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ScienceDirect
Geomorphology 94 (2008) 153–169
GEOMORPHOLOGY
www.elsevier.com/locate/geomorph

Temporal patterns and processes of retreat of drumlin coastal cliffs — Strangford Lough, Northern Ireland

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Received 21 March 2006; received in revised form 25 April 2007; accepted 9 May 2007
Available online 21 May 2007

Abstract

Monthly measurements of erosion pins at sixteen sites around the very low energy marine environment of Strangford Lough, Northern Ireland, were used to investigate temporal patterns and processes of retreat of low cliffs of glacial material. Erosion rates were extremely varied: the mean was 76±49.03 mm a^{-1}. Erosion is strongly seasonal with 86.6% of the total erosion occurring during 'winter' (September to March) periods. This seasonal pattern was most exaggerated in some of the more rapidly-eroding sites on the exposed eastern side of the lough. 'Preparatory processes' – heavy rainfall, desiccation and frost action – reduce the compressive strength of the cliff materials and act as important forcing of the erodibility of the cliffs. Direct wave attack on cliffs around the lough takes place when threshold conditions of wind speed and tidal heights are met (tidal levels > 1.50 m above O.D. with wind speed of 15.4 m s^{-1} (30 knots), maintaining for more than 4 h). During the study period eighteen events exceeding the above criteria were identified. Extremely low atmospheric pressure has also been identified as important in raising water levels. Slumps, falls, topples and slides were the forms of cliff failure observed.

Keywords: Coastal erosion; Drumlin cliffs; Episodic erosional events; Erodibility; Environmental thresholds

1. Introduction

Research on the paraglacial retreat of bluffs or low cliffs of glacial material has taken place in a number of locations, including the coastlines of Nova Scotia, Canada, the eastern seaboard of the United States of America, the shorelines of the Great Lakes, and numerous locations in Great Britain and Ireland. Much of this research has focused on the factors controlling the retreat of non-consolidated cliffs (e.g. Buckler and Winters, 1983; Jones and Williams, 1991; Komar and Shih, 1993; Amin and Davidson-Arnott, 1997; Bray and Hooke, 1997; Himmelstoss et al., 2006). Less attention has been given to the seasonal and climatic factors which may 'prepare' the glacial material to be eroded, as well as the actual forms of slope failure. Preparatory processes are thought to be especially important, in terms of rates of erosion, for episodic erosion events in areas of low marine energy.

This paper aims to investigate various aspects of erosion and failure of low cliffs composed of glacigenic

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0169-555X/$ - see front matter © 2007 Elsevier B.V. All rights reserved.
doi:10.1016/j.geomorph.2007.05.004

sediments around the shoreline and islands of Strangford Lough, Northern Ireland (Fig. 1), considered as a 'very low wave energy environment' (Carter, 1982; Carter and Newbould, 1984). The relative importance of subaerial erosion and direct wave erosion will be examined, as will the threshold conditions required

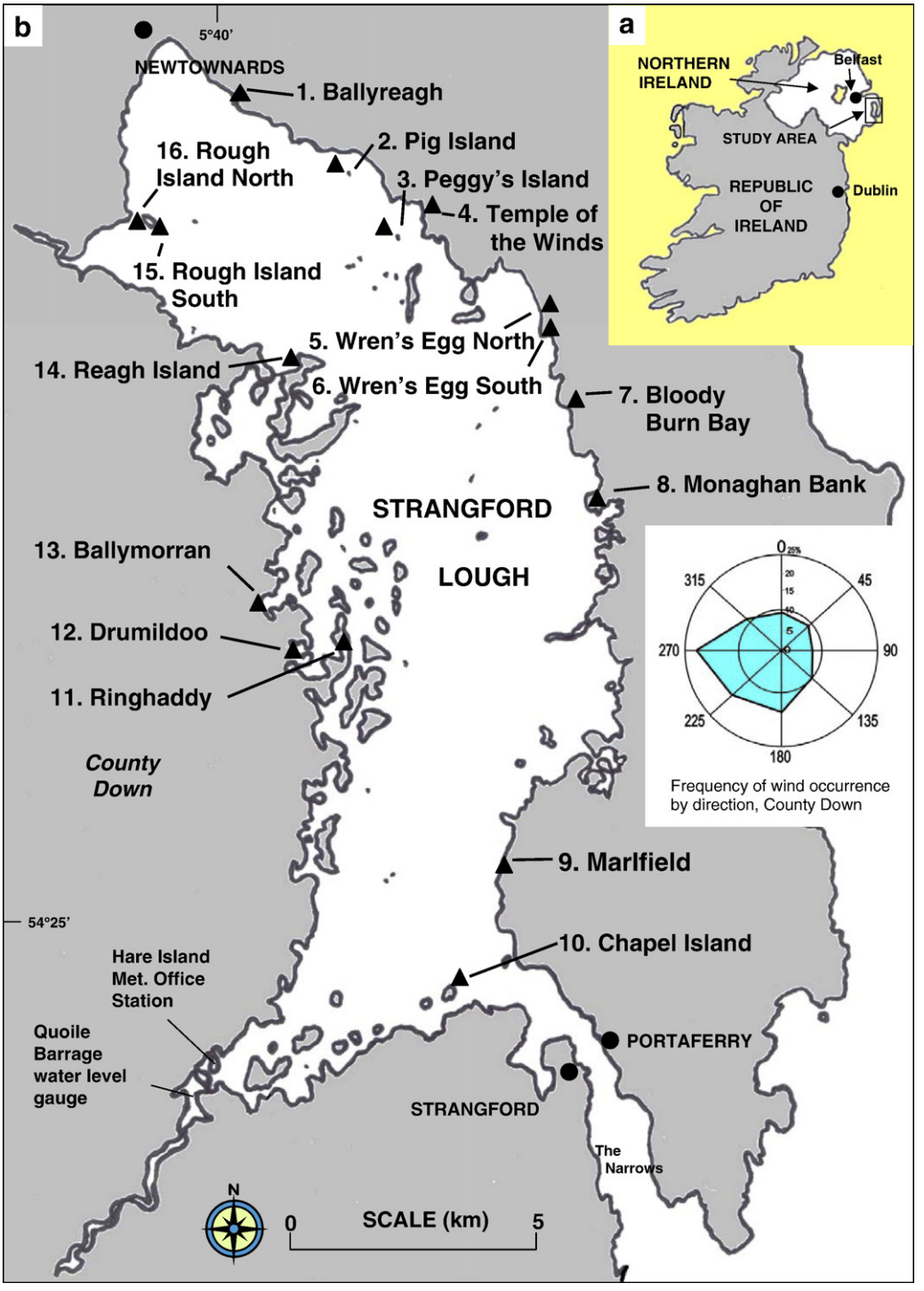

Fig. 1. a and b: Maps showing the location of Strangford Lough and the 16 monitored sites.