Ocean & Coastal Management 84 (2013) 204–207

Contents lists available at ScienceDirect

Ocean & Coastal Management

journal homepage: www.elsevier.com/locate/ocecoaman

Review

Defining coastal squeeze: A discussion

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ARTICLE INFO

Article history:
Available online 19 September 2013

ABSTRACT

In the UK the term 'coastal squeeze' is commonly used to describe the loss of coastal habitats in front of sea defences. This brief discussion paper explains how the usage of the term has evolved since its origins and how imprecise definitions have led to confusion when discussing changes in coastal habitat extent. The paper clarifies the geomorphological processes responsible for habitat extent and concludes with a more precise definition of coastal squeeze.

1. Introduction

In Europe, the EU Habitats Directive (1992) and Birds Directive (1979, 2009) have provided a legal requirement to protect a range of designated conservation sites, known as *Natura 2000* sites, from deterioration. The reduction in extent of habitats is one possible cause of deterioration. In the UK the term 'coastal squeeze' is commonly used to describe the loss of coastal habitats in front of sea defences. However, the term is poorly defined and this can lead to the role of defences in the loss of habitats being overstated. Where the lost habitats form part of the European *Natura 2000* network there is commonly a requirement to restore or recreate habitats and this requires significant financial outlay. It is therefore important to understand the causes for coastal habitat loss in order that suitable targets for habitat recreation can be agreed.

The present paper clarifies a number of concepts mentioned by Doody (2013). The paper documents how the usage of the term 'coastal squeeze' has varied and illustrates how this can lead to confusion when discussing changes in coastal habitat extent. The paper clarifies the processes that control habitat extent and proposes a more precise definition for coastal squeeze.

2. Previous definitions of coastal squeeze

The origin of the term 'coastal squeeze' was documented by Doody (2004) who cited it as having arisen from observations of the loss of saltmarsh and mudflat in the Wash, due to reclamation; and the loss of seaward portions of saltmarshes in Essex, due to erosion. At this time, in the late 1980s and early 1990s, the term 'coastal squeeze' was being used as part of a conservation argument against further saltmarsh reclamation in the Wash. In this regard, the term 'coastal squeeze' was an attempt to describe a process for non specialists and was not defined precisely (Doody, pers comm. 2013).

In his more recent paper Doody (2013) illustrates how the coastal squeeze has come to be used in some instances:

> *'The term coastal squeeze describes the process where rising sea levels and other factors such as increased storminess push the coastal habitats landward. At the same time in areas where land claim or coastal defences has created a static, artificial margin between land and sea or where the land rises relative to the coastal plain, habitats become squeezed into a narrowing zone. Manifestation of this process is most obvious along the seaward margins of coastal habitats, especially salt marshes, when erosion takes place.'*

For saltmarshes this definition is illustrated diagrammatically in Fig. 1.

The definition of coastal squeeze as summarised by Doody (2013) is considerably broader than other definitions (Table 1), the majority of which limit their definition to the effect of sea level rise[1] (SLR) and anthropogenic defences (Fig. 1).

The range of the definitions of coastal squeeze shown in Table 1, plus those given by Doody (2013), can lead to confusion in a number of areas:

1. Which habitats are included? Some authors take the term to refer to intertidal habitats alone, whilst others take it to include entire coastal zone composed of sub-tidal, inter-tidal and supra-tidal habitats.

[1] In this paper, sea level rise is taken to mean a rise in sea level relative to the stretch of coast being considered. This relative rise is dependent on a number of elements, including: global or eustatic changes, for example as a result of melting ice-caps; and isostatic elements, such as the local subsidence or uplift of land.

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http://dx.doi.org/10.1016/j.ocecoaman.2013.07.010

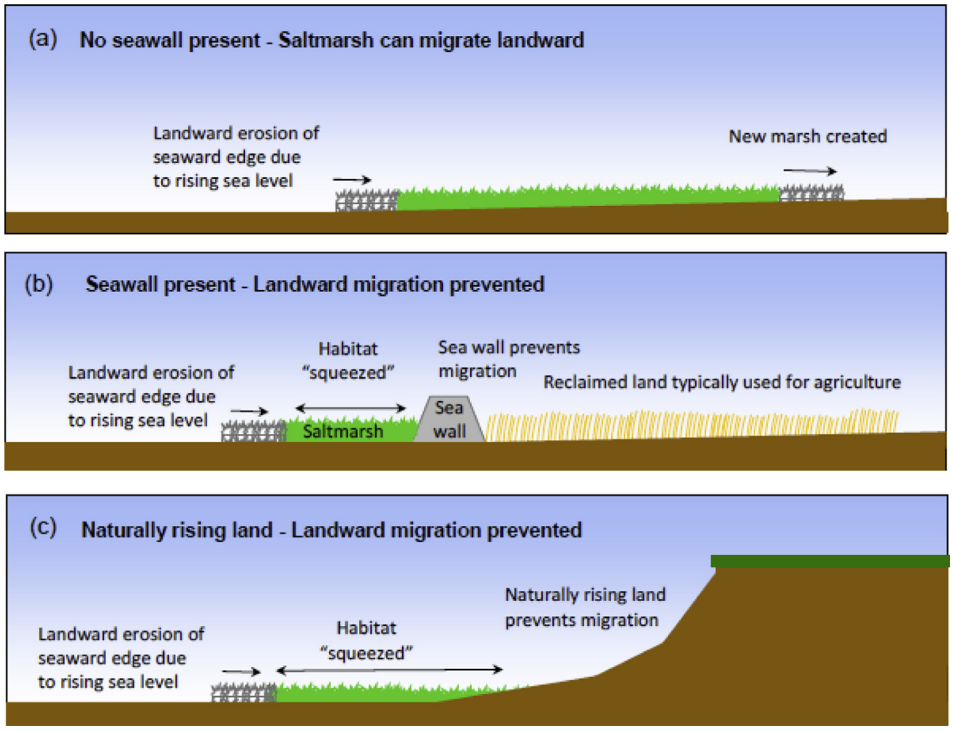

Fig. 1. A simplified illustration of coastal squeeze as defined by Doody (2013). (a) Unrestricted landward translation of saltmarsh habitat in low lying areas, which maintains coastal habitat extent – sometimes referred to as natural transgression or rollover. (b) Landward translation of saltmarsh is prevented by a sea defence, which results in a reduction in the width of saltmarsh – the most common definition of coastal squeeze. (c) Landward translation of saltmarsh is prevented by rising land, which results in a reduction in the width of saltmarsh – occasionally referred to as 'natural coastal squeeze' by some authors.

2. Does the term coastal squeeze include natural obstructions (e.g. rising land) in addition to anthropogenic obstructions to the landward migration of habitats (e.g. flood or coastal erosion defences)?
3. Which processes/driving forces are included in the term coastal squeeze? Most definitions only make mention of SLR, whilst Doody (2013) includes to other factors such as increased storminess.
4. What are the timescales by which coastal squeeze is identified? This is important in order to distinguish between cycles of short term variability and trends of long term deterioration.

The definition of coastal squeeze provided by Doody (2013) appears to include all instances of coastal narrowing. Such broad definitions can cause confusion by failing to distinguish the driving forces and causes for changes in coastal habitats. This can lead to the presumption that coastal habitat losses are always due to the presence of defences. The next section clarifies the processes responsible for changes in intertidal morphology.

3. Causes of intertidal change

Changes in intertidal width can arise due to many causes (Table 2) in addition to the influence of sea defences and sea level

Table 1
Previous definitions of coastal squeeze used by various organisations. (SLR = Sea level rise[1]).

Source	Definition	Main causes
Defra (2003)	*'The process by which coastal habitats and natural features are progressively lost or drowned, caught between coastal defences and rising sea levels'.*	• SLR • Anthropogenic defences
Defra (2005)	No specific definition	• Anthropogenic defences
English Nature (2003)	*'Flood defence can play a beneficial or detrimental role in the maintenance of designated features by preventing flooding of freshwater habitats or by causing coastal squeeze. This creates dilemmas for organisations advising on and implementing flood defence.'* *'… in the face of relative sea level rise and shoreline change, these defences will lead to a continued 'squeeze' on designated intertidal habitats from sea level rise….'* *'The process by which coastal habitats are progressively reduced in area and lose functionality when caught between rising sea level and fixed sea defences or high ground.'*	• SLR • Anthropogenic defences • SLR • Anthropogenic defences • High ground
English Nature (2006)	*'In many coastal and estuarine environments, flood and coastal defences constrain the ability of intertidal habitats (notably saltmarsh) to naturally move landward in response to sea-level rise. This effect results in intertidal habitat loss, and is commonly termed 'coastal squeeze'.*	• SLR • Anthropogenic defences
Black and Veatch (2006)	*'If sea levels rise without flood defences in place, the inter-tidal area is able to gradually move inland over time and there is no net loss of habitat. With defences or other constraints present, the movement inland of the high water line is impeded but the low water line moves shoreward, which leads to a loss of the intertidal area.'*	• SLR • Anthropogenic defences