EMILY TIDEY AND BECKY CAMERON

How Can I See What I Can't See?

The Art + Oceans project has given us the opportunity to consider our usual artistic and scientific endeavours from new angles. Here we present a dialogue of thoughts from our interactions throughout the collaborative process.

Emily – I came into this Art and Oceans collaboration with two thoughts. The first was that engaging with those outside my usual sphere would encourage me to work on clearly communicating my research. And secondly, I love learning about the hidden world below the sea, sharing how we can measure it and learning from what we measure. I presented artists with examples of seabed bathymetric maps showing depths and seabed images showing intensity – from which we infer substrate type or habitat changes. I also pointed those interested to a website called *Visual Soundings* (http://visualsoundings.org) which demonstrates some of the fascinating patterns and shapes that have been observed while mapping the seafloor.

Becky – The Art and Science collaborations have provided me with a way to expand my knowledge and subject matter for my art practice. Much of my art deals with ideas around how we relate to our environment, and how that is influenced by our knowledge, belief and memories. This has resulted in works based on the New Zealand landscape; not just as a scenic view, but rather landscape as something built up from layers of geography, history, memory and ideas; as being contested and in flux. But up till now, very much based on the land, rather than the sea, despite its huge importance. Art + Oceans suggested an expansion of my area of investigation; a way to see beyond the land.

Emily – Mapping underwater is difficult: optical methods only work in shallow, clear water. Hydrographers require the use of echo sounders to make remote measurements of things we cannot 'see.' Water is an ideal medium for acoustic propagation. Modern multibeam echo sounders transmit an acoustic pulse and time how long it takes to return from hundreds of points across the seabed. This is translated into a distance and intensity, and a swath of data is collected across the seafloor. In reality, underwater acoustic measurement must take many complex factors into account. These include: the strength, frequency and duration of the sound source; the ever-changing speed of sound in the water column, which in turn is influenced by temperature, salinity and pressure (depth); refraction due to changes in the speed of sound; absorption and scattering; and the variable geology of the seabed which the sound is reflecting back from. Finally, the sound that is used for the final depth measurement must be louder than all the other underwater acoustic noise such as vessel engines, waves, rain or underwater species.

Traditionally, hydrographers have used their knowledge to set sonar parameters to measure the shallowest depth to create charts enabling safe navigation. I am interested in connecting this knowledge with other marine science applications to ensure measurement uncertainties are considered by those who use depth data in their research. From this, I aim to develop measurement protocols for coastal habitat mapping and coastal monitoring that will result in high-quality, repeatable scientific outcomes.

Becky was interested in my presentation of seabed data around Quarantine Island / Kamau Taurua that I had collected with undergraduate students who are studying hydrographic surveying and oceanography at Otago University. It is presented in Figure 1 in its raw state for demonstration only – no noise has been removed and the depths have not yet been reduced to allow for the effect of tide. The rainbow colour palette used has deep water at the purple/blue end of the spectrum, and shallow when orange/red show. In it you can clearly 'see' the main channel in Dunedin Harbour which gets very deep at the Dunedin Volcano centre just southwest of Quarantine Island / Kamau Taurua. There is a shallower channel north of the Island that leads east to the Portobello Marine Lab. In both channels, the edges of sandbanks and sandwaves are visible – evidence of a dynamic environment likely influenced by the tides and currents in the area.

Becky – Quarantine Island / Kamau Taurua is an area I've been interested in for a while and have made frequent visits to.

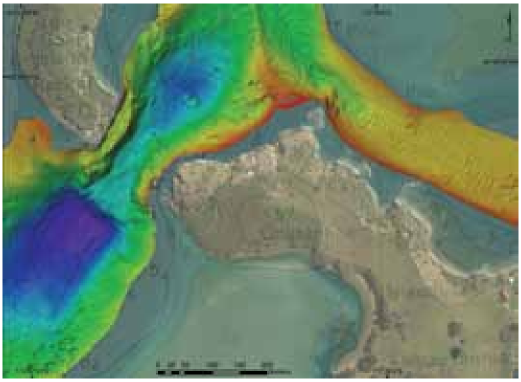

Figure 1. Raw seabed data collected around Quarantine Island / Kamau Taurua using the University of Otago's R2 Sonic 2026 multibeam echo sounder – noise and tide artefacts remain. (Data: E Tidey. Aerial photo: From LINZ Data Service (data.linz.govt.nz), CC By 3.0 NZ: Imagery was captured for the Dunedin City Council by Aerial Surveys Ltd. Chart: NZ6612 © LINZ.) Not to be used for navigation.

Figure 2. Becky Cameron, *Dunedin Roadmap*, gouache and coloured pencil on topographic map, 850 x 600 mm.

It has been significant historically, as a food-gathering site (its Māori name refers to the setting of nets) and then as a part of the colonisation of Otago. Today it is a place where ideas of community and habitat restoration are being explored. It features at the centre of one of the images I'd sent to Emily to give her an idea of my work (Figure 2).

I'd been working with maps in my art, but in ways that tried to resist their flatness and their abstract, impersonal nature. In works such as this one I drew over the top of a topographic map, incorporating multiple viewpoints as I moved through the landscape that it represented. I sought to explore the difference between the abstract and the on-the-ground reading of a place. However, as Emily pointed out, as in the topographic map it is drawn on, the sea is only really present as a few ripples, a gap between the parts of the land.

Emily – When we first met, we had a really in-depth discussion on acoustics. What fascinated both of us, I think, was realising the emphasis we place on vision in our day-to-day lives, as well as when we are undertaking art and science. I discussed other data that is often used in seabed mapping including depth from multibeam and singlebeam echo sounders; intensity returns from sidescan sonars or multibeams which show us where sediments are different; motion sensors to correct measurements for vessel movement; tide gauges to correct for vertical changes while taking observations; and profiles through the water column to correct for sound refraction.

Becky decided she would probably focus around the Quarantine Island / Kamo Taurua area as she has spent some time on the island, and was planning to again. We hypothesised how she might be able to map sounds she heard while blindfolded, or possibly record them. We also briefly wondered about incorporating music as a representation of the various components and measurements I had been describing (drums for a low-frequency acoustic pulse, light piano for interference from a school fish, violins as background reverberations from a passing ship?). I liked the idea of losing our visual sense and trying to work with (or even enhance) others, particularly hearing. I wondered if touch or smell would also come into this, as their faculty may appear to increase on loss of sight. Probably unsurprisingly, as a surveyor, I could see results being plotted on a map of the island, displaying what is heard in each location. I thought Becky would do something quite different to this very literal interpretation of drawing sound, and was looking forward to it.

After Becky visited Quarantine Island / Kamo Taurua, she showed me some drawings of sound that she had made (Figure 3). It was fascinating that at times I was clearly able to distinguish the loud or hard anthropogenic sounds – such as vessels or talking – from softer, more rounder, natural ones. One piece showed the wind and had grass poking through it. This made me think of interference patterns we see in our data, or the way strands of kelp extend from the sea floor and often block our acoustic sensor. I really like the idea of

Figure 3. Becky Cameron, *Mapping Sounds*, graphite on paper, 297 x 210 mm.

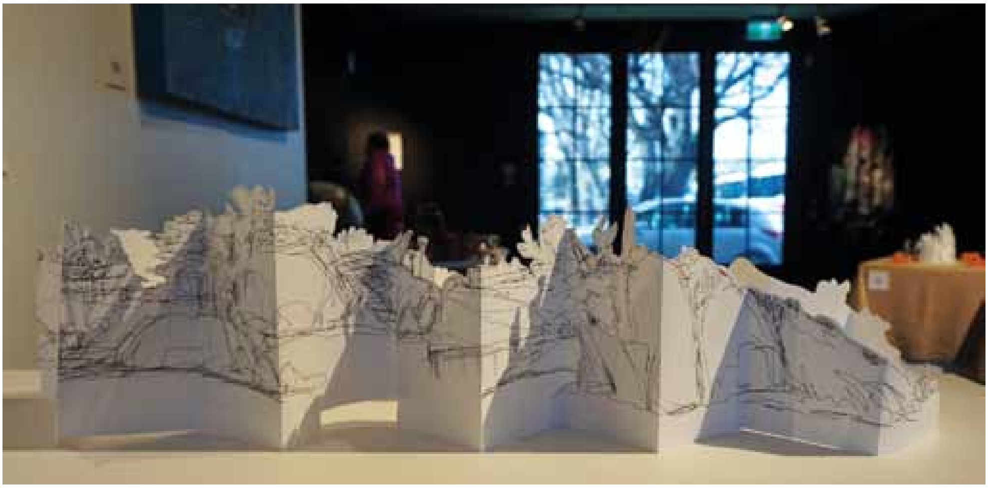

Figure 4. Becky Cameron, *A Circumnavigation of Quarantine Island Kamau Taurua by Kayak*,
ink on paper, approx. 700 x 500 x 220 mm.

using senses that are often neglected in favour of sight. It is a novel way to embrace the environment by feeling and hearing surroundings. I think Becky's sounding pictures are like our sonar recordings – an intriguing start, but still not the full picture until you add some element of ground truthing such as photography, grab sampling or diving.

Becky – Yes, I agree. While my drawings try to depict and map out sounds and wind patterns, this resulted in some interesting graphic marks. This certainly prompted me to really listen to rather than look at my surroundings, they were very subjective and arbitrary – lacking what Emily refers to as "ground truthing."

Emily – Some of Becky's other pieces folded out to watercolour landscapes of views from the island. One was an intriguing vertical slice, with beautiful oily water at sunset. I usually think of my data collection method as a vertical slice from my sensor down through the water column to the seabed.

Becky – I put aside the drawings based on sound, and experimented with several playful ways of mapping the island, concentrating on the boundary between land and sea. I circumnavigated the island by kayak, pausing every 100 metres or so to pull my pen and sketchpad from out of my life jacket to draw the profile of the land as seen from the sea. European sailors made drawings of coastal profiles to help them navigate and find safe harbours and other features. This close to the land, it was more difficult to be clear and objective as I was pushed around by wind and tide. I joined the resulting drawings into a continuous loop, concertina-ed together to form a pop-up island, albeit one with numerous overlaps and inaccuracies in the drawings (Figure 4). A remotely controlled fixed-wing glider (UAV) had been used by School of Surveying students and Dr Sirguey to survey Quarantine Island from the air (https://www.otago.ac.nz/surveying/), producing a virtual model of it which was quite amazing to look at, and much more accurate than my attempt at creating a 3D model of the island. Even here though, inconsistencies were present, in the form of mysterious cliffs appearing on the top of the island in the place of a clump of trees.

Emily – Profiles still feature in pilot books used today. Despite modern electronic navigation taking precedence on most vessels, they remain a useful component of a navigator's spatial awareness. I find the landscape is somewhat flattened when viewed from a distance at sea level, so it was interesting to see Becky's closer perspective from her kayak. She also picked up on the challenges of remote measurement – how hard it is to get the full picture from just one angle as you move past with your aerial vehicle or vessel.

Becky – Even sophisticated mapping has its limits, and Emily mentioned that there was a gap between the information that could be gathered by a drone and by hydrographic mapping, which needs at least 0.5m of water to get a clear image. This prompted me to try to map a small section of the shoreline at low tide. I perched on a rock, attempting to depict the boundary between land and water, masked as it was by plant growth, and changing incrementally as the tide began to come in (Figure 5). It was an elusive and fractal boundary – impossible to depict all the detail present even at the level my eyes could see. I was reminded by a short story by Borges, "On Exactitude in Science," in which he imagines a country in where the science of cartography becomes so exact that they end up with a map on the same scale as the country itself.

Figure 5. Becky Cameron, *Shoreline Mapping*, ink on paper, 297 x 210 mm.

Emily – The link between land and sea is one of the big challenges in hydrography, where historically measurements have been related to different vertical datums, or equipment only works in certain areas, as Becky mentions. In New Zealand, we don't have the benefit of large tidal ranges allowing terrestrial methods at low water, which will easily overlap with hydrographic measurements at high tide. In my research, I am investigating Global Navigation Satellite System (GNSS) methods which can be used with new technology, such as aerial drones and remotely operated vessels, to support seamless land–sea connections, which then enhance research such as tsunami and storm-surge modelling or sediment runoff.

Figure 6. Becky Cameron, *Tidal Contour Mapping*, ink on paper, 297 x 210 mm.

Becky – Having got quite wet in the length of time it had taken me to map a really small area of the island's coastline, I decided that maybe one small rock would be more mappable than a whole island. Looking down on rocks at the water's edge, I drew a line to mark where the water came up to on the rocks, starting again as soon as I'd finished. As the tide rose and gradually submerged the rocks, I ended up with a kind of contour map of the rocks. This felt like a very small-scale and short-term equivalent to maps I'd seen showing how Dunedin would be affected by the insidious creep of sea-level rise to different levels.

Figure 7. Becky Cameron, 3-D island models, cut paper, each approx. 297 x 210 x 100 mm.

Emily – I am fascinated by Becky's rock contours showing the height of the water in terms of 'time.' In the dynamic marine environment, I always have to consider timing in my work, both to link measurements made multiple times a second by different sensors and the influences of changing environmental effects such as heave and tide. So far, I have always ended up using the temporal information to generate a spatial value. The view Becky has presented is pertinent to my research on understanding processes that are observable through habitat mapping, and something I will now consider more in my own work.

Becky – I'd also been experimenting with making three-dimensional representations of islands out of paper. I'd started cutting into flat paper maps, then concentrated on more abstract paper models. Some of the more aesthetically pleasing versions, I realised, resembled sound waves. I was sort of back where I'd started, having travelled round the island and through a variety of different mapping techniques (Figures 6 and 7).

Emily – Some of the details on the exhibited images show coordinates, datums and contour values. The 3D images change height as the island does. This is all familiar to me. I would usually include these cartographic details and realistic representations of the landscape in presentations of my research.

Becky – In all of my different experiments in mapping I'd tried to be as accurate as possible, while also embracing the fact that errors were inevitable. Some of the inaccuracies were perhaps interesting in their own right, pointing to how changeable the environment was compared to a fixed depiction of it, and how dependant any mapping is on what it is that you're looking for. I was bothered though that I had not really mapped the ocean, but rather the places the ocean and land intersect. I had made attempts to respond to Emily's hydrographic mapping more directly, but wasn't happy with any of them; they lacked ground truth, as I was looking at images of the ocean bed rather than the place itself. This feels like an ongoing investigation rather than a finalised project.

Emily – Hydrographic charts and maps help us to understand our marine environment. They may provide a single snapshot in time, or form a series of observations that can be layered to allow us to deduce change due to spatial and temporal processes. If the uncertainties inherent in the measurements are understood, the analysis becomes robust and repeatable. If they are linked with ground truthing, the picture becomes more complete. If the data can be linked to terrestrial measurements, an even more holistic understanding of our environment can be gained.

One aspect this collaboration has made me consider is the interpretation of data and the maps created from it. Through my work, I hope to reduce uncertainty in measurement methods and application, but I have also been thinking more about the various communities – scientists, artists, local iwi, policymakers, resources users and protectors, and the general public – who will interpret and make use of my data or research that builds on it at a later stage. Additionally, it has also made me consider the potential breadth of research in marine habitat mapping and that there is always more to investigate. Becky's work has shown the importance of multiple trials, to keep trying new angles, the power of combining some of these and the need to archive others. It's a useful reminder that each investigation is a useful drop in the ocean of science.

CONCLUSION

Through the Art + Oceans process, we have both been made truly aware of the complexity and immensity of the relatively unknown world beneath the waves. By focusing on a small area in Otago Harbour, this project has enabled Becky to expand her artistic investigations as she looked beyond her more traditional work on the land and began to consider the marine environment. Emily has found that the collaboration has served as a useful reminder that each field trial she undertakes will add to the progression of her marine mapping project, that multiple angles should be considered and that these may be combined in ways yet unrealised. For both of us, this collaboration has added a new dimension to our ongoing investigations in the ocean.

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Becky Cameron is an artist who explores ideas of landscape, memory and belonging. She is an Master of Fine Arts student at the Dunedin School of Art, Otago Polytechnic.
(See www.beckycameronart.co.nz.)

Photographs: Figures 3-7, Pam McKinlay.