# An introduction to the plant ecology of Haida Gwaii

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## 1. Physical setting

### *1.1 Location and size*

Haida Gwaii is the most remote island archipelago in Canada and consists of over 350 islands 50–130 km off the northern mainland coast of British Columbia (Fig. 1). The two main islands, Graham and Moresby, together constitute nine-tenths of the total 995 000-ha area of the group.

### *1.2 Protected areas on Haida Gwaii*

Haida Gwaii includes three large, formally protected areas. Naikoon Park (71 000 ha) was created in 1973 to preserve 100 km of beaches and dunes, along with sphagnum bogs and coastal temperate rainforest. Gwaii Haanas (147 000 ha), which constitutes approximately 15% of Haida Gwaii and encompasses over 200 islands, was established in 1988 to protect marine, intertidal, and terrestrial ecosystems as well as a diverse and rich cultural history. The V.J. Krajina Ecological Reserve (7800 ha) on the west coast of Graham Island contains productive temperate rainforest as well as rare species of vascular plants and bryophytes (B.C. Parks 1992). These areas protect a significant land base (23% of the archipelago), representing a broad spectrum of island species and ecosystems. There are several other ecological reserves, small but biologically very significant, including Rose Spit, Tow Hill Bog, Drizzle Lake, and Lepas Bay.

### *1.3 Physiography and bedrock geology*

There are three physiographic regions on the archipelago (Brown 1968): 1) the Queen Charlotte Ranges, forming the rugged, mountainous western region; 2) the Skidegate Plateau, a partially dissected peneplain of the north-central region; and 3) the Queen Charlotte Lowland—plains and low hills of the northeastern region.

Haida Gwaii has a complex bedrock geology, with hard and soft volcanic, sedimentary, and acid intrusive rocks well represented (Brown 1968; Brown and Yorath 1989). The productive forests of the Skidegate Plateau and Queen Charlotte Ranges are underlain mainly by volcanic rocks, with some minor but very productive sedimentary rocks. Sedimentary rocks underlie most of the deep surface deposits (glacial and marine) on the Queen Charlotte Lowland. Intrusive bedrock is largely restricted to the Queen Charlotte Ranges, where it and the hard volcanics tend to support low-productivity forest and sloping bogs.

### *1.4 Climate*

The climate is a cool temperate, oceanic, humid–perhumid type. Late fall and early winter are very wet. Winter is cool but mild, rainy, and snowy. Snowpack along the

coast is usually ephemeral, but more snow falls at higher elevations (especially above 600 m) and in the interior of the larger islands. Summer is cool and wet, but sometimes has dry warm spells. Cloud cover is very common, and fog is frequent. Strong winds are common and form an important climatic feature. Mean annual temperature of the tidewater stations is 8°C; daily, seasonal, and annual ranges in air temperature are narrow. Recorded mean annual precipitation ranges from 1100 to 4200 mm (Environment Canada 1980). The Queen Charlotte Ranges cast a rain shadow on eastern Graham and Moresby islands, resulting in a decrease in annual precipitation from an estimated 5000+ mm on some of the windward slopes to around 1000 mm on the eastern lowlands (G.O.V. Williams *in* Calder and Taylor 1968).

## 2. Present-day vegetation

### *2.1 Temperate rainforest biome*

The plant cover of Haida Gwaii is a complex of forests and nonforested wetland, maritime, and high-elevation communities (Banner et al. 1983, 1989; Pojar and Broadhead 1984). There is a full range of ecosystems and successional stages. Nevertheless, the landscape is largely forested, and, over most of preindustrial time, most of the forests were old. As a consequence of a history of infrequent, large-scale, stand-destroying disturbances in a wet, mild, mountainous environment, productive forests are characterized by big old trees, tremendous accumulations of biomass, coarse woody debris (downed logs plus standing dead trees, or snags) as a key structural component, and gap dynamics (i.e., most tree replacement occurs on a tree-by-tree basis, with regeneration in gaps resulting from the death of individual or small groups of canopy trees) (Pojar and MacKinnon 1994; Lertzman et al. 1997).

Coastal temperate rainforest is a globally rare biome, represented in North America by the dense evergreen Pacific Coast Conifer Forest, which stretches from northern California through southeast Alaska (Barbour and Billings 1988). Over the past century, this biome has been reduced to only 44% of an estimated original extent of 25 million hectares, with most of the remaining forest occurring north of 48°N (Schoonmaker et al. 1997). Haida Gwaii, with over 540 000 ha of intact temperate rainforest, contains a significant portion of what remains (Alaback and Pojar 1997). Western hemlock *Tsuga heterophylla*,[a] western redcedar *Thuja plicata*, and Sitka spruce *Picea sitchensis* dominate the closed coniferous forest of Haida Gwaii at low elevations, while mountain hemlock *Tsuga mertensiana* and yellow-cedar or cypress *Chamaecyparis nootkatensis* gain in importance at higher elevations. Yellow-cedar and shore pine *Pinus contorta* var. *contorta* join western (and often mountain) hemlock, western redcedar, and Sitka spruce in boggy windward forests.

### *2.2 Zonal forests*

Mature and old stands on zonal (average) sites at low to moderate elevations typically have abundant natural regeneration of western hemlock. Usually there is little if any regeneration of either western redcedar or yellow-cedar and scattered spruce

[a] Nomenclature of vascular plants follows Douglas et al. (1998–2002).

regeneration in openings. The overstory trees form a dense canopy that casts deep shade, although old-growth forests have ragged canopies with frequent gaps that allow patchy penetration of light. Bryophytes carpet the forest floor, and epiphytic mosses and lichens are also abundant. However, there is a conspicuous lack of understory shrubs (except for hemlock regeneration) and herbs. The sparse understory appears to be a function of shade (shrubs and herbs that do occur are most frequent in forest gaps) and browsing by deer. Typical scattered shrubs are species of *Vaccinium* (red huckleberry *V. parvifolium*, Alaska blueberry *V. alaskaense*, oval-leaved blueberry *V. ovalifolium*), false azalea *Menziesia ferruginea*, salal *Gaultheria shallon*, and western yew *Taxus brevifolia*. Characteristic herbs include ferns (deer fern *Blechnum spicant*, spiny wood fern *Dryopteris assimilis*), twayblade orchids *Listera caurina* and *L. cordata*, twisted-stalks *Streptopus amplexifolius* and *S. lanceolatus*, bunchberry *Cornus canadensis*, spleenwort-leaved goldthread *Coptis aspleniifolia*, and single delight *Moneses uniflora*.

### *2.3 Azonal forests*

Dry forests are uncommon and dominated by western redcedar, western hemlock, and occasionally shore pine, often with a fair amount of salal in the understory. Moist but freely drained sites on slopes support vigorous mixtures of western hemlock and Sitka spruce, with a component of yellow-cedar at higher elevations. The most impressive forests on the islands occur on recent alluvial deposits adjacent to streams and on fluvial/colluvial fans in gullied terrain. Large, tall, widely spaced spruce and hemlock dominate such stands, the shrub layer is sparse, and the ground cover is often grassy rather than ferny and mossy. Sitka spruce forests also have developed along marine shorelines, on stabilized sand dunes, and on rocky headlands and steep slopes exposed to salt spray.

Wet, rather scrubby forests are common on subdued, poorly drained terrain generally, especially on the eastern Skidegate Plateau and Queen Charlotte Lowland. Boggy forest and woodland are also widespread on sloping, windward terrain underlain by nutrient-poor, resistant bedrock, as over much of the Queen Charlotte Ranges portion of Moresby Island. These scrubby forests consist of mixtures of western redcedar, western hemlock, and often yellow-cedar, shore pine, and mountain hemlock as well. Salal, deer fern, spleenwort-leaved goldthread, false lily-of-the-valley *Maianthemum dilatatum*, bunchberry, Indian hellebore *Veratrum viride*, Nootka reedgrass *Calamagrostis nutkaensis*, and sedges (*Carex* spp.) are typical understory vascular species.

### *2.4 Subalpine vegetation*

The subalpine zone on Haida Gwaii occupies elevations between about 600 and 800 m. Subalpine forests are not extensive but are distinctive, with dominance by mountain hemlock and yellow-cedar and open stands with relatively short, strongly tapered trees. Species of *Vaccinium*, false azalea, and copperbush *Elliottia* (*Cladothamnus*) *pyroliflorus* typically form the shrub understory, which is sparse (usually) to dense, depending on the openness of the canopy and the intensity of deer browsing. Subalpine forest thins out at yet higher elevations, into a parkland mosaic of tree clumps and heather meadows.

### *2.5 Alpine vegetation*

Alpine vegetation occurs above 600–800 m and is concentrated in three areas: southwestern Graham Island, north-central Moresby Island, and the San Christoval Range south of Tasu on Moresby Island. An alpine heath of evergreen dwarf shrubs, especially white mountain-heathers (*Cassiope* spp.), yellow mountain-heather *Phyllodoce glanduliflora*, and partridgefoot *Luetkea pectinata*, is the dominant type of closed alpine vegetation. Herb-dominated alpine meadows are less common but very lush, with a variety of grasses (especially tufted hairgrass *Deschampsia cespitosa*), sedges (especially large-awned sedge *Carex macrochaeta*), and vigorous forbs. High-elevation rock outcrops, cliffs, boulder fields, talus slopes, wet runnels and gullies, and avalanche tracks have a sparse and discontinuous plant cover, but these rocky habitats support a rich flora that contains many of the rare vascular plant species of Haida Gwaii.

### *2.6 Freshwater wetlands*

Freshwater wetlands are among the most conspicuous features of the plant cover of Haida Gwaii (see Banner et al. 1988). Wetland classes widely recognized by ecologists and at least generally familiar to many people are bog, fen, marsh, and swamp. Flat and raised bogs cover extensive areas of the Queen Charlotte Lowland. Slope or blanket bogs are especially widespread on the windward Queen Charlotte Ranges, where in some areas they are essentially continuous from sea level to alpine. Both types of bogs are typified by stunted, shrubby conifers, evergreen-leaved shrubs, including common juniper *Juniperus communis*, Labrador tea *Ledum groenlandicum*, and western bog-laurel *Kalmia microphylla* ssp. *occidentalis*, several sedge-family species (cotton-grasses *Eriophorum* spp., tufted clubrush *Trichophorum cespitosum*, sedges), as well as pools with yellow pond-lily *Nuphar lutea* ssp. *polysepala*, numerous rills and streams, and *Sphagnum* peatmosses.

Fens also have peaty soils but are less acid and more nutrient-rich than bogs, and their vegetation is dominated by sedges, grasses, and often also shrubs such as hardhack *Spiraea douglasii*, sweet gale *Myrica gale*, Pacific crab apple *Malus fusca*, willows *Salix* spp., and Labrador tea. Marshes are also relatively rich in nutrients but occur on mineral sediments and support strictly herbaceous vegetation that is emergent from standing water. Sedge marshes are the most common type on Haida Gwaii. Fens and marshes are localized along flowing water and lake margins and are of minor extent, even on northeastern Graham Island, where they are most frequent. The “Pontoons” at the head of the Tlell River is the largest fen/marsh complex on the Islands.

Swamps are forested wetlands, rich in minerals and nutrients, but with moving rather than stagnant waters and mucky soils sufficiently aerated to support tall shrubs and trees. Conifer swamps are common on Haida Gwaii but are usually localized and do not dominate the landscape as do bogs. Dominant tree species are western redcedar, Sitka spruce, western hemlock, sometimes red alder *Alnus rubra*, and yellow-cedar at higher elevations. Skunk cabbage *Lysichiton americanum* is a very characteristic understory species of swamps, as is the liverwort *Conocephalum conicum*.

### *2.7 Maritime communities*

Maritime terrestrial vegetation occurs on a variety of tidelands and uplands between the forest and the sea. Nonforested types restricted to the land–ocean interface include sand and shingle beach communities, rock and cliff communities, and tidal marshes. Calder and Taylor (1968) provide detailed descriptions of these vegetation types.

## 3. Pre-European vegetation

By "pre-European" vegetation, I mean the plant cover prior to first-hand, written historical accounts—that is, prior to 1850. My assumption is that the vegetation of Haida Gwaii then was much like that of temperate rainforest areas of southeast Alaska and of British Columbia's northern mainland coast now (Pojar and MacKinnon 1994; Alaback and Pojar 1997), except that it was relatively poor in species of vascular plants but had some endemic and otherwise phytogeographically interesting taxa (Schofield 1989; Taylor 1989; Brodo 1995). Paleobotanical studies indicate that the forests of Haida Gwaii "have existed in essentially their present form for the last 5,500 years or so, with the only significant natural change since then being the increased importance of red cedar during the past three millennia" (Mathewes 1989).

What is the "pristine benchmark," and how can we know? Following the argument of Jackson et al. (2001), we can recognize at least three partially overlapping periods of human impact on ecosystems: Aboriginal, colonial, and global. We are now in the global period, but most of the apparent change in Haida Gwaii forests took place in the colonial period—i.e., 1850–1970. Is it reasonable to assume that during the Aboriginal, pre-1850 period when only Haida were on the islands, impact on the vegetation was not great? Perhaps. Haida culture *is* marine-based. Presumably they would not have gone too far inland to harvest big trees, and their selective harvesting was consonant with the gap dynamics of the coastal forest. However, they have had lots of time, maybe 13 000 years (Hetherington 2002). And certainly 6000 (Duff 1964) to 15 000–20 000 people (Fedje et al. 2001) would have had a noticeable impact on native vegetation in and around villages, on shorelines and tidelands, and on selected species used as food, as medicine, or in technology (e.g., western redcedar, western yew). Evidently the Haida practised a form of agriculture, and not just with native species. They also cultivated potatoes and ate and traded them widely (Meilleur 2001). We remain uncertain about the role and extent of fire on Haida Gwaii. Wildfire seems to have played a minor role in shaping the vegetation (Banner et al. 1989). However, there are reports of Aboriginal burning along Skidegate Inlet (Turner 1999), and if it occurred there, it probably was practised elsewhere, especially near villages and in drier eastern areas—where there is some evidence in the form of charcoal in soil profiles and some of the forests have a suggestive age and structure.

## 4. Impacts of postindustrial humans[a]

Explorers such as Perez, Quadra, and La Pérouse glimpsed Haida Gwaii in the late 18th century, and soon the word spread that fortunes could be made trading with the Haida for sea otter pelts. No trading post or fort, however, was established on Haida Gwaii, and the sea otter and the fur traders vanished from the Islands during the early 1800s. The Islands experienced a minor gold rush in the 1850s, but no permanent white settlement resulted. There were other mining ventures (mostly for copper or coal close to tidewater) later in the 19th century, but proper settlements were not established until 1869, when the Hudson's Bay Company set up trading posts in Masset and Cumshewa Inlet. Christianity and more settlers arrived in the 1870s. The early 1900s saw a flurry of homestaking and townsite development, especially on eastern Graham Island. The major surviving settlements are Masset, Queen Charlotte City, Sandspit, and Port Clements, plus small settlements at Tlell, Lawn Point, and Skidegate Landing. Major Haida villages remain at Old Masset (Haida) and Skidegate.

Two whaling stations, one at Rose Harbour and another at Naden Harbour, operated for many years, from around 1910 to 1943. Salmon canneries existed in the early part of the 20th century at Alliford Bay, Naden Harbour, Lagoon Inlet, and Masset. There were cold storage and fish processing plants at Pacofi in Selwyn Inlet and in Rennell Sound, several salmon salteries, a crab cannery, a clam cannery, and kelp processing plants (one at Pacofi and another more recently at Nadu). Short-lived iron mines with fairly large workforces played out at Ikeda Bay, Jedway, and Tasu, all on Moresby Island.

Numerous logging camps have come and gone since 1910, including many small floating camps of the "gyppo" loggers. Terrestrial camps and extensive road networks were built at Cumshewa Inlet, Thurston Harbour, Masset, Juskatla, Moresby Camp, Sewell Inlet, Lyell Island, Eden Lake, and Rennell Sound, most resulting in temporary but intensive settlement.

Obviously, all of these settlements affected the native vegetation, directly and indirectly. Forests were cleared for homes, pastures, gardens, and stump farms; trees were cut for construction, pickets, firewood, corduroy roads, and so forth. Trails were hacked and roads were pushed through the bush. Domestic animals were brought to the Islands, and some went feral—like the wild cows of Naikoon Park—with impacts on vegetation that can only be guessed. Alien species were introduced, plants as well as animals. At first glance, it appears that settlement and the persistence of a sparse but aggregated human population have had mostly local effects on the plant life of Haida Gwaii. A closer look, however, reveals some extensive impacts—in the form of roads and access, introduced species, and consumption of energy and natural resources—that collectively define the rather large "ecological footprint" (Wackernagel and Rees 1996) of the resident and nonresident human population.

Present-day old-growth forests are in no way pristine and could be called "unnatural." Sometimes drastic changes, even in recent times, happen so fast that the memory of what used to be fades quickly (Golumbia and Rowsell this volume). Most people who now live on Haida Gwaii have never seen the original predeer forests, and it

[a] See Dalzell (1968, 1973).

can be difficult for them (and others) to visualize or comprehend what it was like or even *could* be like. There seems to be a similar inability to comprehend preindustrial, order-of-magnitude-larger runs of salmon or the previous abundance of marine mammals, seabirds, and other marine animals.

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