



Climate adaptation in ‘new world’ cultural landscapes: The case of Bay of Fundy agricultural dykelands (Nova Scotia, Canada)



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ABSTRACT

North America has few cultural agricultural landscapes, and often commensurately poor governance arrangements for managing change in such settings. This research uses the Acadian dykelands of Nova Scotia, Canada, as an opportunity to explore the social and governance limits to coastal climate adaptation in ‘new world’ cultural agricultural landscapes, as well as inform local decision-making. Approximately half of Nova Scotia’s coastal wetlands were converted to dykeland in the 1600s, lowering local resilience to the increased frequency and storm severity anticipated with climate change. Today, dykelands protect a diversity of public and private interests, meanings and values, yet are controlled by the agricultural sector, which can no longer afford to maintain them all to 2050 climate projections. We report here on a representative online Q-methodology survey of 183 adult Nova Scotians in the spring of 2015. Respondents sorted 34 statements along a normal distribution about whether they prefer dykeland maintenance or wetland restoration, and under what governance arrangements. Four factors were derived: the dominant discourse was local, female and strongly pro-dykeland, indicating the likelihood for local resistance to dykeland removal on for cultural, recreational and farming reasons. The second factor was supportive of wetland restoration for reasons of efficiency, not wetland affinity, but characterized by those in positions of management power. The two minority viewpoints were less informed about dykelands, characteristic of outsiders, and concerned more with governance. More education is needed about the challenges facing dykelands, the benefits of coastal wetlands, and the management options, but this research shows proposals to change landscape should emphasize flood mitigation over cost-saving. Cultural values and status quo bias are clearly barriers to adaptation planning, even when discussing the removal of man-made structures. The factors were surprisingly polarized, suggesting the forced-normal distribution affects the space available to convey nuanced perspectives. Large *p*-set Q-method of this kind is likely most useful for characterizing the emergent discourses demographically, and understanding their prevalence; the same discourses had emerged within a much smaller pilot study.

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1. Introduction

In the face of climate change, the fate of wetlands is entangled with the fate of human societies. The RAMSAR Convention observes that – unlike climate mitigation, which is all about carbon – climate adaptation is all about water (Ramsar Convention on Wetlands, 2010). Wetlands have been promoted as contributing to both (Erwin, 2009; Euliss et al., 2006; Mitsch et al., 2013). Changing precipitation levels and intermittency will make water shortages the predominant concern in some places, while oth-

ers will be coping with an oversupply (Beaumont et al., 2011; Hughes, 2003). Wetlands can act as sponges to regulate irregularity and increased amplitude in precipitation, moderating drought and flood alike (Bolund and Hunhammar, 1999; Millennium Ecosystem Assessment, 2005). Everywhere, however, rising ocean levels present additional threats, particularly in combination with changing storm patterns and intensity, and the ocean surges they bring (Jongman et al., 2012). Coastal areas are already sites of long-standing and increasingly heavy human use (Small and Nicholls, 2003), which brings adaptation measures into conflict with other land uses and cultural values (Adger et al., 2013; Graham et al., 2013). Destruction and loss of natural buffers such as coastal wetlands exacerbates the challenge (Barbier, 2007; Nicholls, 2004).

A number of the strategies humans have used to hold back, control or even harness the ocean are no longer adequate, but

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individual values can limit the alternatives (Adger et al., 2009a, 2013; O'Brien, 2009). History provides compelling examples of misplaced over reliance on engineered protection systems such as levees, as well as the difficulty of adapting such landscapes to suit new realities (e.g., Tobin (1995)). Many countries are exploring managed realignment, de-embankment and other approaches to finding space for water amidst high population density (Alexander et al., 2011; Harman et al., 2015; Luisetti et al., 2011; Oosterberg and Fiselier, 2004; Roca and Villares, 2012; Wolters et al., 2005). Where these serve inadequate to protect people and infrastructure, however, managed coastal retreat is sometimes necessary. Adaptation to sea level rise is also challenging in places used for food and fibre production, even in the context of widespread agricultural land abandonment. This is because such production is often associated with cultural practices and iconic landscapes, such as the polders of the Netherlands, and the salternes (salt pans) of Brittany, France (Bouzillé et al., 2001), each over a millennium old. Europe has acknowledged the cultural value of certain agricultural practices and settings, and developed approaches to preserve its cultural agricultural landscapes (Antrop, 2005). Though Canada is a young country, it has one cultural agricultural landscape recognized by UNESCO, the Landscape of Grand Pré, created by French settlers (Acadians) to the Bay of Fundy coast who imported the practice of using dykes to reclaim rich coastal soils for agricultural purposes in the early 1600s (Bleakney, 2004; Butzer, 2002). These landscapes, like the salternes and polders of Europe, result from converting coastal wetlands, which might otherwise form a natural buffer from the seaward impacts of climate change (Spalding et al., 2014).

In a context of widespread agricultural land abandonment, some agricultural landscapes become the site of other land uses (Beilin et al., 2014; Verhoeve et al., 2015), causing problems for land managers unused to multifunctionality. In the Bay of Fundy dykelands, split between New Brunswick and Nova Scotia in the Canadian Maritime provinces (Bowron et al., 2012), agricultural production has decreased (MacDonald et al., 2010; Singh et al., 2007). Food security is typically the argument for maintaining agricultural zoning when economic pressures shift toward other kinds of development (Nova Scotia Agricultural Land Review Committee, 2010). For dykelands, more immediate is the fact that dykes still foster recreation, tourism, sense of place and identity, and protect an increasing amount of residential, commercial, industrial and transportation infrastructure, all at risk given increased flooding that features in climate projections for the region (Climate Change Nova Scotia, 2005; Richards and Daigle, 2011). It is important to note that neither dykes nor wetlands are guaranteed to provide long-term protection in this dynamic setting, and that coastal retreat may yet be necessary. For instance, coastal wetlands could continue to retreat if sea level rises faster than sediments can accumulate and stabilizing vegetation become established. In such cases, well-maintained dykes may be more adaptive, but it is indeed the capacity for maintenance that is in question here.

Scholars of adaptive governance, in agriculture and otherwise, agree on the need for planning to involve multiple stakeholders, including various scales of government with local businesses and individuals (Adger et al., 2009b; Bauer and Steurer, 2014; Scherr et al., 2012). The governance of dykelands does not match their multifunctionality, and is thus not adaptive (Folke et al., 2005). In Nova Scotia, full responsibility for the upkeep of dykes falls to the Nova Scotia Department of Agriculture (NSDA) and farmer-dominated Marsh Body organizations (Government of Nova Scotia, 2000), which cannot afford to bring all dyke infrastructure to 2050 sea level and storm surge projections (van Proosdij and Page, 2012). The province is starting to prioritize the marsh bodies within their control for potential restoration to coastal wetland based on vulnerability to climate change (Tibbetts and van Proosdij, 2013) and type

of asset (Kevin Bekkers, pers. comm.), but – as elsewhere (Adger et al., 2013; Morris et al., 2014; O'Brien, 2009) – citizen and stakeholder perceptions of these structures and landscapes may limit the acceptability of such land use changes for climate adaptation.

Adaptation research in such complex settings must be context-specific, but can hold lessons for other places. This research uses the dykelands of Nova Scotia, Canada, as an opportunity to explore the social and governance limits to coastal climate adaptation in 'new world' cultural agricultural landscapes, as well as inform decision-making. Specifically, we examine the multiple and sometimes competing perspectives on the management and future role of dykelands in this region. Q methodology was thus employed to identify public discourses, first in a pilot study in the Annapolis Valley (p -set = 20) to test concourse statements about dykelands, coastal wetlands, and management alternatives, then again in a provincial sorting exercise (p -set = 183) using online panels. Discourses were then characterized by additional variables such as age, gender, education, climate change concern, and stakeholder group membership. The research aims to inform urgent decision-making in Nova Scotia, climate adaptation in cultural agricultural landscapes, and governance of multifunctionality more broadly. In doing so, it is also pushing the boundaries of Q methodology by incorporating indices and statistical regression, enabled by the large p -set, with insights for practitioners and policy-makers.

2. Methods

2.1. Case study

Dykelands played a critical part in the early settlement and agricultural productivity of Nova Scotia (see Supplemental Box 1 for details). The province otherwise has very little high-quality agricultural land due to shallow, acidic soils and fine-grained topographic variation (Nova Scotia Agricultural Land Review Committee, 2010). The provincial budget for dyke maintenance is not adequate to prepare all dykes for projected sea level rise and storm surges. According to the NSDA, the province controls 241 km of dykes and 260 aboiteaux, protecting 17,400 hectares of dykeland (NSDAM, 2010). Relative sea level rise in Nova Scotia over the next century is projected to range from 70 to 140 cm; along with this sea level rise comes the added vulnerability to storm surges, which have been recorded as already topping some dykes by over 80 cm (van Proosdij and Page, 2012).

Other uses are increasingly common on dykelands as agriculture wanes. First, dykes provide high and solid ground along the water and are popular for walking, running and other activities like birdwatching, hunting and fishing (Asiedu, 2013). In fact, such recreational use of dykes contributes to their erosion. Dykes and dykelands are also emblematic of the cultural history of Acadians, for which the most active contiguous area of dykeland, Grand Pré, was named a UNESCO World Heritage Site in 2011, increasing local tourism (Grand Pré World Heritage Stewardship Board, 2011). Other dykes and dykelands contribute to a sense of identity, for those who have a farming background, and a sense of place for other residents who have grown attached to these landscapes. Dykelands are often biodiverse as ecotones that contain both grassland and marshland species (Nova Scotia Department of Natural Resources (NSDNR), 2009). Finally, however, a diversity of public and private assets and infrastructure have been approved for construction in dykeland areas, such as roads, malls, suburbs, and sewage treatment plants. The agricultural governance of dykes and dykelands is clearly a poor fit for the multifunctionality that they represent today.

A range of management options exists, whether undertaken by the Department of Agriculture or others to whom they divest

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