Point Reyes National Seashore
Summer 2010 Raven Disturbance Monitoring
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Summary:

Weekly observations of common raven (*Corvus corax*) predation and disturbance events were conducted at two common murre (*Uria aalge*) colonies within Point Reyes National Seashore (PRNS). The observations were conducted at six established viewing points and surveyed predefined sub-colonies once a week from April through August, 2010. Eight disturbance events were observed in 165 hours of surveying, with the largest percentage occurring in the early morning and mid-day. Though total number of disturbances was lower than expected, the results are still indicative of the negative impacts that corvid populations can have on common murres.

Methods:

The two monitored common murre colonies at PRNS (Point Reyes Headlands and Miller's Rocks) were divided into 8 sub-colonies (Table 1, Figures 1, 2) through consultation with USFWS Biologist G. McChesney. Observations took place for 2 to 4 hours between 0600 and1800 hours, from early April until there were no longer common murres roosting on the sub-colony (late August).Each monitored site had a minimum of 2 hours of observation conducted weekly and on a rotating schedule so that all hours of the day were covered in a six week period.

Table 1: List of observation points and the respective sub-colonies that are observed from each

Observation Point	Sub-colonies Observed
Arch Rock	Sea Stack
Millers Point Obs. Point	Millers Point South Rock
Point Resistance Obs. Point	Point Resistance Rock
PRH Lighthouse Building	Lighthouse Rock (LHR)
East Seal Cove Obs. Point	Middle Rock, East Rock, Flattop Rock
Boulder Rock Obs. Point	Boulder Rock (BOR)

For each day that a sub-colony was monitored, the following was recorded: The start and end time of monitoring, location, visibility, and approximate number of murres on the rock. Sites were categorized as either an edge site (defined as a site located within 5m of the edge of the occupied area) or an interior site (defined as a site located more than 5m from the edge of occupied area). Additionally, the number of vertical rock faces (0-3) within one bird's width of disturbance location and any ravens roosting or nesting in the area were recorded (see Raven Disturbance Datasheet).

In general, disturbances were observed when the visibility was clear, because dense fog along the coast often made it difficult to see the sub-colonies. But when conditions allowed, monitors (working alone) would continuously scan the rocks using a combination of binoculars and a spotting scope until they observed a predation event or disturbance. Once an event was observed, monitors recorded the following information on the aforementioned datasheet: the start and end time of the event, number of ravens involved, the technique used by the raven (Table 2), characteristics of sites attacked, number of neighboring sites within one murre width of site attacked, outcome of the event (number of birds flushed, and number of chicks or eggs taken), and other anecdotal observations (e.g. permanent marking on ravens, raven nest locations).

Ravens typically lay clutches in March or early April, consisting of 1 to 5 eggs (Boarman and Heinrich 1999). Their chicks can be expected to fledge around 5 weeks, so early detection of nest locations is beneficial to controlling raven population numbers. Adult ravens that appear aggressive towards intruders on their territory can be good indicators of nesting locations and pair boundaries, especially during the breeding season (Webb et al. 2003). When a raven nest was observed near the study area, the location was recorded using a Global Positioning System (GPS) and plotted on a map of the study site so that the nesting pair could be easily located in the future.

Table 2: Techniques used by ravens to take murre eggs or chicks.

Technique	Explanation
Lunge	Lunging at murre with beak to force murre from its site
Pull	Pulling the murre off site by a wing, foot or beak
Snatch	Snatching an unattended or poorly guarded egg or chick without driving the parent off the site
Easy Picking	Taking unattended eggs or chicks following a flushing event
Air Attack	Taking an adult murre from the air
Incidental Loss	Egg rolled away from sited during flushing and broke

Results:

Common ravens were observed flying by all monitored sub-colonies, and 3 of the 8 sub-colonies (37.5%) had recorded disturbance events (Table 4). The total number of observed disturbance events for the 2010 monitoring season was 8. Four of these occurred on Point Resistance, 3 on Boulder Rock (1 being a chick), and 1 on Flattop Rock (Table 4). Of all 8 events, seven occurred when visibility was clear and all events took place at an edge site. In all situations, one to two ravens were involved, and no large groups were observed flying by sub-colonies. Most events occurred in less than ten minutes and all events happened during the months of May, June, and July; which would coincide with the peak breeding period for the murres and ravens. One raven nest was located just south of Point Resistance and GPS points were recorded (Figure3).

Graph 1 shows that the highest rate of disturbance per 2 hour survey was in the early morning (0600-0800) and at midday (1200-1400) However, of the eight total disturbances, 62.5% (0.625) occurred between 1200 and 1400. See Table 3.

Data in Table 5 and Graph 2 show that the overall predation rate on the sub-colonies for common murre eggs was 0.04 per survey hour and 0.01 chicks were depredated per survey hour for the 2010 season. Point Resistance Rock received the most combined egg and chick predations per survey hour (0.15), followed by Boulder Rock (0.11) and Flattop Rock (0.03). Boulder Rock was the only sub-colony to have a chick taken by ravens; all other disturbance events involved the taking of eggs.

Discussion

The increase in raven population numbers at Point Reyes National Seashore over the past 2 decades is assumed to cause more disturbances on common murre colonies and other avian species throughout PRNS. This observed rise in raven numbers highlights the need for an established management plan for the coming years (Engle and Young 1989, Stiehl and Trautwein 1991, Marzluff et al. 1994). Although only 8 disturbance events were recorded during 165 hours of monitoring, it is likely that more events

occurred outside of the monitoring window. On average, approximately 1 egg was lost every 2.5 days throughout the eight sub-colonies (total egg loss rate for all sites being 0.04 per survey hour). These and other types of non-anthropogenic disturbances may have kept murres from breeding in certain areas (Roth et al. 1999). The variance among disturbance rates at different rocks appeared to be related to the number of murres present on that rock (In decreasing order, the following sites contained the most murres: Lighthouse Rock, Point Resistance Rock, Boulder Rock, Flattop Rock, Middle Rock, East Rock, Miller's Point South Rock, and finally Sea Stack), but also could be related to the presence of a territorial raven pair, as seen at Point Resistance. Point Resistance was one site where a territorial pair was observed taking eggs and the raven pair's nest was located 0.09 kilometers south of the sub-colony. Distance of murre colonies from the coast or ranches did not appear to influence likelihood of depredation (Table 6).

High raven numbers have been documented in the Western U.S. and have been attributed to the species' ability to adapt and exploit a variety of food resources and thrive in human-structured environments (Engle and Young 1989, Stiehl and Trautwein 1991, Marzluff et al. 1994). Breeding ravens construct nests throughout the landscape, and may feed their young at least partially with forage obtained at anthropogenic resources (Kristan 2001). Findings by Webb et al. (2004) on a study of raven nest distance from anthropogenic resources in the western Mojave Desert suggest that ravens are reluctant to contract their territories simply in order to nest near anthropogenic resources, even though the natural resources within their territories may be scarce. Juvenile non breeding ravens are reported to have survived better if nests had been closer to anthropogenic resources and were routinely observed foraging at these locations during the study by Webb et al. (2004). At Point Reyes National Seashore, dairy farms and cattle ranches provide a year round anthropogenic food source. Ravens have been observed feeding at livestock feed bins, water troughs, and calving pens, where they can obtain nutrients more easily from scavenging instead of hunting. Consistent access to these food and water sources may permit larger raven clutch sizes or recruitment with the result being higher number of non-breeding ravens moving around in flocks. Roth et al. (1999) describe the differences between breeding versus non-breeding home ranges, suggesting that breeding birds have smaller home ranges with more localized movement patterns.

Preliminary observations at the monitored sub-colonies in which disturbance events were recorded have revealed that most disturbances were caused by lone birds or a breeding pair, not large flocks, supporting the hypothesis presented in previous publications that territorial individuals have learned to capitalize on the murre colonies (Roth et al. 1999). It would be difficult to investigate this hypothesis further at Point Reyes without placement of permanent identifying markers (i.e. leg bands, radio-tagged) on individual ravens.

Recommendations

Conclusively determining the effects that raven predation has on egg and chick loss will remain a challenge without collection of data on the total number of eggs laid at the colonies and the total number of eggs and chicks lost to predation, abandonment, non-viable eggs, etc. (Roth et al. 1999). Collaboration with common murre researchers from USFWS could help in providing an estimate of the total number of eggs and chicks in one season on each monitored location. However, it will remain difficult to obtain precise numbers due to the logistic infeasibility of monitoring the entire colony from land-based vantage points.

A study from 1999, conducted by PRBO, Audubon Canyon Ranch, USFWS, and PRNS on the ecosystem-level management of common ravens, recommended alteration of land-use practices (i.e. ranching) and the possible use of controlled taste aversion (CTA) to help control the raven population and reduce depredation, respectively. Immediate changes by dairy ranches could include covering food troughs, setting up exclusion fencing to keep cows away from sensitive areas, and immediate removal of raven food sources such as afterbirths and calf carcasses. CTA could be effective if administered to

territorial ravens near murre colonies, but accessibility and disturbance issues make the task of placing treated eggs in murre colonies at Point Reyes difficult (Roth et al. 1999).

Lethal control of territorial or paired ravens in the vicinity of these and other sub-colonies is another management option, but may also allow larger numbers of non-territorial ravens to depredate the previously defended colonies (Nicolaus 1987). Successful long term removal efforts would be required for lethal control to remain effective. Additionally, lethal raven control at Point Reyes presents logistic and public relations challenges because of the close proximity of monitored locations to high-use visitor areas, such as the lighthouse and Arch Rock.

In order to further determine the effects that ravens are having on common murre populations in the Seashore, an ongoing raven monitoring and management program is warranted. Part of this program should involve monitoring the effects of implementing the National Park Service's Best Management Practices on ranches (i.e. covered food bins, exclusion fencing, and debris removal) adjacent to the headlands (A, B, and C Ranches). The impacts of lethal removal should also be monitored under this program in order to determine the most effective methods of decreasing raven predation pressure on common murre colonies.

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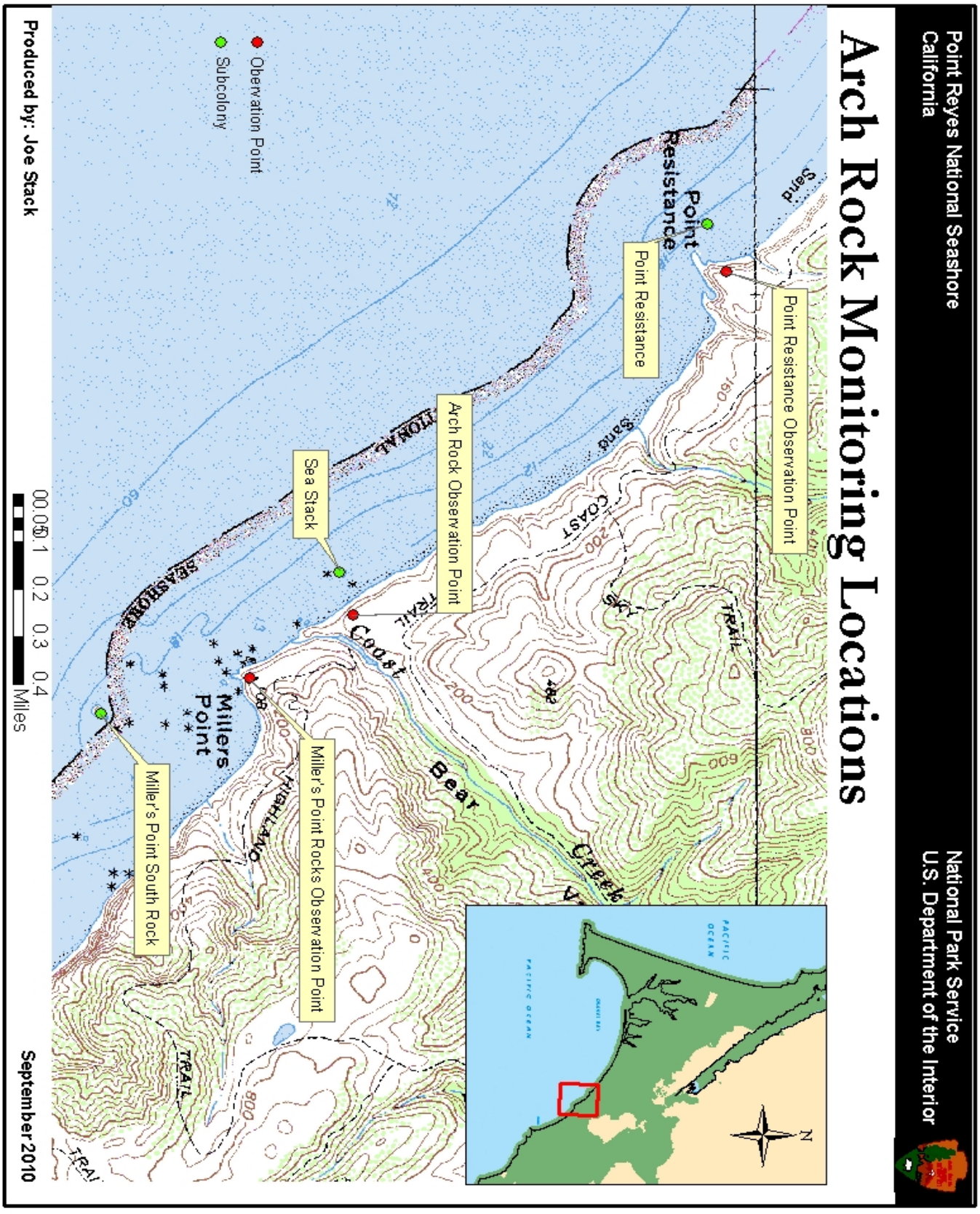


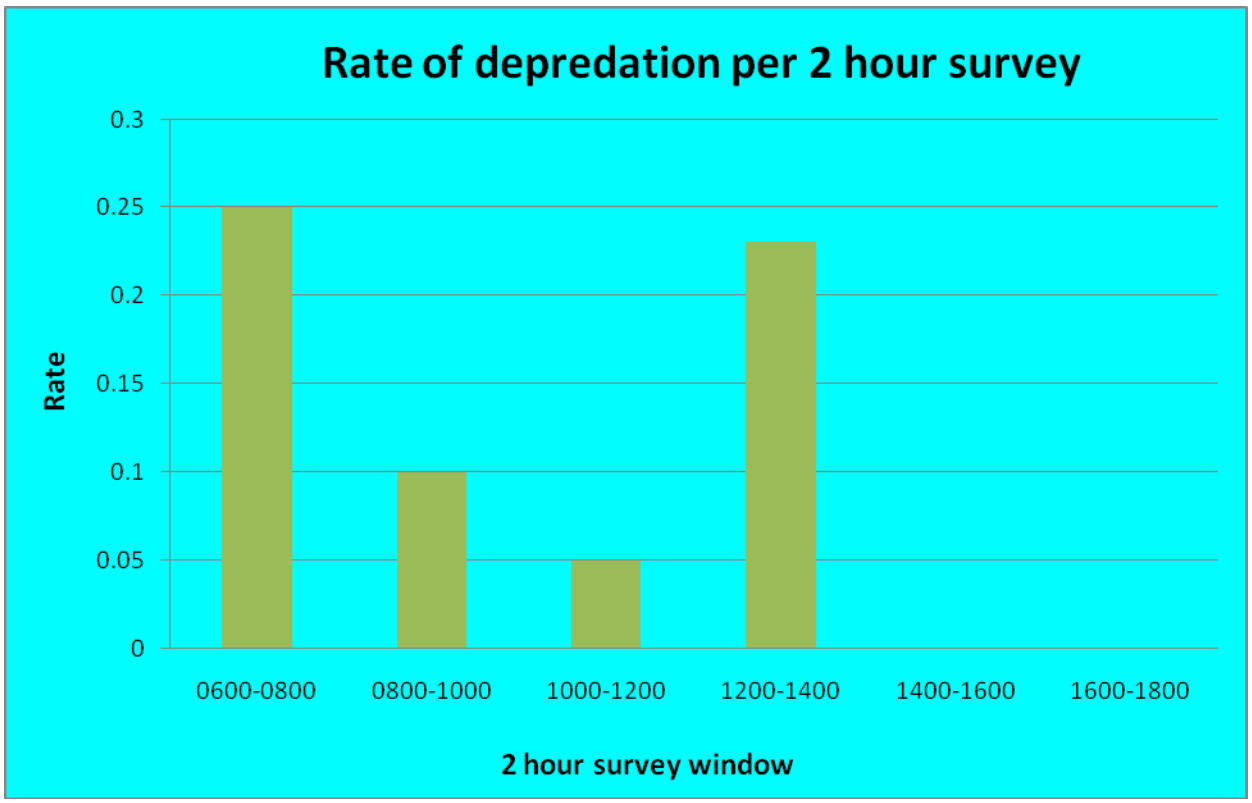
Figure1. **Map of sub-colonies and observation sites near Arch Rock.**

Figure 2. **General location of monitored sub-colonies along the Point Reyes Headlands.**

Figure 3. **General location of raven nest found close to Point Resistance Rock.**

Table 3. **Depredation disturbances during 2 hour survey windows**

Survey Time	# Disturbance Events	#of Surveys Conducted	Disturbance rate per 2 hour survey
0600-0800	1	4	0.25
0800-1000	1	10	0.1
1000-1200	1	20	0.05
1200-1400	5	21	0.23
1400-1600	0	16	0
1600-1800	0	5	0
Total:	8	77	0.1



Graph 1: **Rate of surveys during 2 hour survey windows that had a recorded disturbance event in 2010**

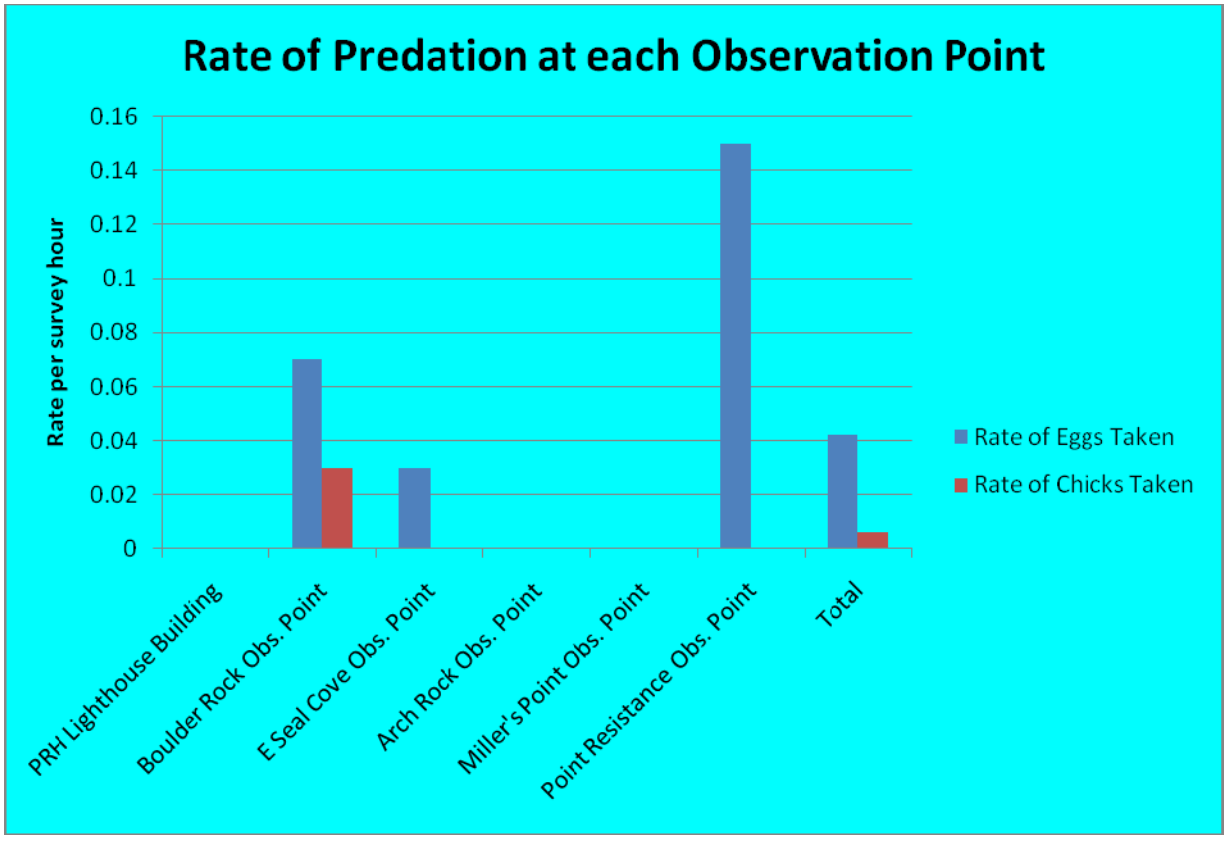
Table 4. **Comparison of numbers of disturbance events on sub-colonies in 2010.**

Survey Area	# Disturbance Events	# of Surveys	% surveys with disturbance
All Monitored Areas	8	77	0.1
PRH Monitored Locations			
Lighthouse Rock	0	14	0
Boulder Rock	3[2]	13	0.23
Flattop Rock[1]	1	13	0.08
Middle Rock[1]	0	13	0
East Rock[1]	0	13	0
Arch Rock Monitored Locations			
Sea Stack	0	11	0
Miller's Point South Rock	0	11	0
Point Resistance Rock	4	12	0.33

1. Flattop Rock, Middle Rock, and East Rock are all surveyed from the same observation spot during the same monitoring time.
2. One of these disturbance events was a chick taken.

Table 5. **Rates of predation (events per survey hour) obtained from 2-hour survey periods on Common murre colonies in 2010**.

Observation Site	Predation Rate	
	Eggs	Chicks
PRH Lighthouse Building	**0**	**0**
Boulder Rock Observation Point	**0.07**	**0.03**
East Seal Cove Observation Point	**0.03**	**0**
Flattop Rock	0.03	0
Middle Rock	0	0
East Rock	0	0
Arch Rock Observation Point	**0**	**0**
Miller's Point Observation Point	**0**	**0**
Point Resistance Observation Point	**0.15**	**0**
All observation sites	**0.04**	**0.01**



Graph 2: **Rates of predation for each observation point obtained from weekly 2 hour survey periods during 2010**.

Table 6. **Comparison of number events per sub-colony to its location and size.**

Survey Area	# of Events	Distance from Coast	Distance from Nearest Ranch	Area of Colony (sq. meters)
PRH Monitored Locations				
Lighthouse Rock	0	0.030	2.562	1684.387
Boulder Rock	3	0.020	1.960	381.781
Flattop Rock	1	0.049	0.769	176.205
Middle Rock	0	0.076	0.803	237.128
East Rock	0	0.069	0.794	465.452
Arch Rock Monitored Locations				
Sea Stack	0	0.140	5.022	306.211
Miller's Point South Rock	0	0.458	5.073	1014.039
Point Resistance Rock	4	0.163	5.771	585.726

Distance is recorded in kilometers from center of rock to the edge of coast or center of ranch buildings