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Rip Density and Dynamics along the New Zealand Coastline

A thesis presented in partial fulfilment of the requirements
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ABSTRACT

Rip currents are the most obvious component of the nearshore cell circulation system. The aim of this research was to investigate the applicability to the New Zealand coastal setting of a rip density scaling hypothesis, based on regional wave climate as proposed by Short and Brander (1999). Leading on from this investigation was a second aim to explore the relationship between rip velocities, rip density and surf zone morphology. Rip morphometrics were assessed for the entire New Zealand coastline through the use of aerial photographs. It was intended that four case study sites be investigated in more detail: The Gap, Castlepoint; Taranaki; Piha; and Tairua, but due to prevailing low wave energy, only two sites were examined.

Seventy-one beaches were examined around the New Zealand coast. Aerial photographs were examined and the following features were measured: rip spacing (Y_s); rip length (L_r); rip width (W_r); surf zone width (X_s); length of beach sampled (L_b); total beach length (L_{bt}); and beach type (Wright and Short, 1984; Short and Aagaard, 1993).

It was found that the scaling relationship for rip density suggested by Short and Brander (1999) of 2.5 between West Coast Swell (WCS) and East Coast Swell beaches is incorrect for New Zealand. The use of significant wave height as a rip spacing predictor produced no relationship, while the utilisation of mean sediment size as a rip spacing predictor produced the best relationship, with an R^2 value of 0.61 (p-value <0.01). Furthermore, although sediment size produced the best outcome, sediment fall velocity, which is used in a variety of morphodynamic models, had no statistically significant relationship. This relationship warrants further investigation. Finally, Muriwai beach, which is indicated by Short and Brander (1999) to be a representative New Zealand WCS example, is in fact, a highly atypical WCS beach. Therefore, the use of this beach as the sole New Zealand example is problematic in Short and Brander's (1999) investigation.

The exploration into rip current velocities at the Gap, Castlepoint provided some useful insights into rip velocities for beaches in a transitional state. Periodic velocities

of between 3ms^{-1} and 4ms^{-1} were recorded on four occasions at this site. However, Short (1985) states that rip velocities in mega-rips can approach 3ms^{-1} . The outcome from this research suggests that there is a strong need to gain further quantitative measurements of rip currents both in transitional and cellular (i.e. mega-rips) states.

The rip currents that were investigated at the Taranaki beaches of Fitzroy and Oakura were examples of unsteady, episodic rip currents. Rip current trajectories demonstrated marked differences between rips in different surf zone types. Fitzroy, in a transverse bar and rip state, produced rip currents that exited through the surf zone. Oakura, a double bar, inner bar rhythmic bar and beach state, produced rip currents that were inhibited from exiting the surf zone by the outer bar. A circulatory flow was observed, which may have been produced through a combination of onshore directed wave energy and return flow from the rip current.

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