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Eradication of *Rattus norvegicus* from Seabird Habitat in Canada

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Synthliboramphus antiquus chicks (courtesy of CWS, Delta, BC.)

http://www.ecoinfo.org/env_ind/region/seabird/seabird.htm

Introduction

Introduced *Rattus norvegicus* (Norway rat) has rapidly diminished ground-nesting seabird populations, such as *Synthliboramphus antiquus* (ancient murrelets). Historically, the Langara Island seabird population of ancient murrelets was one of the largest and most successful colonies in the world, with an estimated 200,000 nesting pairs. Langara Island is situated at the northwestern most tip of Graham Island, the largest of the Kiisgwaii Archipelago, or Queen Charlotte islands (Haida Gwaii), British Columbia. The murrelet colony size declined from 101 hectares in 1981 to 48 hectares in 1988. 1988 population records estimate that there were 24,200 ± 4,000 murrelet breeding pairs remaining. The murrelet population started declining after the arrival of *R. norvegicus*. *R. norvegicus* did not come from Norway as its name suggests. Rather, it originated in northern China, and has now spread all over the world. *R. norvegicus* colonized Graham and Moresby (largest islands in the archipelago) after escaping from ships from early European explorers and fur traders (Bertram and Nagorsen 1995). *R. norvegicus* was first reported on the Queen Charlotte Islands in 1981. In addition to severe losses of murrelets, several other species have also been extirpated: *Fratercula cirrhata* (Tufted Puffin), *Oceanodroma furcata* (Storm Petrels), *Cerorhinca monocerata* (Rhinoceros Auklet), and *Ptychoramphus aleutica* (Cassins's Auklet).

Description of Langara Island

Langara Island includes 3,105 hectares of land and is dominated by *Picea sitchensis* (sitka spruce) forest cover. Proceeding inland from the sea, the forest composition shifts to *Tsuga heterophylla* (western hemlock), and then to predominately *Thuja plicata* (western red cedar) with a moss covered understory. Areas of open *Sphagnum* bog are found in the island's interior, with dense patches of *Calamagrostis* and *Elymus* grasses. The topography is undulating (160 meter maximum elevation). Rocky, steep cliffs, that are cut by ravines are found on the west and north coasts. The east and southwest coasts slope gently, with sand and cobble beaches (Taylor et al. 2000).

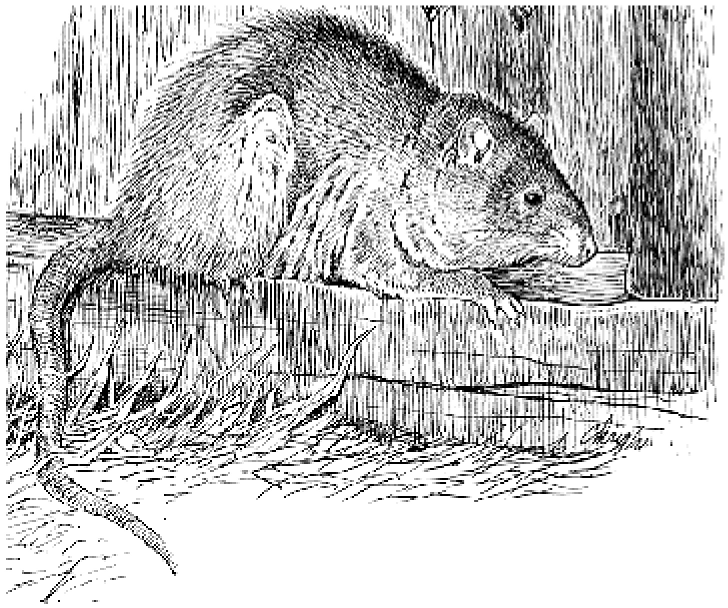
Human presence on Langara Island is minimal. The Canadian Coast Guard maintains a lightstation, and a fishing lodge operates from May to October. Commercial anchorage occurs in Henslung Cove. Currently, Langara Island has no legal protective status against development or tourism (Taylor et al. 2000).

Invasive Biology of *Rattus norvegicus*

R. norvegicus are extremely adaptive to most environments. As omnivores, this species exploits the highest quality and most available food items of each area and habitat. They eat whatever food is available to them including meat, fresh grain, seeds, fungi, fruits, plant shoots, terrestrial invertebrates, marine invertebrates, fish, and birds (Drever and Harestad 1998). On Langara Island, murrelets were found in 53% of stomachs from a total of 19 trapped *R. norvegicus*. In addition to the feeding habits of *R. norvegicus*, this mobile species have expansive movements and home ranges. At a similar infestation site on Motuhoropapa Island, New Zealand, *R. norvegicus* movement was recorded at 330 meters in 48 hours (Moors 1985).

R. norvegicus are prolific mammals, which aids in its invasiveness into new habitats. Maturity is reached at three months of age. Litters consist of six to 12 young, which are born 21 to 23 days after mating. Spring and fall is the most active breeding time with females producing six to eight litters per year. Lifespan ranges from 1.5-3 years of age.

The examination of the *R. norvegicus* species size and weight has led to the deeper understanding of how they have become an invasive species. *R. norvegicus* is a larger species than its *R. rattus* counterparts, which explains how the *R. norvegicus* has been more successful on Langara Island than the *R. rattus*. *R. norvegicus* seems to have replaced *R. rattus* on the island. Research shows that rat predation on *S. antiquus* increased with the overpowering, larger species of *R. norvegicus*. Seabirds are most threatened if invaded by a rat species with a body weight equal or greater than that of the seabird species. Size comparison shows that adult rats trapped on Langara Island were approximately 1.5 times heavier than the *S. antiquus* (Bertram and Nagorsen 1995). The weight of the predator species is greater than the prey species, which shows the competitive success of the *R. norvegicus*.



Rattus norvegicus

http://www.nature.ca/notebooks/english/brnrat.htm

Control Techniques

While there are several control measures for *Rattus norvegicus*, all but one technique is ineffective for successful island eradication. Ineffective control measures include rat-proof construction, traps, and predator control. Rat-proof construction changes the structure of buildings to prevent entry. This method does not apply to Langara Island since the problem of low seabird populations is outdoors rather than indoors. Trapping is another indoor control technique when dealing with low numbers of *R. norvegicus*. Studies have shown that although predators, such as dogs or cats, can keep an area rat free, they cannot remove an existing infestation. Birds of prey and snakes are other predators, but they could not totally eradicate the species from the island. Thus, the predation control technique is inapplicable on Langara Island. (Koehler and Kern 1991).

The only successful control measure for situations like Langara Island is the use of an anticoagulant poison called brodifacoum. This method was initially developed on the Noises and Motukawao Islands of New Zealand (Moors 1985). Brodifacoum trade names include Havoc, Klerat, PP 581, Ratak, Ratak Plus, Talon, Volid, and WBA 8119. This poison, set up in bait stations, is a green tablet that can be ingested or absorbed through the skin (Sax and Lewis 1989). For the *R. norvegicus*, this poison blocks the vitamin K oxidization-reduction cycle in the liver, and prevents the production of blood clotting proteins (Hallenbeck and Cunningham 1986). *R. norvegicus* death results from massive internal hemorrhaging. Acute toxicity exposure (to *R. norvegicus)* effects include anemia, abdominal pain, back pain, capillary wall destruction, dermal problems, hematologic disorders, hemorrhage of mucous membranes, prothrombic depression, renal colic, weakness and paralysis due to cerebral hemorrhage (Hallenbeck and

Cunningham 1986). Symptoms become apparent within a few days or weeks following exposure. Usually, repeated exposure is required for damage to occur. Several small exposures can be more damaging than one large exposure (Hallenbeck and Cunningham 1986).

Control Approach for Langara Island

Environmental review and public consultation was mandated by 'The Canadian Environmental Assessment Act of 1995' before brodifacoum treatments could begin on Langara Island. The Langara Island project assessment looked at secondary and nontarget poisoning, poison persistence, leaching into water systems, prevention techniques for accidental spillage, and environmental mechanical damage.

Bait stations were designed and implemented carefully. The poison was prepared as a 20-gram wax briquette improgthe nated with brodifacoum at 50 ppm [TALON 50 WB (New Zealand) RATAK + Weatherblock (Canada)], and placed into bait stations. Specifically, it was designed for *R. norvegicus* extermination from seabird colonies. The poison's toxicity with nontarget species was unknown before it was used on Langara Island. Therefore, the researchers assumed it was toxic and used appropriate bait station locations to minimize the potential poisoning of nontarget species. Assuming that neophobic reactions take place, unbaited stations were set out six weeks prior to poisoning. Based on the bait station design by Taylor and Thomas (1989), the devices were made from 0.5 m lengths of 100 mm diameter plastic drainage pipes which were secured to the ground by wire hoops. Open sides enabled the *R. norvegicus* to enter and remove baits at their own will. The baits were checked and refilled by an upper opening.

Bait operators and researchers implemented a monitoring system. In order to minimize environmental impacts, a walking trail was constructed around Langara Island during August – November 1994. This "ring trail" enabled easy long-distance travel for the project to continue. This trail was situated 200-300 meters from the shore, above seabird-nesting areas. Next, Langara Island was divided up into five working units, each with a camp, supervisor, and staff members. All bait stations were checked every 48 hours. Bait operators laid baits, recorded the amount of bait taken, and noted other activity at the bait stations. Finally, increased density of rats within 300 meters of shore prompted the decision to use 12 bait stations per hectare every other day. The remainder of the island was baited with six baits per hectare. The project's progression was monitored with the electronic database geographic information system using MapInfo.

The initiative was considered to be successful, as no *R. norvegicus* activity was detected at bait stations following the final treatment. *R. norvegicus* activity was assessed by the presence of foot prints, feces, and predation leftovers of murrelets. Seven stations near the fishing lodges, checked in September 1995, showed evidence of rats. Thus, 17 baits were applied, and no further rat activity has been detected. In January 1996, the light keeper at Langara Point caught one rat in a grain store. Therefore, eight bait stations were placed surrounding the lighthouse. No further *R. norvegicus* have been found around the lighthouse since then. Chew-stick checks in spring and summer 1997 showed no *R. norvegicus* activity. May 1997 inspections revealed zero foot prints, feces, or predation leftovers.

Limitations to Brodifacoum Control

Two potential brodifacoum use problems became apparent to Taylor and Thomas (1989) on a similar *R. norvegicus* eradication project. One was the possible development of a genetic resistance to frequently used poisons. The other concern was the potential increase in neophobia, the inherited tendency (which can be enhanced by learning) for animals to avoid any new object or changed situation in the environment. This effect is almost always temporary since the poison bait stations became familiar with time. Bait shyness may occur in rats that have previously suffered from sub-lethal poisoning, and these can remain long-term effects.

Primary and secondary poisoning is a potential threat to nontarget species. Because no data was available about effects on nontarget species, project managers assumed the poison could affect species other than the rat. Primary poisoning occurs when a species directly ingests the poison and dies. Secondary poisoning occurs when a scavenger species eats the poisoned animals. *Corvus corax* populations suffered through primary and secondary poisoning. Evidence of bait station tampering was seen with the advent of missing bait stations in areas of low *R. norvegicus* population. Brodifacoum residues were also found in other nontarget species, but not enough decline was seen in their population to cause any concern. In addition, many shrews died as a result of this initiative. However, these population declines were not for long. In fact, the shrew population may have gained stability from the absence of *R. norvegicus* due to reduced competition for insect prey and decreased predation.

Conclusion

R. norvegicus are important predators of *S. antiquus*. Through the hard work of over 90 people, successful extermination of *R. norvegicus* at Langara Island has been attained. Nearby Cox Island (0.15 km away) and Lucy Island (.20 km away) have been included in the program, and there has been no evidence of rats since. Increased traffic to the island has the potential to cause *R. norvegicus* re-infestations. Fishing lodges have implemented pest management techniques to prevent new rat arrival (Taylor et al. 2000). Seabird population recovery data has not yet been acquired. Perhaps it is too soon to infer substantial possible increases in seabird populations. Regardless, a census study should be taken as soon as possible to check how the seabird populations have responded to rat eradication. In addition, steps should be taken to prevent the potential re-introduction of rats to Langara Island.

Literature Cited

Bertram, D.F. 1995 The roles of introduced rats and commercial fishing in the decline of Ancient Murrelets on Langara Island, British Columbia. Conservation Biology 9: 865-872.

Bertram, D.F. and D.W. Nagorsen. 1995. Introduced rats, *Rattus spp*., on Queen Charlotte Islands: Implications for seabird conservation. Canadian Field-Naturalist 109: 6-10.

Botman, A., C. Douglas, and M. Lipman. "Brown Rat." The Canadian Museum of Nature Online. www.nature.ca/notebooks/english/brnrat.htm November 2000. (Accessed 20 Nov 2000).

Drever, M.C. and A.S. Harestad. 1998. Diets of Norway rats (*Rattus norvegicus*) on Langara Island, Queen Charlotte Islands, British Columbia: Implications for conservation of breeding seabirds. Canadian Field-Naturalist 112: 676-683.

Gaston, T. "Seabirds an Indicator of Marine Ecosystem Status for Coastal British Columbia." Environment Canada. www.ecoinfo.org/env_ind/region/seabird/seabird.htm 2000. (Accessed 20 Nov. 2000).

Hallenbeck, W.H. and K.M. Cunningham. 1986. Pesticides and human health. Springer-Verlag. PESKEM. The Australian Directory of Registered Pesticides and their Uses. Compiled by K. Hamilton, Center for Pesticide Application and Safety, University of Queensland.

Koehler, P.G. and W.H. Kern. "Rat and Mouse Control." The National Food Safety Database. www.foodsafety.ufl.edu/consumer/mg/mg220.htm 1991. (Accessed 29 Nov 2000).

Moors, P.M. 1985. Norway rats (*Rattus norvegicus*) on the Noises and Motukawao Islands, Hauraki Gulf, New Zealand. New Zealand Journal of Ecology 8: 37-54.

Sax, N.I. and R.J. Lewis. 1989. Dangerous Properties of Industrial Materials. 7th edition. Van Nostrand Reinhold, Melbourne.

Taylor, R.H. and B.W. Thomas. 1989. Eradication of Norway rats (*Rattus norvegicus*) from Hawea Island, Fiordland, using brodifacoum. New Zealand Journal of Ecology 12: 23-32.

Taylor, R.H., G.W. Kaiser, and M.C. Drever. 2000. Eradication of Norway rats for recovery of seabird habitat on Langara Island, British Columbia. Restoration Ecology 8: 151-160.