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‘*Do You Want the Good News or the Bad News?*’ Measuring Rip Currents at Muriwai Beach, New Zealand

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Measuring waves and currents in the surf zone on beaches is never an easy task although it always seems doable when planning an experiment on paper. The challenges involved in bathymetric surveying, instrument deployment, maintenance and retrieval in the midst of breaking waves, strong currents and rising tides are significant as documented in many of the stories in this volume. Field experiments also take a considerable amount of advance planning and the logistics involved with travel and personnel availability do not often suit flexibility in the timing of the experiments. Essentially, you get what you are given and there is never any guarantee that you will always get the environmental conditions that you actually want. Sometimes you get more than you bargained for.

I had been extremely lucky during my Ph.D. fieldwork at Palm Beach, Sydney, Australia in 1994, when conditions were almost textbook perfect and we managed to capture rip current morphodynamics over a 2-week period of downstate intermediate beach transition (Brander, 1999; Wright and Short, 1984). The experiments involved daily dumpy level surveys of the beach and surf zone, deploying instrument pods consisting of a pressure sensor and vertical arrays of ducted flowmeters at various locations within the rip current system. The instrument pods had a heavy galvanised steel base that weighed about 60 kg (132 lbs) that required two people to carry (Figure 1), while others managed the attached cables, which connected to the onshore data acquisition system.

Figure 1. Gerd Masselink (left) and Rob Brander (right) carrying an instrument pod. This is not from the Muriwai experiment that is the focus of this story, but pod carrying was equally unpleasant no matter where it occurred. (Photo: R.W. Brander.)

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Without SCUBA gear, the trick to getting the pods into deeper parts of the rip channel was to take a final deep breath and then run along the bottom as far as possible underwater before *carefully* placing the pod down (*i.e*. dropping it). One quickly learned to match up with someone of the same height. A tall person, like Gerd Masselink for instance, was able to keep his head above water for a considerably longer time than I could, which meant I was already underwater and out of breath when we started running. We had to get the pods out every day which required a bit of digging if they had become partially buried, but basically we managed it all pretty well and ended up with a fantastic dataset (Brander, 1999; Brander and Short, 2001).

With such a successful experiment under our belts, and perhaps being a little overconfident, we decided to use the same deployment strategy to tackle something bigger: measuring rip current flow at Muriwai Beach, New Zealand. Muriwai is located on Aucklands' high-energy west coast and lies at the southern end of an extensive Holocene beach and dune barrier system (Figure 2) extending 50 km to Kaipara Harbour to the north (Parnell, 2020). The term *high-energy* is not a misnomer as Muriwai is characterised by breaking wave heights ranging from 2-5 m, incident swell periods of 10-15 s, and a surf zone width of 400-500 m, consisting of an inner bar exhibiting intermediate beach state topography and an outer dissipative bar (Brander and Short, 2000). While these conditions are not really conducive to actually measuring *anything* with instruments, our thought was that because it was a meso-tidal environment (mean spring tidal range of 4 m), that we could deploy the pods at low tide and retrieve them the following low tide – easy!

Figure 2. Muriwai Beach, New Zealand looking north from our accommodation. The rip current we measured is indicated by the blue arrow. Wave conditions were relatively benign on this day. (Photo: A.D. Short.)

So with this in mind, our University of Sydney Coastal Studies Unit team of myself, Andy Short, Michael Hughes and our trusted Field Technician, David Mitchell, arrived at Muriwai with high spirits in late November 1997. We stayed on a house on the southern headland, not far from the Muriwai Argus camera site (Emami, Bryan, and de Lange, 2019), with commanding views of the beach that showed a perfect, albeit massive, rip current system waiting for us. The rip system was characterised by an approximately 450 m long and 50-70 m wide feeder channel leading into an equally wide (150 m) rip-neck that headed obliquely offshore, seemingly forever (Figure 2).

While Dave was getting the instruments and pods ready, Andy suggested we do some rip floats. Rip floats involve placing two theodolites along the foredune crest, measuring the distance between them and then recording the angles to a person floating in the rip at set time intervals. Basic trigonometry then allows for the trajectory, and thus velocities, of the rip floaters to be determined. Andy and Bruce Thom had been doing rip floats for years (Short and Hogan, 1994), mostly with undergraduate students, and they had served as a useful Lagrangian method for tracking rip current flow speed and trajectory. Just to be safe, we arranged for an inflatable rescue boat (IRB) and crew from the Muriwai Surf Life Saving Club to pick us up. Andy did the first two rip floats waving an orange flag to help the theodolite operators spot him and signal for pick up (Figure 3). I did the second two. Jumping in at the head of the alongshore feeder, it was like a joy ride. The people on the beach were flying by. Almost imperceptibly though, you turned seaward in the rip neck and before too long, you were almost 300 m offshore …. and still going.

Figure 3. Andy Short about to jump in the Muriwai rip to carry out a Lagrangian rip float. The flag was used to assist the survey crew spot the rip floater in the water. The Muriwai surf lifesaving club inflatable rescue boat is in the background. It was indeed a lifesaver. (Photo: R.W. Brander.)

At this point I started to think about the common advice given to people on what to do when caught in a rip (McCarroll *et al*., 2014). '*Swim parallel to the beach*' came to mind, which was easier said than done given that I would have to swim about 100 m to even get out of the rip. Then there was '*float and ride it out, the rip will eventually bring you back to the beach.*' Would it? Really? This didn't seem likely to me, not actually being able to see the beach I had been standing on just a few minutes previously. All I could see were walls of water. Finally, there was the tried and true '*don't panic, just relax.*' That was okay for me as the Surf Club IRB was close by, but I imagined that a normal swimmer would just assume they were shark bait and feel no comfort at all by that advice. The rip was enormous. It was hard to know when we had actually stopped, and in fact, we hadn't. The rip float plots showed we were still going (Figure 4). The last rip float was done by a 14 year old surf club volunteer and she went further than us both, a total distance of over 600 m at speeds of up to 1.4 ms^{-1} (Brander and Short, 2000).

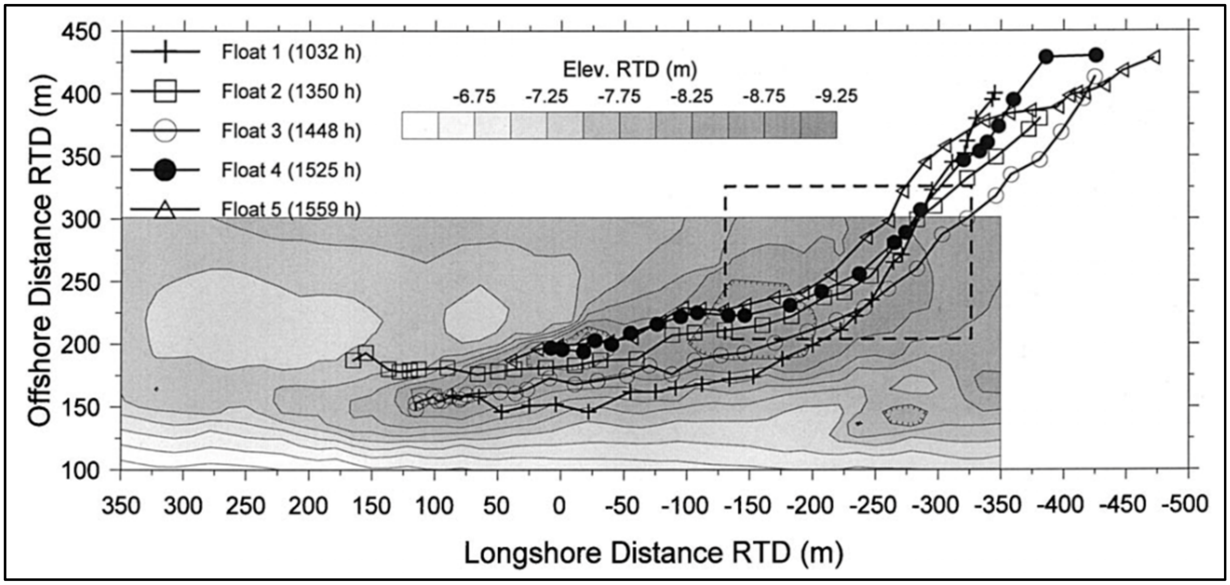

Figure 4. Trajectories of the rip floats conducted at Muriwai Beach on November 30, 1997. The boxed region (dashed line) defines the region of maximum flow velocity. RTD = relative to survey datum. (Source: Brander and Short, 2000.)

Fun and games over, it was time to put in some instruments. Our first foray at deploying the pods did not exactly go to plan as the flow in the rip feeder was extremely strong and we could barely stand up, even when carrying the 60 kg pods. Even at low tide, there was zero chance of getting a pod anywhere near the rip-neck so we ended up deploying three pods only a few meters offshore into the rip feeder channel itself and spaced about 100 m apart alongshore. As the tide rose, the drag on the cables was immense and an extensive field of star pickets was needed to keep them in place. Dave had come up with a mobile data acquisition interface that could be housed in a van parked higher up on the beach.

Problems started immediately with the ducted flowmeters on the seaward-most pod closest to the rip neck failing, but it was almost impossible to wade in and retrieve the pod to inspect them as they were submerged even at low tide. So we hired some SCUBA gear and I went to have a look, loaded up with as much weight as possible on my weight belt. Even so, the feeder current was so strong that I was barely able to get to the instrument pod and when I did, I had to hang onto the vertical support with both hands with the rest of my body streaming like a windsock with the current, bending the vertical stainless-steel support in the process. It was hopeless. We made the call to take the sensors off to use them on the other pods (and get the pod later). This was a one-handed job with the other hand holding on to the vertical support for dear life. Eventually I managed to get them off and put them in a dive bag. Then I had to get back to shore and even though it was only a few meters away, getting out on my own just wasn't happening. Dave and Michael ended up throwing me a rope that I could loop around my waist and they basically pulled me out. Unfortunately, the pod remained where it was, with its base mostly buried and the vertical support still sticking up (albeit at an angle). This wasn't good as it was a recreational beach, but there wasn't much we could do at that point. We got the other two pods out … barely.

Unlike Palm Beach, where we did daily measurements, it took us 4 days to fix the carnage, re-group (an impromptu visit by *Bad Dune Boy* Patrick Hesp didn't help!) and get the remaining two pods back in for the first low tide to low tide measurement, which as it turned out was overnight. Dave and I hunkered down in the van in the ambient (this being New Zealand after all) gale force winds and took shifts watching the data real time on the computer, while the other slept. Everything was going fine until I was woken up for my shift about 2 am by a grinning Dave (Figure 5) who said, '*Do you want the good news or the bad news?*' The good news was that Pod 2 was working fine. The bad news was that the cables to Pod 1 had completely snapped just before high tide. That was the last of the pod deployments and Eulerian measurements for the experiment, but the data showed mean flows (at only the edge of the feeder!) of up to 1 ms^{-1} and maximum instantaneous flows of 2 ms^{-1} (Brander and Short, 2000). The latter were probably higher than this because the ducted flowmeters effectively maxed out at 2 ms^{-1}.

Figure 5. Dave Mitchell with the good news and bad news in the middle of the night in the van. The yellow flat line on the computer screen was not the good news. (Photo: R.W. Brander.)

The following day we conducted a beach and surf zone survey using a total station and prism rod. Even at low tide, getting across the feeder to get to the bar to take measurements was difficult as the water depth in the channel was mostly overhead. A key point to measure was the slope interface between the inner bar and the feeder. At one point Andy was standing on the bar that was almost completely exposed, while I was standing on the edge of the bar, leaning over placing the prism rod at the base of the steep slope. Suddenly a surge of water, only about shin deep, came pouring across the bar and knocked me into the feeder channel. Try as I might, I just could not get back onto the bar with the water pouring across it. Meanwhile, I was drifting rapidly in the feeder towards the rip-neck.

Andy realised the severity of the situation immediately and threw me his fins to help me swim across the feeder and back to the beach. This was a bit awkward as I was carrying the prism rod and had my wetsuit on, but I was motivated by the fact that if I turned the corner into the rip-neck, I was long gone and looking at a helicopter rescue, because no one was on the beach but us (Figure 6). Eventually I made it and crawled onto the beach and laid there for a long time, exhausted, heart pounding, scared and pissed off. Dave and Michael, who had been watching from the total station on the dune said they were waiting for me to drop the prism rod before running to the 4WD to go and get help. It was easily the most frightening experience I'd ever had in the field. But we finished the survey.

At this stage, we were running out of gear so we thought we'd cut our losses and started to wind things up. It was during this time that something bizarre occurred. The house we stayed at had an eccentric gardener who was in his late 50's with streaming grey-blonde hair and who would mow the lawn in bare feet, wearing nothing but red speedos, despite the temperature being a damp and windy

15° C. Andy got talking to him and the chat turned to surfing and Andy figured out that it was Dave Jackman, an Australian who was the first to surf the famous big wave at the Queenscliff Bombora off of Sydney's Manly Beach in 1961. It was the only time I've seen Andy visibly taken aback – Jackman was clearly a legend to him – and he shook Jackman's hand out of respect.

Figure 6. Surveying the rip current came with challenges. The extent of the feeder (blue arrows) is evident in the left image and the rip-neck almost imperceptibly flows obliquely offshore in the right image. (Photos: R.W. Brander.)

As for the experiment, we ended up being lucky once again. We had started the experiment soon after Muriwai had been hit by a major storm event and during our period of fieldwork, Muriwai experienced unusually low-energy conditions and once again, we managed to capture elements of a downstate beach transition (Brander and Short, 2000). This allowed us to make several morpho-dynamic comparisons with the Palm Beach dataset that revealed several scaling relationships that eventually led us to link rip current channel spacing with wave climate in a later study (Short and Brander, 2001). The luck continued on the very last day when I went back to the beach one final time to search for the missing pod. The waves were small and the feeder current was gentle and I could wade easily at waist depth. I walked backwards and forwards and was about to give up, when I stubbed my toe on something … the top of the vertical support! Phil Osborne was with me at the time and as the sand was quite mobile, we were able to dig the pod out and Phil kept it at the University of Auckland.

I eventually inherited the pod back when I returned to New Zealand in 1998 for my first academic position at Victoria University of Wellington. But by then, my fieldwork luck had run out. I spent all of my start-up funding on *the perfect* rip current experiment at Tairua Beach in the Coromandel Peninsula in late 1999. I flew Michael and Dave over, all the Sydney University gear, and we had a cast of thousand come to help from various places in New Zealand. And then it was flat calm along the entire east coast … for a month. No data. Zilch. It set me back for years!

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