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The impact of recreational boat traffic on Marbled Murrelets (*Brachyramphus marmoratus*)

Danielle Bellefleur [a,*], Philip Lee [b], Robert A. Ronconi [c]

[a] *Pacific Rim National Park Reserve of Canada, 2040 Pacific Rim Highway, Box 280, Ucluelet, British Columbia, Canada V0R 3A0*
[b] *Western and Northern Service Centre, Parks Canada Agency, 300-300 W. Georgia Street, Vancouver, British Columbia, Canada V6B 6B4*
[c] *Department of Biology, University of Victoria, P.O. Box 3020, Station CSC, Victoria, British Columbia, Canada V8W 3N5*

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Abstract

This study evaluated the impact of small boat traffic on reaction distances of Marbled Murrelets (*Brachyramphus marmoratus*), in the marine waters of Pacific Rim National Park Reserve, British Columbia, Canada. Observers on moving boats recorded the minimum distance the boat came to murrelets on the water, and any disturbance reaction (fly, dive, no reaction). Out of the 7500 interactions 11.7% flew, 30.8% dove and 58.1% exhibited no flushing reaction. Using a product-limit analysis, we developed curves for the proportion of Marbled Murrelets flushing (dive or flight) as a function of reaction distance. Overall, the majority of Marbled Murrelets waited until boats were within 40 m before reacting, with 25% of the population reacting at 29.2 m. A stepwise Cox regression indicated that age, boat speed, and boat density (loaded in that order), significantly affected flushing response. More juveniles flushed than adults (70.1 versus 51.7%), but at closer distances. Faster boats caused a greater proportion of birds to flush, and at further distances (25% of birds flushed at 40 m at speeds >29 kph versus 28 m at speeds <12 kph). A stepwise logistic regression on diving and flight responses indicated that birds tended to fly completely out of feeding areas at the approach of boats travelling >28.8 kph and later in the season (July and August). Other secondary variables included; boat density and time of day. Discussion focused on possible management actions such as the application of speed limits, set back distances, and exclusion of boat traffic to protect Marbled Murrelets.

Keywords: Species at Risk Act; SARA; Boat disturbance; Bird disturbance; Seabirds; Protected areas; Environmental management; Seabird ecology; Wildlife habituation; Human use impacts; Pacific Rim National Park Reserve; Set back distances; Buffer zone

1. Introduction

Human disturbance of wildlife is an inherent problem that most parks face. In part, the attraction of parks for the public is the opportunity to interact with nature. In marine protected areas, the presence of recreational boating opportunities can generate conflicts between humans and coastal birds and mammals. In an extensive literature review, Carney and Sydeman (1999) found significant impacts on physiology, reproductive behaviour, reproductive success, and population trends for waterbirds facing disturbance pressures. In general, human disturbance results in a temporary displacement of individuals with a range of potential impacts depending on the length and frequency of displacement and the type of activity interrupted. Individuals may cease activities such as feeding, care of offspring, resting, or mating and may temporarily leave the area. Frid and Dill (2002) argued that human disturbance was a form of predation risk, whereby animals reduce activity levels in order to avoid encounters with potential "predators". Aside from direct energetic and opportunity costs, an important implication for land managers is that persistent disturbance reduces the habitat available to wildlife. Otherwise suitable habitat can be transformed into marginal habitat in which there is a local reduction in animal populations (e.g. Tuite et al.,

* Corresponding author. Tel.: +1 250 726 7165; fax: +1 250 726 4691.
E-mail addresses: danielle.bellefleur@pc.gc.ca (D. Bellefleur), philip.lee@pc.gc.ca (P. Lee), rronconi@uvic.ca (R.A. Ronconi).

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1983), or in extreme cases, into unusable habitat (McGarigal et al., 1991).

A number of studies have examined the impact of nearshore boat traffic and human presence on diving birds (Burger, 1981; Kuletz, 1996; Cairns et al., 1998). The reaction to disturbance varies between species (Burger, 1981), time of day (Agness, 2006), and by season (Pierce et al., 1993; Knapton et al., 2000). The degree of disturbance is also affected by differences in boat behaviour, such as the type of boat, speed and approach (Kahlert, 1994; Ronconi and Cassady St. Clair, 2002). The costs of boat disturbance have been documented for a number of diving birds. Human or boat disturbance can compromise survivorship via increased predation (Ahlund and Gotmark, 1989; Mikola et al., 1994) and abandonment of nest sites (Cairns et al., 1998). Feeding rates and availability of preferred foraging sites can also be reduced due to boat traffic (Mikola et al., 1994; Ronconi and Cassady St. Clair, 2002; Kuletz et al., 2003).

Marbled Murrelets (*Brachyramphus marmoratus*) are listed as a threatened species under both the Canadian Species at Risk Act (2002) and the U.S. Endangered Species Act (2006), both of which mandate protection of individuals and of their critical habitats. The primary threats to Marbled Murrelets in the marine environment include oil spills and mortality due to accidental capture in gill-nets (Carter and Sealy, 1984; Kuletz, 1996; Burger, 2002). Research has also demonstrated that Marbled Murrelets are negatively affected by boating activity. At three different sites in Alaska, Kuletz (1996) found that the number of Marbled Murrelets was negatively correlated with the number of boats. Hamer and Thompson (1997) observed small-scale movements of murrelets away from boats during line-transect surveys. Speckman et al. (2004) found that boat traffic caused Marbled Murrelets holding fish in their bills (presumably to be delivered to chicks), to swallow the fish instead. However, we are not aware of any study that has quantified flushing reaction distances and behaviour of Marbled Murrelets in the face of small boat traffic.

The West Coast Trail unit (WCT) of Pacific Rim National Park Reserve of Canada includes one of the largest populations of Marbled Murrelets in the marine environment in Canada, representing 16% of Canada's entire population (Burger, 2002). During prime fishing season along the West Coast Trail, recreational boat traffic can be dense and continuous. The Canada National Parks Act (2000) allows permitted recreational fishing in park waters, however, ecological integrity is the stated first priority for national park management and Canada's new Species at Risk Act (SARA) provides additional protection for listed species and their critical habitats. As Marbled Murrelet populations have shown a general decrease in British Columbia over the past number of years (Burger, 2002), understanding the nature of human disturbance to the Pacific Rim National Park Reserve Marbled Murrelet population could assist in recovery planning as well as in national park management planning.

The purpose of this study was to determine the reaction of Marbled Murrelets to boat traffic. Specifically, we wanted to (1) determine the reaction distance of Marbled Murrelets to approaching boats under a variety of different circumstances, i.e. daily feeding period, boat speed, season, and age, and (2) use these data to suggest management options to reduce the impact of boats on Marbled Murrelets.

2. Methods

2.1. Study area

This study was conducted in the marine waters of Pacific Rim National Park Reserve, British Columbia, Canada. The park is located on the southwest coast of Vancouver Island (Fig. 1). The marine area of the park is bounded by the 20 m depth contour adjacent to the coast (ranging from 200 m to 1.4 km offshore). Data were collected in park waters adjacent to the West Coast Trail, one of the three separate units that make up the park. The West Coast Trail spans 65 km on the sea, and is part of Vancouver Island's Shelf Marine region.

Marine traffic on the West Coast Trail is largely composed of small recreational boats (typically single engines, 5–8 m in length), and a few commercial fishing and tourism vessels. Due to the recent proclamation of the Park (2000), there have been no restrictions on recreational boat traffic. Most of the boat traffic is concentrated close to the adjacent town of Port Renfrew, located at the southeast end of the trail.

2.2. Experimental design

The reaction distances of Marbled Murrelets to boats were measured at sea while following fixed width, line transects. We observed bird reactions from our own boats rather than observing interactions with local boat traffic. In doing this, we were able to standardize approaches, ensure consistency and accuracy of observations, increase sample size, and investigate boat disturbance in areas of the park with little or no boat traffic. Boats travelled along predetermined routes in order to emulate casual boat travel, rather than chasing or directing the boat towards birds to induce a response. Prior to data collection, observers were trained to accurately estimate distances across the sea surface. This was done by estimating the distance to training buoys, similar in size and overall shape to Marbled Murrelets, placed over a range of set distances from the boat. Once an observer could estimate a distance to within 10 m, they were deemed qualified to estimate distances.

In data collection sessions, observers visually estimated and recorded the minimum distance to each bird in front and on either side of the boat to a maximum of 100 m. Observers also recorded any response, classified as: flight, dive, or no response. A bird was considered to have flushed if they flew or dove. If a bird took flight, the approximate distance the bird flew was recorded where possible. A bird was considered to have "no reaction" if they did not fly or dive. It is important to note that most "no reaction" responses observed from the boat included a range of vigilant behaviour including turning to face the boat to actively swimming away from approaching boats. Alert or swimming responses were not distinguished