the shallow subtidal waters of the Firth. Suspended sediment concentration and hydrodynamic measurements are used to infer sediment fluxes across the transect. The obtained fluxes near the mangroves are directed seawards, while for the rest of the transect the fluxes move coastwards. Results provide a basis for the hypothesis of how the mudflats might be accreting with a prograding bar near the fringe of the forest that progressively moves forward towards the sea.

Jordi's work was supervised by Giovanni Coco (UoA), Andrew Swales (NIWA) and Iain MacDonald (NIWA) and funded by NIWA's Managing Mud Programme (FWCE2011).

Auckland Region Coastal Management Plans

The Auckland Council is to develop Coastal Management Plans (CMPs) to apply a long-term sustainable approach to the management of the Auckland Region's coast over the next 100 years. The CMPs will take a systems-based approach to co-develop adaptive management plans with mana whenua and communities, considering both the experiences and values we place on the coast, and how these may change due to the impacts of coastal hazards and climate change.

The Whangaparāoa Peninsula has been chosen for the pilot CMP. This is because it includes several coastal 'hotspots', areas of high concern identified as part of the Auckland Council Coastal Management Framework (2017), is a smaller-scale site where established datasets are available, and Council staff have a comprehensive working knowledge of the coastline in that area.

The CMP pilot process includes widespread community engagement with three public presentations, two workshops with a community reference group, two public open days, and a four month digital engagement via the Social Pinpoint platform. The consultation period runs from 18 February to 30 May 2021.

Completion of the pilot will enable the engagement process to be trialled, and lessons learnt applied to the roll out of the remaining Coastal Management Plans for the Auckland Region.

Shallow marine research – Project EAST

Marta Ribó, Lorna J Strachan, Sally J Watson

The health of the coastal and shallow marine zone has been identified as a key research priority in New Zealand, due to its cultural, social, ecological, and economic importance. Project EAST (**E**cosystems, **A**nthropogenic impact, **S**ediment dynamics, **T**aiao), led by scientists from University of Auckland (Drs Strachan and Ribó) and from the National Institute of Water and Atmosphere (Dr Watson), is a multidisciplinary project with a holistic approach that aims to integrate the understanding of ecosystems, human impact, sedimentary processes, and Taiao.

The research is based on high-quality bathymetry data that is used to evaluate the impact of human activities on seafloor morphology (i.e. dredging, mooring blocks, anchor marks) and benthic habitats distribution. Moreover, sediment samples are used together with water column data to evaluate the hydrographic structure and distribution of suspended sediment. The first case study is in Queen Charlotte Sound-Tōtaranui, Marlborough Sounds, and targets areas that are potentially at risk due to human activities.

Research results aim to improve marine management measures that will be essential to respond to growing pressures on coastal and marine environments in New Zealand.

A novel approach to cliff erosion monitoring at Rothesay Bay

Lovleen Chowdhury

Rapid population growth in Auckland has led to increasing dwelling densities on eroding coastal cliffs. To appropriately plan for the future, it is necessary to understand the rate, pattern and processes responsible for observed cliff retreat. Cliff erosion at Rothesay Bay, Auckland, is being monitored as a part of a broader PhD project.

These cliffs are a part of the Waitemata group of rocks, composed of alternating sandstone and siltstone. The comparatively weaker siltstone with its high clay content makes the cliffs susceptible to erosion. Various methodologies have been used to quantify recession rates, including a proxy method based on shore platform width and rock mass properties, use of aerial photographs, and total station surveys. Terrestrial Laser Scanning (TLS) has been shown to provide high resolution data with minimal error, which makes it possible to detect small changes (unlike historical aerial photographs) that can be used to estimate longer term recession rates with data collected over relatively short monitoring intervals.

The University of Auckland has collected TLS surveys of the cliffs at Rothesay Bay for several years. This dataset is being added in to the current PhD project with an aim of calculating volumetric changes along the cliff face to quantify annual erosion and deposition rates. An additional technique currently being trialled in conjunction with TLS scanning are InfraRed Thermographic surveys of the exposed cliff face to quantify daily and seasonal thermal cyclical behaviour associated with heating and cooling. The research literature suggests that uninterrupted cyclic exposure to solar radiation can act as a preparatory cause for block failure: thermal heating and cooling promotes expansion and contraction within the cliff rock matrix, potentially leading to irreversible accumulative strain and microstructural stress. The research aims to quantify cliff erosion rates at Rothesay Bay and identify the mechanisms responsible for the observed erosion.

Bay of Plenty

Jonathan Clarke, Kieran Miller and Josie Crawshaw, Regional Representatives

‘Ten cars dropped from a ten storey building’ for harbour entrance

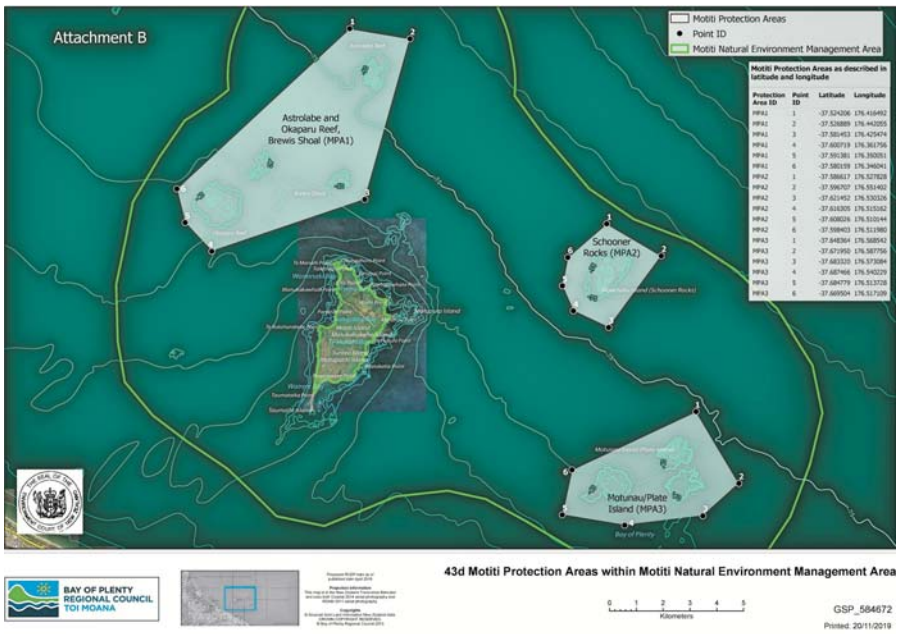
If you have seen a very large crane operating out at the Opotiki Harbour project site, you may have wondered about the activity and what is involved. The work is a vital piece of the build process called ‘dynamic compaction’. David Wyeth, HEB Construction’s Project Manager on the site, explained the process. “An essential part of construction of the Opotiki Harbour breakwaters is the foundation they will sit on. Investigations of the seabed foundation have demonstrated that the breakwater foundation is loosely compacted sands that may be susceptible to liquefaction in the event of a significant earthquake. This means any loads on the top of the sand (buildings or, in this case, seawalls) can sink.”

“To combat this, we can improve the sand foundation using dynamic compaction. In very simple terms, this means hammering the top surface, compressing the underlying sand layers making the ground less prone to liquefaction and the seawalls will be more stable during an earthquake in the future,” Mr Wyeth said. To evaluate the impact of dynamic compaction on the specific ground conditions out at the harbour entrance, HEB Construction, the head contractors on site, are carrying out dynamic compaction trials. “We are trialling various patterns of drops, drop heights and weights on a constructed section of proposed breakwater to determine the best foundation improvement.” Drop heights from the crane range from 20 m to 30 m and the drop weights range from 20 tonnes to 30 tonnes. At its maximum, this is the equivalent to 10 family cars being dropped from a 10 storey building.

Motiti Protection Area

The Motiti Protection Area rules were signed off by the Minister of Conservation on 1 March 2021, following the resolution of two outstanding appeals relating to the Motiti Protection Area and to Matakana Island. The Motiti Protection Area, of particular interest to local fishing communities, was signed off after a six year, multi-court legal process.

In April 2020, the Environment Court directed the Bay of Plenty Regional Council to implement new rules to protect three reef systems around Motiti Island, where the taking of all plants and animals (including



Map showing the Motiti Protection Area (Bay of Plenty Regional Council).

fish and shellfish) will be prohibited for everyone. These rules will come into effect later this year.

The three areas affected are Ōtaiti (Astrolabe Reef), including Te Papa (Brewis Shoal), Te Porotiti, and O Karapu Reef; Motuhaku Island (Schooner Rocks); and Motunau Island (Plate Island). These protection areas have all been identified for their significant marine biodiversity, landscape and cultural values.

The regional council has started environmental monitoring within the Motiti Protection Areas to establish a baseline for how the reef ecology looks today, before the reefs are protected. This data will then be used for years to come as a reference point to determine if the protections put in place by the court are achieving the desired biodiversity outcomes.

For more information see: www.boprc.govt.nz/motitipa

Hawke's Bay

José Beyá, Regional Representative

Awatoto wastewater outfall repairs complete

Repairs to the leaking Awatoto wastewater outfall pipe are now complete (as of 5 February, 2021). The outfall project, which was weather dependent, began in September and was originally expected to take a month.

However, when the New Zealand Diving and Salvage Ltd crew got on site, it was clear the design solutions would need to be modified. Further time was needed for the bespoke parts to be manufactured by Warner Engineering in Whakatu. The original deadline for repairs was 30 October, but the Hawke's Bay Regional Council extended this to accommodate the evolving plan.

"It is wonderful to see this project completed. There is still plenty of work to be done, with our next major wastewater project being the construction of ponds next to the treatment plant. We may need to use these during future shutdowns for maintenance, if repairs are needing to be carried out, and to take any overflow on standby for stormwater events. We will also continue to develop our plan to replace the outfall," says Councillor Keith Price, Sustainable Napier committee chair.

Napier City Council will continue to monitor the pipe's performance with drone and dive inspections.

Not including the repair project, Council has spent close to a million dollars on proactive maintenance of the outfall in the past two financial years. The repaired leaks were both discovered during routine inspections. A leak in the outfall, which was constructed in 1972, was first discovered in 2018, 700 m offshore at a point where the pipe was joined, followed by the discovery of another closer to shore in April last year. The first leak to be found occurred at the point where the two sections of pipe were joined. A fibreglass joint was installed at this point in 1984.

In June 2020 NCC adopted a series of wastewater related resolutions. This included bringing forward the replacement of the outfall, and increasing levels of service and linking this to improvements to the wastewater treatment plant. The Wastewater Treatment and Outfall Masterplan has been developed and will help to determine future requirements for the full replacement of the outfall. This replacement could cost between $20 to $40 million, and a detailed investigation needs to be carried out to both make sure the preferred option is the right one, and Council has a more accurate cost estimate.

Further information about this project, including estimated costs, is expected to be included in the next Long Term Plan, later this year. The repair and wastewater storage projects have been funded from reserves so there is no effect on rates.

The NZ Diving & Salvage Ltd crew in the process of lowering the metal box, part of the manufactured repair solution, to the outfall pipe. The box weighs over a tonne.

East Rd corner revetment proposal (update from issue 72)

Hastings District Council (HDC) has submitted a resource consent application for a 100 m long rock revetment wall in Haumoana with the objective of preventing the erosion of Clifton Rd and the adjacent lifelines infrastructure at East Rd corner. The consent is being processed by the regional council's consent department.

Rock sill at Clifton

Temporary coastal erosion protection works were carried out at Clifton in August 2020. The works comprised the placement of a line of limestone rocks (ranging in diameter from 1.2-1.5 m) in an arc along the beach surface, following the contour of the beach for approximately 180 metres south of the existing rock revetment. A rock sill was proposed later to enhance the temporary works. The rock sill was consented in January 2021.

Cape Kidnappers landslide (update from issue 72)

Cape Kidnapers walk is now open to public after a Quantitative Risk Assessment report was finalised. A high level of risk was identified in the report, and soon after HDC and DOC carried out key risk management work before opening the track. Signs were installed to let visitors know about the risk, and the tractor tour operator 'Gannet adventures' resumed activities after nearly two years in suspension. DOC and HDC will not actively promote the walk along the beach.

Clifton to Tangoio 2120 Coastal Hazards Strategy (update from issue 72)

The main concept design report for the short-term pathways has been peer reviewed and finalised. Workshops with community panels have being carried out from November 2020 until March 2021 to socialise details of the design and get feedback from the community. The managed retreat assessment carried out by Tonkin and Taylor is still work-in-progress.

Mr Raynor Asher QC, a retired high court judge, has been engaged to define a longstanding stalemate issue, which has prevented the progress of the funding workstream of the strategy. The issue is to resolve which council should be in charge of leading and collecting the funding for the strategy, where an agreement between the different councils has not been possible in over two years.

Community workshops on triggers and signals are planned for May and June 2021.

Subtidal habitat surveys

A joint project between Hawke's Bay Regional Council and NIWA surveyed the subtidal habitats of the eastern coast of the Mahia Peninsula between January and February 2021. This complemented past multibeam surveys of the Wairoa Hard and Clive Hard/Cape Kidnappers areas.

The Hawke's Bay Regional Coastal Bird Survey (undertaken by Nikki McArthur) has completed the 365 km of the Hawke's Bay coastline. Highlights of the survey include Asiatic whimbrels on Mangawhio Lagoon, with Hawke's Bay hosting approximately 8% of the national population of this Arctic-breeding migrant, and confirming the presence of sooty shearwaters breeding on Motu-o-kura Island. This is the only known breeding site for this species in Hawke's Bay. HBRC have received a completed report on Key Ecological Areas in Hawke's Bay that uses national and regional datasets to identify areas of high habitat value. These are also compared to current areas identified in the Regional Coastal Environment Plan as Significant Conservation Areas to identify how representative our current protection is of key habitats.

Marine customary titles and rights

The High Court hearing regarding Ngāti Pāhauwera's application for both Customary Marine Title and Protected Customary Rights under the Marine and Coastal Area (Takutai Moana) Act 2001 began in February in Napier and is being heard alongside the applications from Maungaharuru-Tangitū Trust, Ngai Tāhū O Mohaka-Waikare and Ngāti Pārau due to overlapping areas in the applications.

The area covered by the applications stretches from Poututu Stream in the north to just south of Napier City. If granted, customary marine title enables the holders to exercise certain rights through involvement in resource consent and Conservation Act processes, customary fisheries management, the ownership of non-Crown minerals and taonga tūturu in the title area, and protection of wahi tapu, such as urupa (grave sites). However, customary marine title does not affect general public access, fishing (subject to bylaws being made to protect customary fishing areas), or navigation rights.

Pollution responses

Wastewater spills from a seafood processing factory, the Napier City Council's wastewater system, and 1000 l of hydrochloric acid from Galvanising Hawke's Bay have occurred in November 2020 and February 2021 in Pandora. The discharges entered the stormwater system reaching the open drains that discharge into the Ahuriri Estuary. The incidents have resulted in clean-up operations and warnings to prevent contact with Ahuriri estuary's waters. An additional intentional wastewater overflow spill occurred during the heavy rainfall event experienced in November 2020 in Napier and a fire incident on a ship docked in Napier Port in December 2020 produced significant atmospheric pollution.

6 Wharf project update

Napier port has installed approximately 70% of the 400 piles and has now completed three of 36 deck pours. 483,000 m^3 of a total of 1,156,000 m^3 has been dredged, with 440,000 m^3 transported to the offshore disposal area 5 km east of the breakwater, and 43,000 m^3 of fine sand taken to Westshore in agreement with the Westshore Dredge Disposal Working Group. The concrete cubes revetment is on track with 15% progress on the placement.

Napier Port has constructed the first reef 1.4 kilometres north-east of Pania Reef with 11 barge loads, or approximately 15,000 tonnes (over 8000 m^3), of limestone boulders to date. The naturally occurring limestone was taken from a revetment wall at Napier Port, which has been dismantled as the Port builds its new 6 Wharf to support regional growth. A second reef was created in a single day last Friday 29 January with a barge depositing approximately 1400 tonnes (750 m^3) of limestone rock at the location of the *Gwen B* shipwreck site.

Canterbury

Justin Cope and Deepani Seneviratna, Regional Representatives

Dynamic Adaptive Pathways planning for Christchurch

In late 2020 the Christchurch City Council endorsed the establishment of a Coastal Hazards Adaptation Planning programme. The programme will undertake collaborative adaptation planning with Christchurch District's coastal communities that will be impacted in the future by sea level rise through coastal erosion, coastal inundation, and rising groundwater. It will roll out in three phases.

Phase One, or the 'setting up' phase of the programme, is nearing completion and has involved the establishment of a Coastal Hazards (Governance and Ngāi Tahu) Working Group, the commissioning of an updated coastal hazard assessment, and the development of other baseline information and adaptation option assessments that will be important for starting the city-wide community conversations.

Phase Two, to start around mid-2021, is the start of a city-wide awareness and education campaign using the information gathered in Phase One. This Phase recognises that while coastal communities will lead their own adaption plans, the impacts of sea level will be shared across the district.

Phase Three is when the work with specific communities begins. Because the timing and severity of sea-level rise impacts will vary across the district there is time for adaptation planning to occur in tranches. This also better recognises the diversity of communities and the different approaches that may best suit each community. Adaptation planning will begin with some of the communities in the Whakaraupō/Lyttelton Mt Herbert area towards the end of 2021.

Otago

Tom Simons-Smith, Regional Representative

News in brief

A district-wide coastal hazard screening process is to begin in March to assess the coastal hazard risk across the district, to inform on monitoring requirements, and to provide more detailed assessments and management planning.

The St Clair-St Kilda Coastal Plan process is now entering into the final round of community engagement. This process is part of the Dunedin City Council's broader efforts to build resilience and plan for climate adaptation in the South Dunedin area (for more, see: www.dunedin.govt.nz/council/council-projects/south-dunedin-future/st-clair-to-st-kilda-coastal-plan).

A recent partnership between the Otago Corrections Facility in Milton, the Dunedin City Council and others has led to the raising of stocks of pikao for planting by community groups, council and Iwi for the purposes of hazard management and restoration (for more see: www.odt.co.nz/lifestyle/resilient/piling-behind-nature).

West Coast

Don Neale, Regional Representative

Te Tai o Poutini Plan

Te Tai o Poutini Plan is being developed as a combined district plan covering the whole of the South Island's West Coast Region, to help streamline the local councils. Overseeing the process is a joint committee from the four West Coast Councils (Buller, Grey and Westland Districts and the West Coast Regional Council) and local Ngāi Tahu iwi (Te Rūnanga o Ngāti Waewae and Te Rūnanga o Makaawhio). The planning process is underway to gather community input on topics that include settlement patterns, natural hazards and biodiversity. With numerous coastal settlements on a high energy coastline, coastal hazards will be an important part of the plan, in order to protect people, property and infrastructure, and to build stronger and more resilient communities. The plan process is seeking feedback on ideas such as hazard lines, managed retreat, building controls and rock protection works. The plan is further explained at www.ttpp.nz

Fox River landfill rubbish

The remaining rubbish at the Fox River landfill will be removed with the help of $3.3 million of government 'Covid-19' funding. The landfill washed out in a March 2019 storm, causing 64 kilometres of coastline and riverbed to be strewn with rubbish (see *Coastal News* #69). Soon after the storm, the remaining landfill was armoured with rock as a temporary fix to reduce the chance of further washout. Westland District Council contractors are now excavating the remaining rubbish and removing it to a safer location at the district landfill near Hokitika.

Transect surveys

Intertidal drone and shore transect surveys were completed in December 2020 at the Punakaiki Marine Reserve and Ōkārito Mātaitai Reserve, in a collaboration between NIWA, the University of Canterbury, and the Department of Conservation. These surveys are helping to map intertidal rocky shore and estuarine habitats at these significant sites, using multispectral analysis and the latest mapping technology. The surveys have shown that drones can be an effective tool to monitor these high energy and hard-to-access shores.

The work is highlighted in a NIWA media release and short video at: www.scoop.co.nz/stories/SC2101/S00008/niwa-drones-going-where-people-cant-on-the-west-coast.htm

Invasive coastal weed

The invasive coastal weed, sea spurge (*Euphorbia paralias*) has recently been found on a Heaphy Track beach, the southernmost record of this weed in New Zealand. It is likely to have arrived on ocean currents from Australia and would seriously impact our coastal environments if it became established.

Sea spurge infestations have caused major environmental problems at many Australian beaches by displacing native plants and changing natural patterns of sand movement. The Heaphy beach infestation is being carefully removed and a Biosecurity NZ factsheet explains how to keep a lookout for this weed (see: www.mpi.govt.nz/dmsdocument/3554/direct).

NZCS Regional Representatives

Every region has a NZCS Regional Representative who is available to help you with any queries about NZCS activities or coastal issues in your local area. If you are interested in becoming involved as a regional representative, please get in touch with Ana Serrano (ana.serrano@wsp.com) or Rebekah Haughey (rhaughey@tonkintaylor.co.nz).

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About the authors

Jose Borrero is a coastal scientist and engineer specialising in tsunami hazards and coastal adaptation to climate change. He is a Director of eCoast Marine Consulting and Research based in Whaingaroa (Raglan) Aotearoa, and has been working in tsunami research and consulting since the mid-1990s.

Murry Cave is the principal scientist for Gisborne District Council, and despite moving to Gisborne four and a half years ago for a quieter life has found himself being kept busy dealing with natural hazards and environmental risk issues, including co-ordinating the new tsunami modelling, coastal erosion issues, mud volcanoes, new landslide dammed lakes, flood hazard mapping and landslide risk.

Shane Orchard is an environmental scientist and policy analyst specialising in the conservation of aquatic landscapes and their resources. He is currently an independent consultant and part-time Research Associate at the University of Canterbury working on natural disasters, protected area management, large-scale restoration strategies and climate change.

Newsletter archive & downloads

Back issues of *Coastal News* are available to download from the Society's website at www.coastalsociety.org.nz (under the 'Media' tab). Also available are author and article indexes for issues 1 to 71 (these will be updated each year), a guide to writing articles for *Coastal News*, and copies of the four Special publications – *Rena: Lessons learnt* (2014); *Adapting to the consequences of climate change* (2016); *Shaky shores: Coastal impacts & responses to the 2016 Kaikōura earthquakes* (2018); and *Coastal systems & sea level rise: What to look for in the future* (2020).

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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 2021.

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