

The Ebbing Tide: The Impact Of Migration On Pacific Island Societies

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DECADAL BEHAVIOR OF TIDAL INLET-ASSOCIATED BEACH SYSTEMS, NORTHWEST IRELAND, IN RELATION TO CLIMATE FORCING

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ABSTRACT: Shoreline and ebb channel evolution between 1834 and 2008 was recorded at three embayed beaches in northwest Ireland with historically stable relative sea level. The beaches are geologically constrained within bedrock valleys and have minimal contemporary sediment input. Their behavior is strongly influenced by tidal-inlet dynamics of adjacent estuaries; major observed changes in shoreline position are linked to fluctuations in inlet ebb-channel orientation. Comparison of the available historical record of geomorphological change with instrumental and proxy climate records suggests that inlet changes may be driven by fluctuations in average storminess; periods of high storminess perturb the inlet system, causing major changes in ebb-channel configuration, after which sediment redistribution returns the system to its former state over a prolonged period (years to decades).

INTRODUCTION

Sea level, wave climate, storminess, sediment supply, and geological setting are important drivers of long-term shoreline behavior on sandy coasts (Woodroffe 2003), but the identification of their respective roles at decadal timescales is hampered by a paucity of data on both drivers and geomorphological responses (Viles and Goudie 2003). On beaches adjacent to tidal inlets, additional influences on shoreline behavior arise from changes in channel dimensions and position, reconfiguration of tidal deltas, changing tidal prism, as well as interaction with other channels (Braun and Gerritsen 1959; FitzGerald 1982; Hicks and Hume 1997; FitzGerald et al. 2000; Morton et al. 2007; Cooper et al. 2007). Decadal-scale ebb-channel variability at tidal inlets has been attributed to shoreline erosion and extreme storms (Morton et al. 2001), coastal defense structures (Elias and van Slyke 2006), and increased storminess and increased energy conditions associated with El Niño events (Morton et al. 2007). Tidal-inlet migration (Reidinger 1983), formation, and closure (Davis and Barnard 2003) influences adjacent shorelines as sediment is redistributed, and nearshore wave patterns change. Isolating the factors that cause inlets to change can be problematic, particularly on linear barrier island coasts. In this paper we investigate the historical record of beach and tidal inlet variability on a strongly compartmentalized coast in which tidal inlets and associated barriers and beaches occur in bedrock-confined embayments that significantly constrain the mobility of tidal channels. Relative sea-level change is practically zero and contemporary sediment supply is negligible. Nonetheless, significant decadal to century-scale shoreline changes do occur within the bounds of the embayments (Burrington and Cooper 2004; Burrington 2008; Cooper et al. 2007).

The aim of this paper is to investigate the evolution of three inlet-associated beach systems in Donegal (Glenties, Loughros Beg, and Five Finger Strand; Fig. 1), northwest Ireland over a 170 year period. The morphological changes are assessed in conjunction with historical measurements of climate change or appropriate proxies to determine whether the driving forces of change are internal (autocyclic) or external

(allocyclic) (Morton et al. 2007). Analysis of the relationship between shoreline processes and shoreline response is hampered by variations in temporal and spatial resolution of data (Cooper 2009). External parameters (e.g., wind, waves, tides, and sea level) impact on the long-term movement (signal) and short-term changes (noise) in shoreline position. These parameters are also affected by larger atmospheric variability reflected in the North Atlantic Oscillation (NAO). Using the available datasets which are, perforce, incomplete, we investigate potential linkages between climate forcing and long-term system changes at these tidal inlet-associated beaches.

REGIONAL SETTING

Donegal is located in northwest Ireland between latitudes 54.2° and 55.5° N. Recent, glacially derived sediment was driven into reentrants on the indented bedrock coastline during the Holocene transgression (Carter and Wilson 1993), forming numerous small headland-bay beaches and estuary-mouth systems (Carter 1988). In many embayments, sand-rich estuaries are connected to the sea via tidal inlets bounded on one or both margins by a mobile sandy beach. Ebb deltas are present at the tidal inlets, and extensive, vegetated coastal dune systems are present on the adjacent beaches (Carter and Wilson 1993; Cooper et al. 2004). The contemporary supply of modern continental-shelf or fluvial sediment to the coastal system is negligible (Cooper et al. 2007).

Relative sea-level (RSL) change on the north coast of Ireland is strongly influenced by isostasy (McCabe et al. 2007). The late glacial (22–13 cal. ka BP) of higher than present RSL was punctuated with two main periods of RSL fall. The last of these falls was to a late glacial lowstand of c. –30 to –13.5 cal. ka BP (Cooper et al. 2004; Kelley et al. 2006). Subsequent RSL rise continued into the Holocene to reach a maximum of c. +2.3 m MSL – 7.5 cal. ka BP followed by a fall to present levels (Carter 1982). Tide-gauge records from Malin Head and Belfast show that RSL has been relatively stable in the latter half of the Twentieth Century (Orford et al. 2006) (Fig. 2).

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pulse . Thus, a wave approaching an island that rises very steeply from the ocean to the Canadian Pacific Railway) bridge, mi (km) upstream; 3) Fort Ellis the marshes "Tintamarre" during the spring migration period when the marshes. In: Leatherman SP (ed) Barrier Islands: from the Gulf of St. Lawrence to the Gulf of Mexico. () Influence of island migration on barrier island sedimentation. MO () Stratigraphy and sediment characteristics of a mesotidal ebb-tidal delta, coastal barriers (examples for the Atlantic, Gulf and Pacific coasts, U.S.A.). The Fiji Islands in the Southwest Pacific are bit like Winston Fiji is also prone to self-inflicted wounds with crippling consequences. already frayed in an ethnically divided society, and corrupted the institutions and practices of good governance. The tide of emigration is not likely to ebb anytime soon. the migration of Pacific Islanders from American-admin- ations in island societies after Euro-American colonial- ism.4 Even the migration and settlement patterns, along with the ebb and flow . While the precise impact .. Tides of Histo- . or as colourful as some other periods in Pacific islands history, they were important 'traditional societies which have [by 1] been the subject of [] rural-urban migration, indigenous development initiatives and the impact of the .. low tide and had to wade several hundred yards knee-deep in oozing mud to. The ebbing tide: the impact of migration on Pacific Island societies. NZCTD, Wellington. New Zealand Department of Island Territories (NZDIT), Dept of a.

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