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Use of time-activity budgets to measure early progress of a social attraction restoration project

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ABSTRACT

Social attraction is a useful technique for re-establishing or relocating waterbird colonies and other species groups. However, little information exists regarding how newly attending individuals behave when the social environment is influenced predominantly by artificial stimuli. To help assess early progress of colony re-establishment, we compared time-activity budgets of common murres (*Uria aalge*) at a social attraction site (Devil's Slide Rock; DSR) in central California with two nearby reference colonies during the first 3 years (1996–1998) of efforts. Murres at all colonies spent over 95% of their time engaged in resting, comfort, courtship, and alert activities during the pre-breeding period and over 88% of their time in similar activities during the breeding period. Although patterns were similar overall, comparisons of pooled and year-specific time budget data revealed significant differences between all three colonies, especially during pre-breeding. Murres at DSR typically engaged in comfort behaviors less frequently and in alert and courtship behaviors more frequently than reference colonies. Differences likely were due to recent re-establishment, including lower bird densities and higher proportions of non-breeders and first-time breeders at DSR, along with other factors such as disturbance. Results indicate that newly attracted birds at DSR behaved "normally" even though the social environment was influenced predominantly by artificial stimuli. Furthermore, re-established breeding in the first year of efforts, subsequent colony growth, and high productivity reflected successful restoration efforts. Thus, time-activity budgets can provide important measures of early progress of social attraction efforts and as such can be used to inform adaptive management decisions.

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1. Introduction

Conservation and restoration of animal populations has traditionally focused on identifying and managing for environmental threats such as habitat destruction, reduced reproduction, or heightened mortality. However, conservationists have begun to recognize that understanding an animal's behavior may be just as important for conservation and restoration efforts as understanding and managing its external environment (Caro, 1999; Sutherland, 1998) and have begun developing conservation techniques that take behavior into account. "Social attraction" is one such technique. Originally developed from work on conspecific attraction in colonial breeding birds (Lack, 1966), social attraction uses social stimuli, typically consisting of decoys, playbacks of recorded vocalizations, and/or mirrors to mimic the visual and auditory cues of conspecifics to influence the recruitment of potential breeders (Kress, 1983) and induce breeding behaviors (O'Connell-Rodwell et al., 2004; Pickering and Duverge, 1992). Multiple studies have demonstrated that social attraction influences both colonial (Jeffries and Brunton, 2001; Kress, 1983; Podolsky and Kress, 1992; Roby et al., 2002) and non-colonial birds (Ahlering et al., 2006; Hahn and Silverman, 2007; Harrison et al., 2009; Ward and Schlossberg, 2004). The description of conspecific attraction in mammals (Hoeck, 1989; Weddell, 1991) and reptiles (Stamps, 1991) suggests this technique may have wider conservation applications.

Abbreviations: CR, Castle Rocks and Mainland; DSR, Devil's Slide Rock; PR, Point Reyes; USFWS, United States Fish and Wildlife Service.

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Social attraction has been used successfully to re-establish or relocate colonies of various colonial breeding birds (Kotliar and Burger, 1984; Kress, 1997, 1998; Parker et al., 2007; Roby et al., 2002), yet little information has been obtained regarding the behavior of newly attending individuals in response to social attraction equipment or other factors associated with newly (re-) established colonies. It often takes several years after birds are first attracted to a desired location before breeding actually occurs (see Kotliar and Burger, 1984; Kress, 1983; Kress and Nettleship, 1988), especially for species that are long-lived or take time to reach a critical number or density. When conducting social attraction or other restoration techniques, progress or success is often evaluated by how many breeding individuals recruit to the site. However, in cases where initiation of breeding is delayed or limited, conservationists and managers are faced with the challenge of assessing the progress of restoration efforts in the absence of any actual breeding and other methods of evaluation are necessary to assist adaptive management decisions. In addition to examining numerical and temporal patterns of attendance, another way to determine early progress of colony re-establishment is to evaluate whether newly attending individuals engage in normal behaviors that: (a) should eventually result in the establishment of breeding (e.g. mating displays, courtship activities, etc.); or (b) if initial breeding occurs rapidly, normal behaviors suggest that continued successful breeding and colony growth can be expected. If newly attending individuals immediately breed or show behavior patterns indicative of future breeding, continuation of similar social attraction applications can be expected to have a greater likelihood of future success, partly justifying continued cost and effort. However, if primarily non-breeding or abnormal behaviors are observed, future breeding may be less likely and project modification should be considered.

On the central California coast, a breeding colony of nearly 3000 common murres (*Uria aalge*; hereafter, "murres") at Devil's Slide Rock (DSR) was extirpated (i.e. no further breeding) in 1986 because of high mortality in a local gill-net fishery, high mortality from the January 1986 *Apex Houston* oil spill, and other factors (Carter et al., 2001, 2003; Takekawa et al., 1990). Between 1986 and 1994, small numbers of murres attended DSR sporadically but breeding was unlikely (Carter et al., 2001, 2003; Parker et al., 2007). Because murres breed colonially and have high colony philopatry, mate and breeding site fidelity (Gaston and Jones, 1998; Halley et al., 1995; Harris et al., 1996), they typically return to breed at their natal colonies or occasionally join existing colonies. As a result, they rarely re-establish extirpated or abandoned colonies and often take decades or more to do so (Carter, 2004; Carter et al., 2001; Manuwal and Carter, 2001). Social attraction can speed colony re-establishment and subsequent growth by encouraging birds to attend abandoned habitats more rapidly, in larger numbers, and induce breeding behaviors. Starting in 1996 with *Apex Houston* oil spill settlement funds, social attraction was employed to re-establish the colony at DSR (Parker et al., 2007).

We compared time-activity budgets of murres at DSR with two nearby established reference colonies. The initial intent of gathering time-activity budget data was to provide information on the progress of restoration prior to re-establishment of breeding, which was expected to take several years. However, since breeding was re-established in the first year that social attraction equipment was deployed (Fig. 1; Parker et al., 2007), time-activity budgets were examined only during the first 3 years of social attraction efforts and colony re-establishment (1996–1998). Murre behavior on DSR was influenced by small numbers of actively breeding birds in all 3 years of the study, but the majority of attending birds were not actively breeding and social attraction equipment well outnumbered attending birds. Thus, social attraction equipment provided the bulk of social stimuli. We expected that if social attraction successfully mimicked the social stimuli of an established colony, then murres attracted to DSR would display normal behavioral patterns and time-activity budgets would not be significantly different from reference colonies.

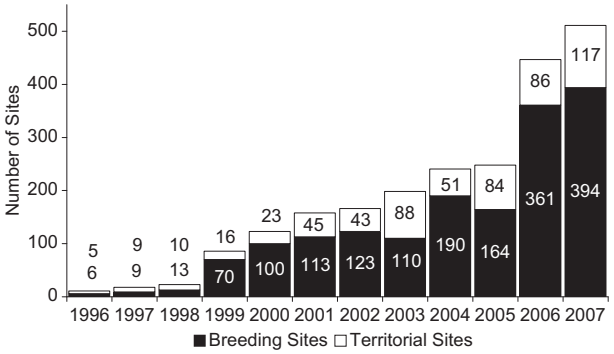

Fig. 1. Number of Common Murre breeding and territorial sites at Devil's Slide Rock, 1996–2007. Numbers within or above bars indicate sample sizes.

2. Materials and methods

2.1. Study colonies

We conducted observations of murre time-activity budgets at three colonies along the central California coast from 1996 to 1998, including the DSR restoration site and two reference colonies for comparison. Social attraction was employed to re-establish breeding at DSR (37°34′N, 122°31′W), a small sea stack (22 m high) located approximately 300 m from the mainland shore. The top of DSR consists of about 200 m^2 of relatively flat vegetation-free substrate and supported 12–26 breeding murres (6–13 pairs) in 1996–1998 (Fig. 1; Parker et al., 2007).

Point Reyes (hereafter, "PR"; 37°59′N, 123°59′W), within Point Reyes National Seashore, is the largest (ca. 27,000 breeding birds) colony in the study and is 63 km northwest of DSR. PR is comprised of multiple subcolonies scattered along much of the Point Reyes Headlands (Carter et al., 1992). We conducted observations at several subcolonies but report results only from the largest subcolony, Lighthouse Rock, where studies on reproductive performance also were conducted. Lighthouse Rock is fairly large and devoid of vegetation, approximately 20 m high and 10 m from the mainland and supported about 18,000 breeding birds in 1996–1998 (USFWS, unpublished data).

Castle Rocks and Mainland (hereafter, "CR"; 36°22′N, 121°54′W) is located 144 km southeast of DSR and is comprised of numerous subcolonies on mostly un-vegetated sea stacks and cliffs. We conducted observations at several subcolonies but report results only from subcolony CR4, where studies on reproductive performance also were conducted. CR4 is a sea stack about 20 m high and 300 m from the mainland and supported approximately 1000 breeding murres in 1996–1998 (USFWS, unpublished data). Both DSR and CR are now part of the California Coastal National Monument, managed by the US Bureau of Land Management.

2.2. Social attraction design

On 12–13 January 1996, 384 life-sized adult murre decoys were deployed on DSR along with twelve 3-sided mirror boxes and two independent audio systems (compact disc player, amplifier, and speakers). To further simulate active breeding, 48 egg and 36 chick decoys were added on 14 April 1996 (see Parker et al., 2007 for more details). Except for the photovoltaic panels and speakers, social attraction equipment was removed each year after all breeding