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Deterring coastal birds from roosting on oyster culture gear in eastern New Brunswick, Canada

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ABSTRACT

An ornithological survey was conducted along the eastern coastline of New Brunswick, Canada, where oysters are cultivated in suspension using PVC bags and wire-mesh cages. Thirteen bird species and a variety of unidentified shorebirds were observed roosting on the floating oyster gear. The double-crested cormorant (*Phalacrocorax auritus*) was the most common species observed (47.6% of all counts), closely followed by herring gulls (*Larus argentatus*) and common terns (*Sterna hirundo*) at 18.7% and 13.0%, respectively. Birds were densely aggregated where few cages or bags had been deployed. A gear-type effect was also detected: birds were more abundant on floating cages (mean = 47.9/100 m^2 of exposed area, S.E. = 5.8) than on floating bags (mean = 32.8/100 m^2, S.E. = 1.9). The survey was followed by two experiments designed to test the effects of gear modifications on bird abundance and diversity. For bags, results indicated that shallow immersion (~6 cm below surface) and floater instability were effective deterrents to *P. auritus*, reducing its abundance by a 37-fold factor. For wire-mesh cages, a dented triangular structure mounted on top of floaters was a harassing physical barrier to roosting behaviour, consequently reducing bird abundances to null (or near null) values.

1. Introduction

Communal roosting is a common behaviour in several species of social animals, including coastal birds (McGowan et al., 2006). This behaviour has evolved independently numerous times (Beauchamp, 1999; McGowan et al., 2006) and is thought to positively impact several species of seabirds (Roycroft et al., 2007) by enhancing the sharing of information (Ward and Zahavi, 1973; Ydenberg and Prins, 1984; Dall, 2002) and by promoting recruitment (Richner and Heeb, 1996; Dall, 2002). Roosting behaviour can also increase foraging efficiency, reduce predation risk and minimize thermoregulatory costs (Ydenberg and Prins, 1984; Beauchamp, 1999; McGowan et al., 2006). The behaviour has been studied extensively from an ecological perspective, providing a better understanding of roost choices (Luìs et al., 2001; Rogers, 2003; Rogers et al., 2006), species distribution (King, 1996; Bugoni and Vooren, 2005; Dittman et al., 2005) and hierarchical dominance in roosting populations.

From an aquaculture perspective, however, communal roosting is considered a nuisance. Birds predate on cultured fish stocks (Jenkins and Smith, 1998; Dorr et al., 2004; King, 2005), and their presence also raises other concerns, such as water contamination by faecal coliforms (Kirschner et al., 2004; Kuntz et al., 2004; Bucio et al., 2006), propagation of pathogenic agents (Flowers et al., 2004; Overstreet and Curran, 2004; Mitchell et al., 2005), and organic enrichment of sediments (Powell et al., 1991). Several bird-deterring techniques have been suggested in the literature (see review by Mott and Boyd, 1995). These methods include scaring effigies (Stickley et al., 1995; Seamans, 2004), repelling chemicals (Cotterill et al., 2004; McWilliam and Cheke, 2004; Harpaz and Clark, 2006), fencing and netting (Mott and Flynt, 1995; Nemtzov and Olsvig-Whittaker, 2003), harassment devices (Mott et al., 1998; Tobin et al., 2002), and the more-drastic solution of hunting (Bechard and Marquez-Reyes, 2003; McWilliam and Cheke, 2004).

In New Brunswick, Canada, oyster (*Crassostrea virginica*) farming is carried out in approximately 15 embayments (Fig. 1). Suspended culture, in which oysters are held inside floating PVC bags or floating cages (Fig. 2), is the predominant farming technique. In winter floaters are removed to lower stocks onto the bottom where they are protected from the thick ice. At other times, however, stocks are suspended at the surface in a relatively

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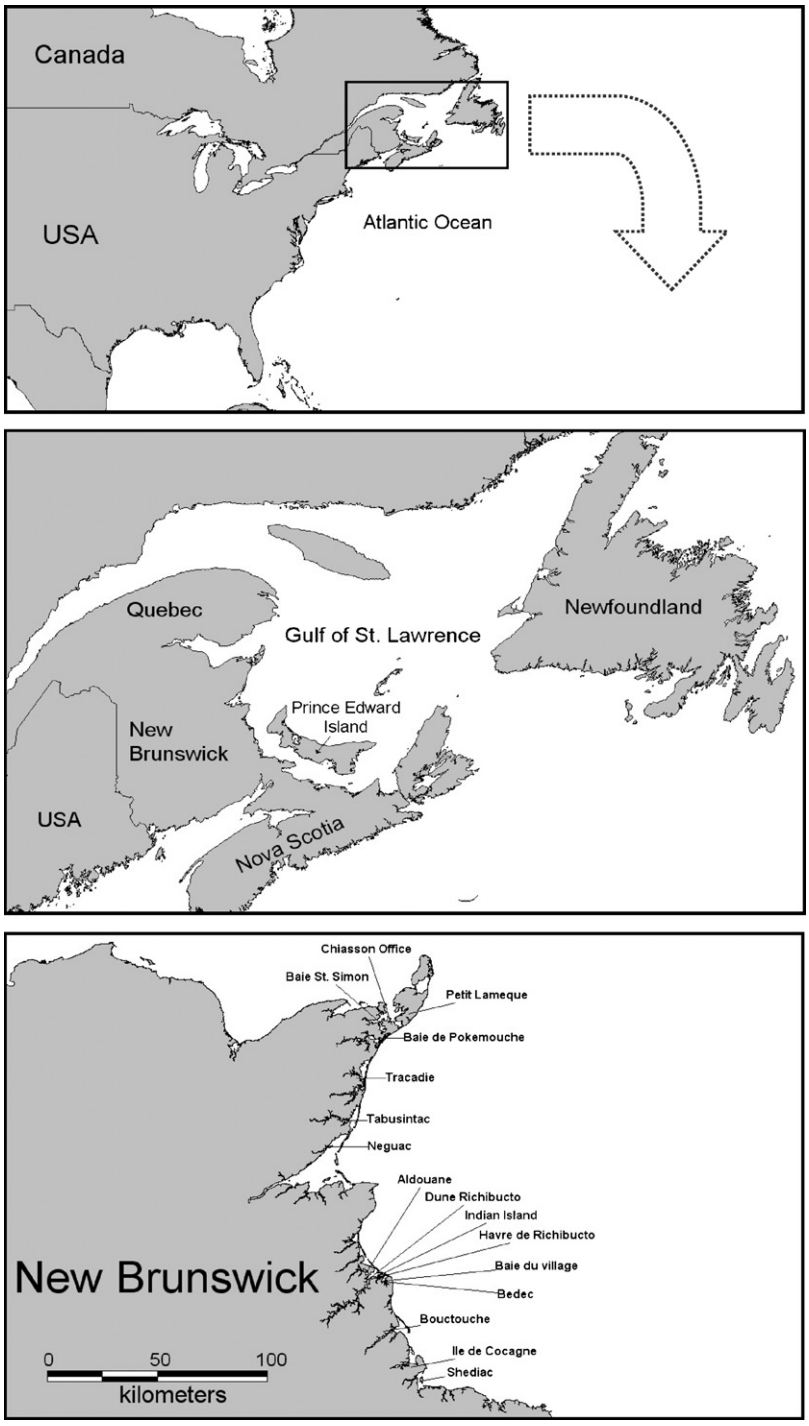

Fig. 1. Map of study area showing oyster farming sites in New Brunswick.

warm and phytoplankton-abundant environment, thereby enhancing shell growth and shortening the production cycle. When at the surface, stocks are easily accessible to growers for harvesting and grading procedures; moreover, the suspended bags or cages can be flipped and temporarily exposed to air, thereby desiccating biofoulers. The entire technique for suspending and flipping bags and cages has been developed in New Brunswick in the late 1990s.

Floating gear, on the other hand, provides substantial roosting areas for coastal birds. In 2004, Canadian food safety and fisheries agencies have requested that all oysters contained in floating bags or cages be depurated prior to harvest. The precautionary depuration procedure requires the transfer of suspended stocks onto the bottom 30 days prior to harvest (14 days if stocks are subsequently tested for coliforms as required by the Canadian Shellfish Sanitation Program, 2005). The new regulation increases both labour and time needed to complete the production cycle. Consequently, there is a growing interest in developing new floating gear designs that could prevent birds from roosting in oyster farms. The underlying rational is that effective bird-deterring designs would ultimately be exempted from the regulation pertaining to depuration.

In this paper, we begin by reporting results from an ornithological survey conducted in NB oyster farms. We identify bird species and report on their abundance in relation to current