

# Introduced Species Management in Haida Gwaii (Queen Charlotte Islands)

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## ABSTRACT

Gwaii Haanas (Gwaii Haanas National Park Reserve and Haida Heritage Site) recognizes species introductions on the archipelago of Haida Gwaii (Queen Charlotte Islands) as one of the more important threats to ecological integrity in this region. These introductions may place many unique species or natural communities at risk. Several initiatives are underway to mitigate the effects of these species as well as to reduce the risk of range expansions or new introductions. This paper provides examples that illustrate the scope of introduced species research, monitoring, and restoration initiatives that are underway on Haida Gwaii.

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**Key words:** biodiversity, black rat, Haida Gwaii, introduced species, island, mule deer, Norway rat, protected areas, Queen Charlotte Islands, raccoon, restoration, wildlife management.

A significant threat to biological diversity, particularly in island ecosystems, is the introduction of nonnative species. Without human intervention to reverse some of the changes that have taken place, and to prevent further introductions, many unique species or natural communities may be at risk. Gwaii Haanas (Gwaii Haanas National Park Reserve and Haida Heritage Site) as part of the larger archipelago of Haida Gwaii (Queen Charlotte Islands), recognizes species introductions as one of the most important threats to ecological integrity (Golumbia 1999). While we cannot reverse the clock to when introductions were not present, a large effort has been focused on identifying those introduced species issues that are of the highest conservation priority and that are feasible, socially acceptable, and cost effective. Several initiatives are trying to mitigate the effects of these species as well as reduce the risk of range expansions or new introductions. Because of the scale and complexity of these issues, partnerships have been necessary to effectively set objectives and achieve our goals. Through the following examples including exotic mammals (rats, raccoons, and deer) and invasive plants, the scope of current introduced species research, monitoring, and restoration initiatives will be illustrated.

Like many island systems worldwide, Haida Gwaii is essentially isolated from continental influences and therefore supports a unique assemblage of plants and animals. This archipelago of several hundred islands and islets covers approximately 1 million ha in area and is located approximately

80 km offshore of northwestern British Columbia. The protected area of Gwaii Haanas (147,000 ha) encompasses the southernmost 15% of the archipelago. Other significant protected areas, including Naikoon Provincial Park and associated reserves (71,000 ha) in the northeast and V. L. Krajina Ecological Reserve (14,000 ha) on the west coast of Graham Island, represent 8.5% of the land base. Many areas outside of these disjunct reserves have been extensively logged and otherwise developed, particularly over the past 25–30 years.

The archipelago is recognized for high numbers of endemic, disjunct and rare species indicative of an insular ecosystem. In terms of species “at risk,” the British Columbia (B.C.) Conservation Data Centre (1998) and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (1998) list 36 floral and 26 faunal species as vulnerable, threatened, or endangered. In addition, 14 plant associations are also listed. The life histories and habits of many island species reflect insular conditions where relatively few species have colonized. Exotic species tend to out-compete and hence displace indigenous forms. The effects are exacerbated in such systems because these species most often arrive without their predators or competitors.

While it is more difficult to track the introduction of flora and avifauna to the islands, the records for terrestrial mammal fauna are more certain and provide an interesting historical perspective to a currently distressing situation. Excluding humans, the terrestrial mammal fauna of Haida Gwaii consists of 13 indigenous species (one of which is extinct). Over the past 125 years, 10 mainland species have been introduced to Haida Gwaii (Table 1) resulting in almost more introduced mammal species than indigenous!

Haida Gwaii also represents some of British Columbia's

**Table 1.** Mammal species on Haida Gwaii (Queen Charlotte Islands).

Indigenous	Keen's mouse	<i>Peromyscus keeni keeni</i>
		<i>P. keeni prevostensis</i>
	dusky shrew	<i>Sorex monticolus elassodon</i>
		<i>Sorex monticolus prevostensis</i>
	ermine	<i>Mustela erminea haidarum</i>
	marten	<i>Martes americana nesophila</i>
	river otter	<i>Lontra canadensis periclyzomae</i>
	black bear	<i>Ursus americana carlottae</i>
	Dawson caribou	<i>Rangifer tarandus dawsoni</i> (extinct)
	Keen's long-eared myotis	<i>Myotis keenii</i>
	little brown bat	<i>Myotis lucifugus alascensis</i>
Introduced	California myotis	<i>Myotis californicus caurinus</i>
	silver-haired bat	<i>Lasionycteris noctivagans</i>
	house mouse	<i>Mus musculus</i>
	black rat	<i>Rattus rattus</i>
	Norway rat	<i>Rattus norvegicus</i>
	red squirrel	<i>Tamiasciurus hudsonicus lanuginosus</i>
	raccoon	<i>Procyon lotor vancouverensis</i>
	beaver	<i>Castor canadensis leucodontus</i>
	muskkrat	<i>Ondatra zibethicus osoyoosensis</i>
	Sitka mule deer	<i>Odocoileus hemionus sitkensis</i>
	European red deer	<i>Cervus elaphus elaphus</i>
Elk	<i>Cervus elaphus nelsoni</i>	

most extensive seabird nesting habitat, with internationally significant populations of some species. Of the 1.5 million seabirds breeding at numerous sites in Haida Gwaii, almost all nest in or on the ground with little or no natural defence to predation. The introduction of efficient terrestrial predators has caused severe losses on even the largest colonies. Several seabird species have been assigned a risk status based on the threats posed by introduced predators.

## RATS

Rats have a long association with humankind. They are revered in some cultures but despised in most. A Jain temple located at Dethnoka in the state of Rajasthan is a place where the rat is sacred and thousands reside in the small shrine. In contrast, the province of Alberta proudly claims "rat-free" status and boasts that "every rat that ends up in the province, ends up dead" (Hodgson 1997). Rats are highly successful colonizers and have spread across the globe as stowaways on many early maritime explorations. The black rat (*Rattus rattus*) has probably been on Haida Gwaii since the late 1700s and may have been here earlier. More recent shipping activity has introduced the larger more aggressive Norway rat (*Rattus norvegicus*) to many islands in Haida Gwaii. Rats are voracious predators, and on those islands where they have been introduced, many seabird species have disappeared or are in decline (Harfenist and Kaiser 1997). Eighteen islands in the archipelago are known to

support rats (Bertram and Nagorsen 1995).

Langara Island, located at the northern extreme of Haida Gwaii, was historically one of British Columbia's largest seabird colonies. However, breeding populations of seabirds have either been lost or have declined precipitously. For example, the ancient murrelet, a COSEWIC-listed species, has declined from an estimated historic population of 200,000 birds to a 1988 estimate of 24,000 (Bertram 1995). This decline has partly been due to rats (Kaiser et al. 1997). Several other islands have exhibited a similar trend in the presence of rats.

Restoration techniques developed and used successfully for rat control in New Zealand over the past 10 years have been used to clear rats from seabird colonies and thus enable seabird populations to recover. The approach uses toxic baits at fixed stations (Kaiser et al. 1997). The key to this program's success is the regular and continuous supply of baits within every possible rat home range. The bait is a second-generation coumarin-based anti-coagulant which is effective after 1 feeding; more traditional first-generation compounds require multiple feedings and are therefore more susceptible to feeding avoidance behaviour and resistance by the target organism (Kaiser et al. 1997).

The eradication project initiated by the Canadian Wildlife Service (CWS) on Langara, Lucy, and Cox islands has been successful. At the other end of the archipelago, Gwaii Haanas has successfully removed rats from St. James Island, which was also a large seabird colony island before the invasion of

rats. Based on the expertise of Gary Kaiser (CWS) and Rowley Taylor (R.H. Taylor Associates), Gwaii Haanas staff improved the methodology and bait station design to further prevent nontarget poisoning in the St. James project. Ten islands within Gwaii Haanas still have rats on them. The intent is to continue with this restoration program on those islands where this type of program is feasible. Ecosystem recovery will also be monitored.

In addition to active restoration, long-term success will require that people do not inadvertently reintroduce rats to restored islands or to any new islands. Gwaii Haanas staff have developed a communications program to inform people about the risks of transporting rats from infected sites to clean sites. The program includes media information releases, backcountry orientation programs, and an information pamphlet which is distributed widely.

## RACCOONS

The raccoon (*Procyon lotor*) was introduced to Graham Island in the 1940s to augment the fur trade. This highly adaptive and opportunistic mammal has successfully colonized many islands in the archipelago. Several surveys in the late 1980s and early 1990s determined the range of the raccoon. Research indicated that raccoons opportunistically swim as far as 1 km to remote islands (Hartman 1993). This finding places over half of the burrow-nesting seabirds on Haida Gwaii at risk (Working Group On Raccoon-Seabird Interactions 1995a). In response to this threat, a working group was formed in 1994 with representatives from the British Columbia (B.C.) Ministry of Environment, Lands and Parks; CWS; the Archipelago Management Board (Parks Canada and Council of the Haida Nations); and the Laskeek Bay Conservation Society. This group developed a monitoring and control protocol (Working Group On Raccoon-Seabird Interactions 1995b). Overall, monitoring and control programs appear to be successful. However, the protocols are being revised to reflect increased knowledge and field experience.

While the raccoon-seabird interaction was considered the most significant conservation issue, the raccoon may also threaten nesting shorebirds, other ground nesting birds, and small mammals, as well as intertidal organisms. Gwaii Haanas plans to expand our efforts to these areas, particularly looking at the long-term effect of raccoon population reduction on the larger islands and in key ecological areas (Golumbia 1999).

## DEER

The Sitka mule deer has a relatively short history of just over a century on the islands. These deer were introduced by the B.C. Game Commission at least 5 times between 1880 and

1925 (Carl and Guiguet 1972, Pojar et al. 1980). Even though few individuals were introduced, they have flourished without competition or predation. Hunting statistics over a 20-year period (1976–1996) indicate that >34,000 animals have been harvested, in addition to food gathering by the Haida Nation (Laskeek Bay Conservation Society 1998). While the impact from browsing deer varies across the landscape, this species has spread to virtually all of the islands in the archipelago with only 8 islands known to be deer-free. These sites are small offshore islands representing approximately 500 ha which is <0.1% of the archipelago's land base.

The large-scale impact of deer on the forest ecology of Gwaii Haanas is obvious and has been recognized since the late 1970s (Pojar et al. 1980). Work in the Gwaii Haanas area by Jean Louis Martin and others in the early 1990s began to measure the effects of deer across the landscape (Martin et al. 1995). Because of this initial work, we began to realize the complexity of the problem and the potential costs associated with addressing the issues. To address these problems, a multidisciplinary research collective was formed in 1995 with interested parties including the Laskeek Bay Conservation Society, Gwaii Haanas Archipelago Management Board, CWS, the Centre National de la Recherche Scientifique (France), and the B.C. Ministry of Environment, Lands and Parks. This group, now known as the Research Group on Introduced Species (RGIS), has initiated a 5-year research program funded by Forest Renewal British Columbia (FRBC), the South Moresby Forest Replacement Account (SMFRA), and the participating agencies. The purpose of this research is to better understand the interaction of introduced species (particularly deer) on the forest ecology of Haida Gwaii. The network of principal investigators and research collaborators has enabled us to investigate several hypotheses simultaneously, the results of which will be useful in designing management solutions in the future.

RGIS is now into its second year of work and much has been accomplished toward achieving the following research objectives: (1) to understand the interactions among flora and fauna shaping forest ecology, forest economy, and biodiversity conservation; (2) to predict vegetation recovery potential if Sitka mule deer are controlled (and the consequences of leaving them uncontrolled); (3) to understand spatial and temporal movements of Sitka mule deer among islands and between habitats; and (4) to understand the individual and synergistic effects of Sitka mule deer and red squirrel on the ecology of forest birds.

Deer browsing has reduced abundance and vigour of virtually all species of shrubs and herbs; in extreme cases, the understory structure of the forest is absent (Daufresne and Martin 1997). The direct effects of browsing are obvious and can range from reduced vigour to elimination of certain species. The indirect effects on forest structure and function

are less obvious but equally important. These plants and their fruits are no longer available for species that use them for food. The physical structure from the forest floor to the canopy in a natural forest provides important habitat for nesting, foraging, and cover used by birds and small mammals. This structure is greatly reduced and simplified in Haida Gwaii forests (Martin et al. 1995, Daufresne and Martin 1997). More subtle effects are likely occurring at the forest floor with regard to nutrient cycling, terrestrial arthropods, and soil structure.

Preliminary research suggested that this loss of cover increases the vulnerability of nesting song birds to predation by another introduced species, the red squirrel (Martin et al. 1996). However, the more significant effect is apparently an increase in activity by native predators who benefit from the increased visibility in the forest (J. L. Martin, Centre National de la Recherche Scientifique, Montpellier, France, 1998, pers. comm.). The lack of understory is also reflected in the growth and survival of tree seedlings and subsequent recruitment into the forest canopy. Heavy pressure on western redcedar (*Thuja plicata*) seedlings, which are a preferred browse species, also threatens the natural regeneration of that species (Baltzinger and Martin 1998). This is of particular concern to forest companies who must regenerate redcedar after harvesting on cedar sites, and to the Haida people, who consider redcedar and other forest plants as central to their culture.

Deer densities are much reduced on the mainland, where natural predators and hunters control numbers. Liberal hunting quotas have been in place throughout Haida Gwaii and are still used outside Gwaii Haanas. Vegetation plots across the islands indicate that hunter accessible areas have up to 3 times more redcedar survival to the sapling stage than more isolated areas (Baltzinger and Martin 1998). However, the effect on deer numbers is localized.

Eradication of deer on Haida Gwaii is neither feasible nor socially desirable. However, deer could be managed on islands sufficiently distant from a "source" population to make eradication or continued control feasible. This proposal would provide "deer-free" islands to represent a benchmark area. To test this concept, an experimental deer cull has been undertaken on 2 islands. Baseline measurements of forest vegetation as well as song bird numbers and diversity have been established on the islands and on adjacent control areas. The results are visible and show obvious reestablishment of the herb and shrub layer after only 1 growing season.

To develop management scenarios for the island deer population, known models for the Sitka mule deer which have been developed elsewhere on the coast must be tested. Radiotelemetry, in combination with DNA analysis, will be used to better understand inter-island movement of deer as well as seasonal movements and habitat use on large and

small islands. This information will be useful in determining where additional control efforts may be successful.

## EXOTIC VEGETATION

There has been a long standing interest in the native flora of Haida Gwaii. Numerous records exist of rare species as well as species that are endemic to these islands or which exhibit disjunct distributions indicative of glacial refugia (Ogilvie 1989). Native vascular flora on the islands totals 657 species of which 34 are considered rare and 10 are considered local or regional endemics. Some 143 species (22%) are considered introduced to the islands, several of which are considered invasive (Lomer and Douglas in press).

Gwaii Haanas staff have begun to document historic and current distribution of introduced plant species. Most exotic plant introductions in Gwaii Haanas appear to be localized around human disturbed sites such as historic logging camps and roads, homesteads, village sites, mining sites, and lighthouses (Fellows 1996). The more invasive species are a particular concern because they spread easily and can outcompete native species especially where disturbance has occurred. The spread of high risk species is also being monitored. Where introduced species are limited in distribution and accessible, attempts will be made to remove the plants before they spread.

The agricultural and horticultural traditions in our cultures continue to support the presence of exotics in the regional ecosystem. Current logging practices, including follow-up activities such as slope stabilization and road deactivation, can introduce invasive weed species through hydro-seeding or other operations. Recent landscape practices have used species such as Scotch broom (*Cytisus scoparius*) and gorse (*Ulex europaeus*). These species are widespread invasive plants in the south but are still limited in their distribution on Haida Gwaii and are not yet found within Gwaii Haanas. In all cases, public education and awareness are the best methods of prevention.

## DISCUSSION

It is difficult, likely impossible, to fully understand the impact of introducing species into a complex array of native plants and animals. However, we know that introducing non-native species anywhere in a natural system can place native species and natural ecosystems at risk. Reversing the changes are difficult, costly, and sometimes impossible. Societal and cultural values must also be considered and can often be equally complex. What is our role in restoring ecosystems? Is there more value in eradicating a "vermin" such as the rat or the raccoon than a species of higher cultural value such as the deer?

The complex nature of these issues confirms the need to adopt an adaptive management approach which combines

research with monitoring and active restoration. The spatial scale of these issues, from island complexes to global distribution, demands that partnerships be forged to develop strategies for reducing the effects of these introductions. Through the research collective that has been established (RGIS), an international network of experts combined with local people and local knowledge can work together to address these issues and collect the information needed to make sound management decisions.

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