Appendix 6

Detailed Species Accounts for Selected Wildlife Species

Taylor's Checkerspot, *Euphydryas editha taylori*

Propertius Duskywing, Erynnis propertius

Northern Alligator lizard, *Gerrhonotus coerulea*

Pacific Treefrog, *Pseudacris regilla*

Townsend's Big-eared Bat, *Corynorhinus townsendii*

Pelagic Cormorant, *Phalacrocorax pelagicus*

Harlequin Duck, *Histrionicus histrionicus*

Species Account for Taylor's Checkerspot, *Euphydryas editha taylori*

Species data

Common Name:	Taylor's Checkerspot
Scientific Name:	*Euphydryas editha taylori*
Species Code:	-
BC Status:	Red-listed
Identified Wildlife Status:	Yes
COSEWIC Status:	Endangered

Taylor's Checkerspot, *Euphydryas editha taylori* belongs to a group of related coastal subspecies of Edith's Checkerspot, *Euphydryas editha,* but *E. editha taylori* is disjunct from the other subspecies, and all coastal subspecies are endangered (Shepard 2000).

Project data

Area:	Helliwell Provincial Park, Hornby Island
Ecoprovince:	Georgia Depression
Ecoregions:	Georgia – Puget Basin
Ecosections:	Strait of Georgia
BGC Units:	CDFmm
Map Scale:	1:5000

1 Ecology and General Habitat Requirements

Most of what is known of the ecology of *E. editha* is due to the work of P.R. Ehrlich and his colleagues. This species is one of the most studied North American butterflies. Studies of *E. editha taylori*, in BC, were conducted by Jon Shepard and Crispin Guppy (Guppy *et al.* 1994, Shepard 1995, 2000).
E. editha eggs hatch in summer, about two weeks after they are laid, and then larvae begin to feed on their host plants (C. Guppy pers. comm. 2000). Primary larval food plants of *E. editha* subspecies on the Pacific Coast are plantain species (Plantago) (Johnson *et al.* 1967). In drought years when plantain species dried up, coastal *E. editha* larvae were shown to survive by moving to a secondary food plant, an owl-clover, Orthocarpus sp. (Ehrlich *et al.* 1980). In the BC population, between Mill Bay and Shawnigan Lake (now extirpated) only *Plantago lanceolata* was available for use as a larval food plant, and was used in both the summer and spring (C. Guppy pers. comm. 2000).

In summer, larvae form larval webs and enter a period of diapause or estivation, during the hot dry period. Dramatic *E. editha* population fluctuations occur, in many years, when peridiapause larvae are unable to reach sufficient size for diapause before their food plants, both plantains and owlclovers, dry up (Murphy *et al.* 1983). Thus large populations are required to act as reservoirs against random extinctions.
Following diapause, *E. editha* larvae emerge and feed in late summer, early fall. They then enter another period of diapause and over-winter or hibernate as mid-stage larva, probably deep in the leaf litter at the base of their food plants (C. Guppy, J. Shepard pers. comm. 2000). During diapause, larvae are sensitive to temperature, humidity and fungal infections (Johnson *et al.* 1967). Larvae emerge from hibernation in spring, probably around March, as 2nd or 3rd stage larvae and start feeding again (C. Guppy pers. comm. 2000). The larvae pupate when mature, probably in the leaf litter at the base of the food plants (C. Guppy pers. comm. 2000).

From April through June (peak early May) in BC, adult Checkerspots emerge from pupae. Individual butterflies live, on average one to two weeks, depending on the temperature, the hotter and sunnier, the shorter the life span (C. Guppy pers. comm. 2000). Emergence of adults is staggered over time, with some individuals living three to four weeks, so that adults can be observed over about a six week period (C. Guppy pers. comm. 2000).

Adults lay eggs on larval food plants (Layberry *et al.* 1998, Scott 1986). Females tend to start flying about one to two weeks later than males and begin egg-laying two to three weeks after first flying (C. Guppy pers. comm. 2000). *E. editha* are capable of producing substantial numbers of eggs without feeding as adults, but additional eggs are produced based on the availability of nectar sources (Murphy *et al.* 1983).

Adult Edith's Checkerspots in California coastal studies relied on several sources of nectar, including Giant-seeded Lomatium, *Lomatium macrocarpum*, California Lasthenia, *Lasthenia californica*, Coastal Tidy Tips, *Layia playglossa* and False baby Stars, *Linanthus androsaceous* (Murphy *et al.* 1983. In BC, wild strawberry (*Fragaria* sp.) and probably spring gold (*Lomatium utriculatum*) are used (C. Guppy pers. comm. 2000, Shepard 2000). In years where the previous winter was wet, nectar sources tended to be more plentiful, then more and larger eggs were laid by *E. editha* (Murphy *et al.* 1983). Specific behaviours of egg-laying, host-plant preference, movements, and mate-location tend to be locally adapted (Scott 1986).

The habitat of coastal populations of Edith's Checkerspot is described as coastal chaparral and Transition Zone open woodland (Scott 1986). In BC, *E. editha taylori* is found in Garry Oak meadows (Guppy *et al.*, 1994, Shepard 1995). Key habitat factors for *E. editha* include the availability of food plants for the larval stages and of nectar sources for the adults. Larval mobility is assisted by open grassland with sparse vegetation, such as that provided by dry rocky sites under Garry oaks. An abundance of food plants reduces the need for larvae to travel large distances. The larger meadows of Helliwell Park provide primary habitat that can support a sustainable population during stresses such as drought (Shepard 1995, 2000). In 1995 and 1996, the *E. editha taylori* population, of the Helliwell meadows was estimated, using a transect count, at 1100 individuals (Shepard 1995, 2000).

Surrounding Helliwell and Hornby, smaller coastal grassland habitats of approximately 0.5 ha, with suitable food and nectar plants, may, in good years be able to support small secondary populations of Taylor's (C. Guppy pers. comm. 2000). Unfortunately Edith's Checkerspot butterflies, in California, were found to be very sedentary, or show "a remarkable lack of wanderlust", despite no apparent barriers to dispersal (Ehrlich 1961). A percentage of tagged butterflies, however, were seen only once, and there may be a portion of the population that are sedentary and a portion that may be dispersal-prone (Ehrlich 1961). Ehrlich (1980) also noted:
"In Euphydryas absence of insects indicates population extinction and not the temporary removal of groups of individuals to some other site from which they might return when conditions are again favourable"

2 Distribution

2.1 Provincial Range

The historical range of *E. editha taylori*, in Canada, was limited to southeast Vancouver Island and some adjacent small islands, and known sites included Hornby Island, Mill Bay, Bright Angel Provincial Park, and ten sites around Victoria (Shepard 2000). Now Taylor's Checkerspot is found only on Hornby Island (Shepard 2000).

2.2 Distribution in Project Area

Taylor's Checkerspot was found throughout the coastal meadows in Helliwell Provincial Park on Hornby Island (Shepard 2000). Other small populations existed in the coastal meadow adjacent to Helliwell Park, in nearby Tribune Bay Provincial Park, and on a power line right-of-way near Norman Point on southwest Hornby Island.

3 Project-specific Food/cover Life Requisites and Habitat-uses

While the habitat requirements all life stages of for Taylor's Checkerspot are found in the Fescue / Camus ecosystem units, at Helliwell Provincial Park and the surrounding area, there are micro-habitats variations for each of the four life stages. These stages include living as larvae during summer and spring; living as larvae during fall and winter; and living and reproducing as adults in summer.

Habitat use	**Significant food/cover life requisites**.
Living as larvae during summer and spring	Food, Security habitat
Living as larvae during fall and winter	Security habitat
Living as pupae during spring and eggs in summer	Security habitat
Living and reproducing as adults in summer	Food, Security habitat

Food/cover life requisites rated for Taylor's Checkerspot in Helliwell Provincial Park

Food/cover life requisite	Habitat-use	Months	TEM unit type suitable as habitat
Food	*Living as larvae during spring (older larvae), summer and fall (new larvae)*	March- April May to August (to October only in cool, wet years)	FC
Food	*Living and reproducing as adults in summer*	late April – June (Individuals usually live for 1-2 weeks over a period of up to 6 weeks. The length of flight period and timing of flight period are variable between years due to weather)	FC
Security habitat	*Living as larvae during spring and summer*	March- April mid-June to August	FC
Security habitat	*Living as larvae during winter*	September-October to February	FC
Security habitat	*Living as pupae during spring and eggs during summer*	Pupae: usually 2-3 weeks March – May exact timing variable due to weather Eggs: Usually 2 weeks May – June	FC
Security habitat	*Living and reproducing as adults in summer*	Up to 6 weeks from mid April – June (length and timing of flight period variable between years due to weather)	FC

3.1 Living as larvae during summer, fall and spring

3.1.1 Food

Plantains were found to be key larval food plants of coastal Edith's Checkerspots (Johnson *et al.* 1967). Taylor's Checkerspot larvae, in Helliwell, were observed feeding on *Plantago maritima* (Shepard 2000). Late stage larvae from Helliwell were successfully reared on an introduced plantain, *Plantago major* in

the laboratory, but their success on this plantain in the wild is unknown (Shepard 2000). Taylor's Checkerspot, at the Mill Bay site and in Oregon, were observed feeding on *Plantago lanceolata*, also an introduced plantain (Shepard 1995, 2000). Four species of plantain are found in Helliwell (see flora species list this report).
In dry years when the plantains withered, larvae on the California coast switched to *Orthocarpus densiflorus*, an owl-clover in the Scrophulariaceae (figworts, snapdragons) (Ehrlich 1979). Other figworts are consumed by Edith's Checkerspots outside the Pacific coast area. Further observations are needed to determine if Taylor's Checkerspot in Helliwell consume a variety of plantains, and if in drought years they switch to either of the two owl-clovers or other plants found in Helliwell Park.

Some important food-plants of Taylor's Checkerspot larvae.

Latin name	Common name	Use confirmed
Plantago maritima	Seaside plantain	Yes
Plantago major	Broad-leaved plantain	No
Plantago lanceolata	English plantain	Yes
Plantago elongata	Slender plantain	No
Orthocarpus attenuatus	Narrow-leaved owl-clover	No
Orthocarpus pusillus	Dwarf owl-clover	No

3.1.2 Security Habitat

While feeding in coastal meadows and while moving along coastal bluffs, Taylor's Checkerspot larvae are vulnerable to trampling by tourists and large dogs. Larvae have been observed moving along heavily-used pedestrian trails at the cliff edge in Helliwell Park (T. Jenzen pers. comm. 2000). Open areas facilitate larval movement while densely grassed areas impede movement, thus pedestrian trails may provide preferred travel corridors in areas where introduced grasses have invaded once open meadows. The need for larvae to travel may be limited if abundant food plants are available. Larvae tend to move to find new or better food, cover or thermoregulatory environment (C. Guppy pers. comm. 2000). The larger the larvae the more they tend to move.
First and second stage larvae tend to be gregarious, moving and feeding together. They may move to find better hibernation and pupation sites. Following hibernation the larvae are solitary, although they may be seen moving past each other (C. Guppy pers. comm. 2000). Areas of the open grassland, where significant plantain populations exist, appear to provide key security habitat for Taylor's Checkerspot larvae, but additional studies are needed to understand the significance and extent of larval activity. Cover is also necessary when Edith's Checkerspot larvae go into diapause for an estivation period during the hot dry summer. The security habitat is probably the leaf litter at base of food plants (C. Guppy pers. comm. 2000). In mid to late summer, following periods of rain and re-growth of food plants, larvae may periodically break the estivation period to feed (C. Guppy pers. comm. 2000).
The larvae, pupae and adults of this species tend to be somewhat poisonous to vertebrates so incidental predation may be limited (Scott 1986). Ground feeding insectivorous birds are probably the most significant potential predator. Mice, garter snakes and alligator lizards may be minor predators (C. Guppy pers. comm. 2000); however, introduced opossum may also prey on larval *E. editha* (Guppy *et al.* 1994).

3.2 Living as larvae during winter

3.2.1 Security Habitat

Taylor's Checkerspot are thought to hibernate/over-winter as mid-stage larvae at the base of their food plants (C. Guppy, J. Shepard pers. comm. 2000). They bury themselves deep in the moist leaf litter and may be immune from all but severe impacts. During this time they may also be vulnerable to certain predators, such as the introduced opossum (Guppy *et al.* 1994). If warming occurs during the winter, larvae may also emerge periodically from hibernation to feed (C. Guppy pers. comm. 2000).

3.3 Living as pupae during spring and eggs during summer

3.3.1 Security Habitat

In late spring (April-May), end-stage larvae pupate in the leaf litter at the base of food plants (*Plantago*) and the pupal stage lasts usually 2-3 weeks, but up to 6 weeks depending on the weather (cool, cloudy weather delays all life stages) (C. Guppy, J. Shepard pers. comm. 2000). Eggs are laid during the adult flight period (April – June) and remain on larval-food plants for about two weeks. During these stages the plants and litter provide security cover.

3.4 Living and reproducing as adults in summer

3.4.1 Food

Taylor's Checkerspot butterflies, in Helliwell Provincial Park, were observed feeding on nectar from Spring Gold, *Lomatium utriculatum (*Shepard 1995, 2000). In Mill Bay, the butterflies fed from wild strawberry flowers (Shepard 1995, 2000). Probably any nectar-producing flower that is present in the habitat during the adult flight season will be used, possibly including introduced species such as dandelions (C. Guppy pers. comm. 2000). Additional studies are needed to determine if there are alternative nectar sources used by *E. editha taylori* in Helliwell.

Latin name	Common name
Lomatium utriculatum	Spring Gold
Fragaria sp. (*F. virginiana*)	Wild strawberry
Plus possibly other currently unidentified plant species.	

3.4.2 Security Habitat

During a six-week period from April to June, adult Taylor's Checkerspots are feeding, mating and laying eggs. The earliest record for BC is mid-April and the latest record is mid-June (C. Guppy pers. comm. 2000). Larval food plants are required as habitat for egg-laying and a certain amount of freedom from disturbance is required for the adult to perform its tasks. Birds are probably the major predator during this period, although the accumulated iridoid glycoides, sequestered in the bodies by larvae, tend to also make the butterflies distasteful (C. Guppy pers. comm. 2000). Moderately undisturbed coastal meadows are required at this time; although light use of the habitat by people is not of significant concern (C. Guppy pers. comm. 2000).

4 References

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Species Account for Propertius Duskywing *Erynnis propertius*

Species data

Common Name:	Propertius Duskywing
Scientific Name:	*Erynnis propertius*
Species Code:	-
BC Status:	Blue-listed
Identified Wildlife Status:	Not listed
COSEWIC Status:	Not listed

Project data

Area:	Helliwell Provincial Park, Hornby Island
Ecoprovince:	Georgia Depression
Ecoregions:	Strait of Georgia
Ecosections:	-
BGC Units:	CDFmm
Map Scale:	1:5000

1 Ecology and Habitat Requirements

The habitat of Propertius Duskywing is open oak woodland (Scott 1986). In Canada, the larvae feed on Garry Oak leaves during the summer and fall. Mature larvae hibernate, probably in the leaf litter at the base of the Garry Oaks, which is probably also where *Erynnis propertius* pupates in spring (Scott 1986, C. Guppy, J. Shepard pers. comm. 2000). Adults emerge in late April to May and have a relatively long flight period, lasting into July (Scott 1986, Shepard 1995). Adults feed on nectar from available flowers in the oak meadows. On southern Vancouver Island, adults were observed feeding on Camas, *Camassia quamash*, Vetch, *Vicia americana*, Hooker's Onion, *Allium acuminatum*, and Wooly Erophyllum, *Eriophyllum lanatum* (Shepard 1995). Propertius Duskywings are thick bodied butterflies capable of powerful flight, but they seldom fly very far (Scott 1986). Eggs are then laid on Garry Oaks.

2 Distribution

2.1 Provincial Range

The Propertius Duskywing is found along the west coast of North America, from California to southern British Columbia (Layberry *et al.* 1998). In BC, it has been found from Mt. Currie, on the mainland, to the Gulf Islands and eastern Vancouver Island (Layberry *et al.* 1998, Shepard 1995). Only six good sites for *Erynnis propertius* were found in a recent survey of southern Vancouver Island and the Gulf Islands and these included Helliwell Park, Nanoose Department of National Defense Lands, Lone Tree Hill Mt. Galiano on Galiano Island, Oaks Bluff on North Pender Island, Mount Tuam on Saltspring Island, and Rocky Point Department of National Defense Lands (Shepard 1995).

2.2 Distribution in Project Area

The Garry Oak meadows within and immediately adjacent to Helliwell Provincial Park provide appropriate habitat for the Propertius Duskywing (Guppy *et al.* 1994, Shepard 1995).

3 Food/cover Life Requisites and Habitat-uses

Habitat requirements for Propertius Duskywings, at Helliwell Provincial Park vary for four life stages. The stages include living as larvae during summer, fall and early spring, living as larvae during winter, living as pupae during spring, and living and reproducing as adults in summer.

Habitat use	Significant food/cover life requisites.
Living as larvae during summer, fall and early spring	Food, Security habitat
Living as larvae during winter	Security habitat
Living as pupae during spring or summer, and as eggs in summer	Security habitat
Living and reproducing as adults in summer	Food, Security habitat

Table 1. Food/cover life requisites rated for Propertius Duskywing in Helliwell Provincial Park.

Food/cover life requisite	Habitat-use	Months	TEM unit type suitable as habitat
Food	Living as larvae during spring and summer (Note: larvae in early spring and after hibernation may not feed)	May-August	DO
Food	Living and reproducing as adults in summer	April – July	DO, FC
Security Habitat	Living as larvae during summer, fall (young larvae) and early spring (mature larvae)	May-Sept. March	DO
Security Habitat	Living as larvae during mid-summer estivation and winter hibernation	August October-February	DO
Security Habitat	Living as pupae during spring Living as eggs during spring-summer	April – May 3 weeks May - July	DO
Security Habitat	Living and reproducing as adults in summer	April – July	DO, FC

3.1 Living as larvae during summer, fall and early spring

3.1.1 Food

Larval Propertius Duskywings feed on Garry Oak leaves and do not move from tree to tree (C. Guppy pers. comm. 2000). Shepard (1995) wondered whether larvae required young leaves to mature, and therefore how late eggs could be laid and still result viable larvae. The larvae may not feed in the fall after estivation for the hot summer period, or in the early spring, prior to pupation. Further studies are needed to confirm this (C. Guppy pers. comm.).

Table 2. The important food-plant of larval Propertius Duskywing.

Latin name	Common name
Quercus garryana	Garry Oak

3.1.2 Security habitat

Cover habitat for larvae feeding on Garry Oaks is provided by the Garry Oak trees themselves and perhaps associated shrubs. Larval Duskwings may be eaten by birds, small mammals, and possibly also by the introduced opossum. Although Duskywings have not been tested, it is unlikely that they harbour distasteful compounds, as the Checkerspots do. Thus Duskwings are probably fully palatable to predators (C. Guppy pers. comm.).

3.2 Living as larvae during winter

3.2.1 Security Habitat

Cover habitat, for larvae during hibernation, is provided by leaf litter at the base of Garry Oaks. Larvae probably bury fairly deep into the moist litter layer (C. Guppy pers. comm.). While in diapause, Duskywings may also be subject to predation by birds and small mammals. Sporadic pesticide use for defoliators of Garry Oak as well as removal of ground debris at the base of oaks may contribute to the disappearance of Propertius Duskwing in urban areas (Guppy *et al.* 1994).

3.3 Living as pupae during spring and eggs in summer

3.3.1 Security Habitat

Cover habitat for pupae is also the leaf litter below the Garry Oak trees. Duskywing pupae are also subject to predation by birds and small mammals. Eggs are laid on Garry Oaks, thus the tree bark, branches, and perhaps the associated shrubs provide the security habitat.

3.4 Living and reproducing as adult in summer

3.4.1 Food

Adult E. *propertius* have a wider habitat area than larval Duskywings. The butterflies search Garry Oak forest and shrub areas as well as open meadows for nectar sources. Known nectar plants are listed in Table 3, but any other nectar-producing flower that is present during the adult flight period is likely to used as well (C. Guppy, pers. comm.).

Table 3. The important nectar-plants of adult Propertius Duskywing.

Latin name	Common name
Camassia Quamash	Camas
Vicia americana	Vetch
Allium acuminatum	Hooker's Onion
Eriophyllum lanatum	Wooly Eriophyllum

3.4.2 Security Habitat

The open meadows and the Garry Oak forest and shrubland provide habitat for Duskywing adults. Adults are particularly vulnerable to disturbance and damage in the open meadows as they forage or rest. Birds are predators on all stages of Duskywings. The Garry Oak trees and associated shrubs provide protected habitat for egg laying.

4 References

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Species Account for Northern Alligator lizard, *Gerrhonotus coerulea*

Species data

Common Name:	Northern Alligator lizard
Scientific Name:	*Gerrhonotus coerulea*
Species Code:	R-ELCO
BC Status:	Not in jeopardy (Englestoft & Ovaska 1996, Orchard 1984)
Identified Wildlife Status:	Not listed
COSEWIC Status:	Not listed

Project data

Area:	Helliwell Provincial Park, Hornby Island
Ecoprovince:	Georgia Depression
Ecoregions:	Georgia – Puget Basin
Ecosections:	Strait of Georgia
BGC Units:	CDFmm
Map Scale:	1:5000

1 Ecology and Habitat Requirements

Preferred habitats of the Northern Alligator lizard are talus slopes, well-drained rocky forest clearings with abundant sunshine, rocky fissures and rocky outcrops, often along the edges of coniferous forests (Orchard 1984). A recent survey reported Northern Alligator Lizards were found most often in dry, rocky outcrops on south-facing slopes, but also in pastures and moist, mature Douglas-fir forests (Englestoft and Ovaska 1996). Earlier work also reported these lizards within the forest (Gregory and Campbell 1984). Northern Alligator lizards conduct all their surface activity during the daylight. They are secretive, usually hiding under rocks and logs, although they can be seen basking in sunny open spots (Gregory and Campbell 1984, Orchard 1984). These lizards can tolerate moist cooler temperatures more than most lizards and they can be found up to 1800m in the Oregon Cascade Mountains (Gregory and Campbell 1984, Nussbaum *et al.* 1983). Alligator lizards feed mostly on small invertebrates, such as, beetles, grasshoppers, crickets, aphids and spiders (Gregory and Campbell 1984, Orchard 1984). They are social at hibernating sites in spring and fall, but in summer they disperse. They breed from April to June; they usually bear 2 to 8 live young during August and September; and then they hibernate from November to February (Gregory and Campbell 1984, Nussbaum *et al.* 1983). The young are 25 to 35mm body length at birth (Gregory and Campbell 1984, Nussbaum *et al.* 1983).

2 Distribution

2.1 Provincial Range

Alligator lizards are found in a narrow strip across BC south of the 51^0 North latitude (Orchard 1984). They are reported as common in many provincial parks including Manning, Champion Lakes, Shuswap, Garbaldi, and Golden Ears, but they are unknown in Kokanee Provincial Park latitude (Orchard 1984).. In general, they are common in southern BC, including Vancouver Island and other coastal islands.

2.2 Distribution in Project Area

An Alligator lizard was seen on the southeast bluffs trail to the cormorant colony on the July 25 1977 and a skeleton was found in June of that year (BC Parks 1977). Northern Alligator Lizards are found on most of the larger southern gulf islands including Pender, Saltspring, Galiano and Saturna (Englestoft and Ovaska 1996). The lizards are also found on adjacent Denman Island (J. Balke unpublished records).

3 Food/cover Life Requisites and Habitat-uses

The significant habitat requirements can be divided into 2 periods.

Habitat use	Significant food/cover life requisites.
Living in spring, summer,fall	Food, Security cover
Hibernating in winter	Security cover

Food/cover life requisites rated for the Northern Alligator Lizard in Helliwell Provincial Park

Food/cover life requisite	Habitat-use	Months	TEM unit type suitable as habitat
Food	Living in spring, summer and fall	March-October	All meadow and probably all forest in park, but particularly the rocky and open sites DS, DAO, DO, FC, OR, RO, CL
Security cover	Living in spring, summer and fall	March-October	All meadow and probably all forest in park, but particularly the rocky and open sites DS, DAO, DO, FC, OR, RO, CL
Security cover	Hibernating in winter	November-February	Sites with rocky outcrops, crevices or large coarse woody debris, especially edges of meadows DS, DAO, DO, FC

3.1 Living in spring, summer and fall

3.1.1 Food

Small invertebrates are the principal food items and these are encountered amongst vegetation, woody debris, and rocks in fairly open areas. Invertebrate prey recorded includes beetles, grasshoppers, crickets, bugs, aphids and spiders (Orchard 1984).

3.1.2 Security cover

Herb and shrub vegetation, as well as logs, other woody debris, and rocks provide cover for Northern Alligator lizards. Open rocky areas, although exposed, may be the easiest for these small lizards to move through. Vegetation, such as thick grass and low shrubs, although protective, may be the most restrictive on movement. Moderate amounts of decomposing woody debris may provide both cover and a certain degree of accessibility for both movement and foraging. The Northern Alligator lizard basks in sunny exposed spots and is vulnerable at these times to disturbance and predators, including humans and dogs.

3.2 Hibernating in winter

3.2.1 Security Cover

Northern Alligator lizards use protected sites such as rock piles, rock crevices, perhaps under large downed woody debris for hibernation sites. Suitable habitat is necessary to provide adequate protection and to be free of disturbance during the winter.

4 References

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Species Account for Pacific Treefrog *Pseudacris regilla*

Species data

Common Name:	**Pacific Treefrog**
Scientific Name:	*Pseudacris regilla*
Species Code:	A-PSRE
BC Status:	Not listed
Identified Wildlife Status:	Not listed
COSEWIC Status:	Not listed

Project data

Area:	Helliwell Provincial Park, Hornby Island
Ecoprovince:	Georgia Depression
Ecoregions:	Georgia – Puget Basin
Ecosections:	Strait of Georgia
BGC Units:	CDFmm
Map Scale:	1:5000

1 Ecology and Habitat Requirements

The habitat requirements of Pacific treefrogs includes fresh water, in ponds, lakes, wetlands, or rivers, although not necessarily permanent open water (Orchard 1984). The adult frogs are distributed throughout the forest and can be located, particularly by their call, high in trees, on shrubs, or on man-made structures. The Pacific Treefrog can retain moisture due to skin glands that produce a waxy coating (Corkran and Thoms 1996). As adults, they feed on a variety of flying or crawling insects (Green and Campbell 1984). Pacific treefrogs set up calling territories and then mate in water, often thick with vegetation. From March to May eggs are laid in clusters, usually attached to vegetation submerged in the water bodies (Orchard 1984). Adults leave the water after the mating period and are active on land. Tadpoles hatch from April through July, and they metamorphose into adults from June through August (Orchard 1984). The tadpoles are vegetarians, eating soft vascular plant material, and unicellular and filamentous algae. They reach maturity in approximately one year (Green and Campbell 1984).

2 Distribution

2.1 Provincial Range

Pacific treefrogs are omnipresent on the southern BC coast, including Vancouver Island and other coastal islands (Orchard 1984). They are also found north to Quesnel and all across the southern 1/3 of the province (Green and Campbell 1984). They were introduced into the Queen Charlotte Islands. They are one of the most abundant amphibians in western North America, and they range from British Columbia to the tip of Baja California and from the Pacific coast to Nevada (Brattstrom and Warren 1955). Treefrogs occur at elevations from sea level up to up to 3,800 m.

2.2 Distribution in Project Area

Mating Treefrogs were recorded in a Helliwell Park wetland in March 2000, at the far end of St. John's Point, and they can be heard in trees throughout the Park. A pond and marsh complex near the Park entrance, but outside the Park, is probably also a breeding site. Surveys are needed of all pond-breeding and forest amphibians to assess their distribution in the Park.

3 Food/cover Life Requisites and Habitat-uses

Habitat use	Significant food/cover life requisites.
Living as adult year-round	Food, Security cover
Reproducing Adult	Security cover
Living as egg and larva	Food, Security cover

Food/cover life requisites rated for Pacific Treefrog in Helliwell Provincial Park

Food/cover life requisite	Habitat-use	Months	TEM unit type suitable as habitat
Food	Living as adult year-round	All year	Forest DS, DAO, DO, RK
Food	Living as egg and larva	March-August	Standing water AS, CS, VP
Food	Living as a Reproducing adult	March-July	Standing water AS, CS, VP
Security cover	Living as adult year-round	All year	Forest DS, DAO, DO, RK
Security cover	Reproducing adult	March-July	Standing water AS, CS, VP
Security cover	Living as egg and larva	March-August	Standing water AS, CS, VP

3.1 Living as adult year-round

3.1.1 Food

Insects, both flying and crawling, are the principle diet of the Pacific Treefrog. Insects are found within the forest canopy layers, from the ground to the treetops.

3.1.2 Security cover

Forest vegetation at all levels provides security cover. In general, treefrog activity is related to temperature and moisture (Brattstrom and Warren 1955). Moisture is an essential criterion. Mild temperatures allow treefrogs within Helliwell, to be active nearly the entire year. During extreme cold and in periods of inactivity treefrogs will find shelter in spaces under leaf litter, in burrows, or under coarse woody debris. Treefrogs will sit on exposed vegetation in the sun to warm themselves, but in warm-desiccating environments, they will seek shelter. Young treefrogs will live adjacent to ponds sheltering in debris and vegetation. Treefrog predators include gartersnakes, waterbirds such as herons, opossums, raccoons, and skunks, and all but the latter two species are present in Helliwell (Brattstrom and Warren 1955, Gregory 1978).

3.2 Living as a Reproducing adult

3.2.1 Food

Insects within the pond environment provide the food source for breeding treefrogs. A variety of prey are selected including beetles, midges, mosquitoes, other flies and leafhoppers, and treefrogs feed mainly above the water surface, often eating insects off pond vegetation (Brattstrom and Warren 1955).

3.2.2 Security cover

Unpolluted, fresh water is necessary for treefrogs to reproduce. Pacific treefrogs appear to occupy breeding habitat based on vegetation, size and temperature and treefrogs seem to avoid pools with no cover vegetation (Brattstrom and Warren 1955). Abundant vegetation and debris within ponds provides protection from predators to treefrogs, such as garter snakes, raccoons and herons (Brattstrom and Warren 1955, Gregory 1978) (De Vito *et al*. 1999). Also, if fish are present in the system, sufficient cover must be present to provide shelter or the recruitment of treefrogs will be reduced or absent.

The size and temperature characteristics of pools are related, such that smaller pools may warm up or cool down more quickly than larger water bodies. Three to six inch deep water is sufficient for treefrogs to breed, and some large, deep spring-fed ponds may never reach suitable temperatures for treefrogs. The frogs will begin singing when air or water temperatures reach 9.8 to 10^{o}C and will cease singing at temperatures of 20^{o}C (Brattstrom and Warren 1955). Eggs are laid at temperatures of between 12 and 15^{o}C and once laid, eggs can survive extremes of temperatures for short periods (Brattstrom and Warren 1955). Tadpole growth is more rapid in warmer temperatures, and although they prefer 19 to 20^{o}C, they will grow in temperatures from 2 to 33^{o}C. Breeding habitat may also be standing water that dries up in the late summer-fall. Treefrogs will reproduce in temporary water in road ditches and in depressions worn into rocks along river systems. At least one of the wetlands within Helliwell has sufficient water in spring to host breeding treefrog. It is unlikely that these wetlands support fish populations.

3.3 Living as egg and larva

3.3.1 Food

Tadpoles are vegetarians, feeding on algae, and soft-bodied vascular plants growing within the ponds.

3.3.2 Security cover

Unpolluted fresh water is essential for the health and growth of eggs and tadpoles of the Pacific Treefrog. Vegetation and debris within the ponds also supplies cover for the tadpoles, particularly if the pond is shallow. Tadpoles will seek out the shallowest warmest water possible. The tadpoles are taken by predators such as garter snakes, water birds, mink, fish and raccoons (Brattstrom and Warren 1955, De Vito *et al.* 1999).

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Species Account for Townsend's Big-eared Bat, *Corynorhinus townsendii*

Species data

Common Name:	Townsend's Big-eared Bat
Scientific Name:	*Corynorhinus townsendii*
Species Code:	M-COTO
BC Status:	Blue-listed
Identified Wildlife Status:	Not listed
COSEWIC Status:	Not listed

Recently, this species' Latin name has changed from *Plecotus townsendii* to *Corynorhinus townsendii*.

Project data

Area:	Helliwell Provincial Park, Hornby Island
Ecoprovince:	Georgia Depression
Ecoregions:	Georgia – Puget Basin
Ecosections:	Strait of Georgia
BGC Units:	CDFmm
Map Scale:	1:5000

1 Ecology and Habitat Requirements

The Townsend's Big-eared Bat occurs in a variety of habitats such as coniferous forest, riparian communities, xeric shrub-grassland, arid plateaus and desert. In BC, it ranges from coastal forests to the arid grasslands of the dry interior. A colony, consisting of approximately 200 individuals, was found roosting, in a building, in summer, near Cranbrook. In other parts of its range, this species has been observed using wildlife trees; although detailed summer roosting ecology in BC remains unknown.

Unlike most British Columbia bat species, several wintering locations have been located for *C. townsendii*. During winter, bats of this species fly from 10 to 65 km to locate winter hibernacula, which are typically caves or mines. Townsend's Big-eared bats roost singly or in tightly packed clusters. There is a record of a hibernaculum in a cave for 20-40 individuals on Thetis Island on the west coast. Observations from the Okanagan Valley to Williams Lake have located this species in caves, tunnels leading to caves, mine entrances and mine shafts. Usually Townsend's Big-Eared bat prefers cold places for hibernation, often using well-ventilated parts of caves and mines, moving to more thermally stable areas with the onset of cooler temperatures. *P. townsendii*, at the northern limit of its range, may be more tolerant to colder hibernacula temperatures than other bat species.

Townsend's Big-eared bats are highly maneuverable in flight, and forage along waterways and edges of forests. This species feeds primarily on small moths, although selected lacewings, beetles, and flies are also taken. Females give birth annually to a single young, and longevity records for *C townsendii* suggest a potential life-span of 16.4 years.

2 Distribution

2.1 Provincial Range

This species is most commonly found in western North American, including much of central Mexico, although isolated populations occur in gypsum caves of north-east Texas, Oklahoma, Kansas, and limestone caves of north-east Arkansas, Missouri, Oklahoma, Kentucky, Virginia and West Virginia. In Canada, this species has only been found in southern and central British Columbia. The range extends west to Vancouver Island, east to Creston, and as far north as Williams Lake. Small colonies of this species hibernate in caves and mines in both the dry interior and Vancouver Island. Recent surveys of the dry interior have confirmed the presence of this species in the Bunchgrass and Interior Douglas-fir Biogeoclimatic zones. Also the bat was shown to use buildings as summer roosting habitat. In BC, this species ranges from sea level to 1070 m.

2.2 Distribution in Project Area

In the summer of 2000, surveys, for Townsend's Big-eared bats, on Denman and Hornby Islands, found roost sites and a maternal colony. The maternal colony, on Denman, was situated in a farm outbuilding and the bats were observed foraging over the open farm fields and along the hedgerows. On Hornby, individual Townsend's bats were found in Strachan Valley approximately 5km from Helliwell (pers. comm. S. Holroyd). Within Helliwell park, the availability of open grass and shrub lands, as well as open forests, and extensive forest edge would support abundant prey and feeding opportunities for these bats. The presence of small wetlands, within and adjacent to the park, contribute to valuable habitat for this species. Mist netting surveys for bats within the Park, as well as, roost searches in adjacent buildings, will assist in providing the necessary inventory information regarding this species.

3 Food/cover Life Requisites and Habitat-uses

Habitat use	**Significant food/cover life requisites.**
Living during summer as a male & as a female or juvenile after the maternal colony disperses	Food, Security habitat
Living during summer in a maternal colony	Food, Security habitat
Living during the winter	Security habitat

Food/cover life requisites rated for Townsend's Big-eared Bat in Helliwell Provincial Park

Food/cover life requisite	Habitat-use	Months	TEM unit-type suitable as habitat
Food	Living during summer as a male & as a female or juvenile after the maternal colony disperses	May - October	Meadows, Open forest, Shrub lands, Wetlands DO, FC, AS, CS
Food	Living during summer in a maternal colony	June - August	If maternal colony near park Meadows, Open forest, Shrub lands, Wetlands DO, FC, AS, CS
Security Habitat	Living during summer as a male & as a female or juvenile after the maternal colony disperses	May – October	Old-growth trees, Rock bluffs and crevices DO, DAO, DS, CD, CL, OR
Security Habitat	Living during summer in a maternal colony	June - August	Large open structure with sufficient protection. Most likely not in Park
Security Habitat	Living during the winter	November - April	Cave or similar habitat. Not in Park

3.1 Living during summer

3.1.1 Food

The foraging needs of females within the maternal colony, and all other bats are considered similar; although there maybe spatial partitioning of food resources between the sexes. This idea was suggested by the netting of disproportionately more males or more females, depending on the particular site in California. The assumption that all the bats forage in available forest and shrub-steppe habitat, as well as grasslands, forest edge, wetlands and riparian habitats remains to be disproven. Undeveloped habitats rich in insects and free of pollutants provide the required diet of small moths, lacewings, beetles and flies. As gleaners, these bats can forage by picking insects off vegetation and can use characteristics of the habitat inaccessible to strictly aerial insectivores. Helliwell Park and the adjacent meadows to the northwest are free of both development and the use of pesticides; however, encroachment of forests has reduced the meadow habitat, while creating additional edge habitat. Several small wetlands in and adjacent to, Helliwell create additional insect-rich habitat as well as a source of fresh water.

3.1.2 Security habitat as a male or as a female or juvenile after the maternal colony disperses

Individual roost sites for day and night include buildings, caves, mines, rocky outcrops, and wildlife trees. Temperature and humidity may determine appropriate roost sites, but the actual requirements are unknown. Helliwell Park provides large old trees as roosts and there may be suitable crevices in overhanging coastal cliffs although the extent of this habitat is unknown. While little is known about specific disturbance factors, Townsend's Big-eared bats appear to be extremely sensitive to change, particularly disturbance caused by humans. When disturbed, the bats may abandon these sites and move to others that offer more seclusion.

3.1.3 Security Habitat for a maternal colony

Townsend's Big-eared Bat females rear young in colonies or "nursery roosts". In California, these roosts are also breeding sites between November and February. These nursery roosts are located in buildings, caves and mines. Criteria used to select suitable sites may include availability, temperature, humidity,

predation pressure, and susceptibility to disturbance. Details of these roost sites will become more evident as more sites are discovered in BC. It appears that buildings suitable as roosts have a large, dark, warm and relatively secluded area with ample access. Bats may become habituated to certain repeated, non-threatening disturbances as evidenced by the recent discovery of a large maternal colony in the tractor shed of a working farm. It may be that maternal colonies, whose choice of habitat is more limited, are somewhat more resistant to minor disturbance than individual roosting bats or small hibernating groups. Buildings adjacent to Helliwell Park should be checked for roost bats, but it is unlikely that maternal or nursery roost habitat is available within the Park. Consideration could be given to creating such habitat in the Park in the future.

3.2 Living during the winter

3.2.1 Security Habitat

At least twenty winter hibernation sites of these bats are known in BC, thus more information exists about winter hibernacula of Townsend's Big-eared Bats than for most bats. Caves and mines provide suitable stable cool temperatures, usually between 0°C and 7.4°C and well-ventilated areas tend to support more bats. These bats seem to nest 2-3 metres up on the walls, rather than on ceilings. Helliwell Park does not appear to provide winter habitat, although caves did exist on nearby Denman Island and caves may be present on adjacent Vancouver Island.

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5 Acknowledgments

Susan Holroyd, Inventory Specialist, Region 1, Ministry of Environment, and a bat researcher, provided most of the material from which this account is compiled, and Susan also edited the account. Some of the Townsend's bat material used was written by Sal Rasheed.

Species Account for Pelagic Cormorant, *Phalacrocorax pelagicus*

Species data

Common Name:	Pelagic Cormorant
Scientific Name:	*Phalacrocorax pelagicus*
Species Code:	B-PECO
BC Status:	Blue/Yellow-listed
Identified Wildlife Status:	Not listed
COSEWIC Status:	G5 S4B, SZN

There are two subspecies of Pelagic Cormorant in British Columbia: *P.p.pelagicus* [blue-listed] breeds from the Queen Charlotte Islands northward but is found along the south coast in winter. *P.p. resplendens* [yellow-listed] is found along the south coast and northward for an undetermined distance (Campbell *et al.* 1990). Although it is most likely to be *P.p. resplendens* that breeds in the vicinity of Hornby Island, no distinction is made in this document. In BC, the Pelagic Cormorant is a common to abundant resident, a fairly common migrant along the coast, and a widespread coastal breeder (Campbell *et al.* 1990).

Project data

Area:	Helliwell Provincial Park, Hornby Island
Ecoprovince:	Georgia Depression
Ecoregions:	Georgia – Puget Basin
Ecosections:	Strait of Georgia
BGC Units:	CDFmm
Map Scale:	1:5000

6 Ecology and General Habitat Requirements

6.1 Habitat

Pelagic Cormorant habitat is the rocky coast. These cormorants forage in bays, harbours, lagoons, surge narrows and coves, and they usually roost on unvegetated islets, cliffs or man-made structures such as navigational beacons, ferry docks, and log booms (Campbell *et al.* 1990). Their unique wettable plumage, a feature that is well suited to underwater pursuit of shallow demersal fish, requires perching sites for drying and thermoregulation. During the non-breeding season, they usually occur as scattered individuals and small flocks, but converge at feeding areas such as herring spawn sites in spring, and population shifts are related to seasonal fish availability.

6.2 Food

Pelagic Cormorants feed from the bottom, in the littoral-benthic zone and its diet includes Pacific Sandlance, Pacific herring, Pacific Staghorn Sculpin, Crested Gunnel, Shrimp, Shiner Perch, Rockfish and Pacific Salmon (Campbell *et al.* 1990, Sullivan, 1998, Vermeer and Ydenberg 1989).

6.3 Reproduction

Pelagic Cormorants breed throughout inner and outer coastal areas in BC with 145 historical breeding sites, 55% of them in the Strait of Georgia (Campbell *et al.* 1990). They are colonial nesters and use cliffs on islands, headlands, caves, and man-made structures (Campbell *et al.* 1990, Vermeer *et al.* 1989). Unlike larger cormorant species, they are not able to defend nests and young against aerial predators but

rely on inaccessibility of cliff-nesting habitat to deter predators (Ehrlich *et al.* 1988). Nests are made on the narrow ledges of cliffs, within sea caves, or on narrow beams and ledges of human structures: the nests are compact and made of grass, seaweeds, feathers and marine debris, or occasionally eggs may be laid on bare rock (Campbell *et al.* 1990, Vermeer *et al.* 1989). The cliff side nesting and roosting sites on St. John Point in Helliwell Park stand out because of the summer "whitewash" they receive from the cormorants fecal deposits. Individual nests may be used for several seasons. Breeding individuals remain in the colony during the day, non-breeding individuals return in the evening (Ehrlich *et al.* 1988).

Records for clutches indicate eggs are laid from late April to late August, with most from mid-June to early July (Campbell *et al.* 1990). If the first clutch is destroyed a second clutch may be laid. Most young fledge by late August – September (Moul 2000).

6.4 Nesting Success & Disturbance

The appearance of natural predators near or within a colony often causes the sudden mass departure of adults from nests; this departure may displace eggs or chicks out of the nest, exposing them to predation or weather. Mass departures seem more easily induced at the beginning of the reproductive season that at other times but can occur at any time especially if the colony is subject to repeated disturbance (Siegel-Causey and Litvinenko 1993). The most critical times of the breeding season for impacts from disturbance are the late egg incubation and first weeks of hatchlings and during these periods an entire colony can be destroyed (*ibid*.). At sites in the Gulf Islands, Bald eagles have been seen to prey on gulls near cormorant nest sites: this disturbance by eagles flushed the cormorants, whose nests were then preyed upon by crows and gulls (Moul 2000). Repeated disturbance by pleasure boaters was also thought to be a possible incitement of depredation of the cormorant nests by gulls; however, during a provincial survey of nesting sites in the Southern Straits it was found that approaching the nest sites by kayak created considerably more disturbance than approaching them in small motorized vessels (T. Chatwin pers. comm. 2000). Disturbance from persons onshore at colony sites has also been reported (*ibid*.) One colony in the San Juan Islands was abandoned due to human disturbance (children throwing rocks and sticks from the cliff top above the nests) (Moule 2000). A visual barrier between humans and the birds is probably sufficient to prevent disturbance of the birds (I. Moule pers. comm. 2000).

7 Distribution

7.1 Provincial Range

The Pelagic Cormorant breeds from Alaska to California and is a common resident along the inner and outer coastal areas of British Columbia. It rarely occurs very far up inlets, and there are no records from freshwater locations. (Campbell *et al.* 1990). In British Columbia, Pelagic Cormorant populations are centred on the south coast and 55% occur in the Strait of Georgia (Campbell *et al.* 1990). These birds are found mostly at sea-level.

7.2 Distribution in Project Area

Pelagic Cormorants were first recorded as breeding on the cliffs at Helliwell Provincial Park in 1955-56 (Vermeer *et al.* 1987). At that time 50 nests were reported. Between 1956 and 1987, the number of nests recorded ranged from 9 to 127. In 1990, four nests were observed at the northwest end of the colony on July 14; by July 31, a total of 124 nests were spread over five areas; then by August 29, 74 half to full-grown Pelagic Cormorant chicks were examined for deformities, and in addition, five immature Brandt's Cormorants were in the colony (Breault 1990).

Since 1990, there have been no formal counts, although naturalists in the area report that the cormorants have not successfully nested at this site for at least 3 years, 1998-2000 (D. Carreck, A. Heath pers. comm.

2000). In 1999 the number of Pelagic Cormorants which successfully fledging offspring in 6 sample sites along southeastern Vancouver Island, was 41% below their historic highs and three other sites also failed to pledge any chicks in 1999 (Moul 2000). The reasons for this decline are not known. A large colony of nesting Pelagic Cormorants is situated on Chrome Island at the southern tip of Denman Island and until 1983 a colony of up to 88 nesting pairs was located on Sisters Islets. Historical trends for these two colonies along with data for the nesting site on St. John Point are shown in the table below.

Trends in numbers of nesting pairs of Pelagic cormorants in and around Helliwell Park 1938-1998.

Location	1938	1955	1957	1961	1968	1974	1977	1978	1979	1980	1981	1983	1987	1990	1991	1992	1993	1994	1995	1998	1999
St. John Point	0	50	30	25	?	9	14	36	59	103	99	127	101	124	?	?	?	?	?	0	0
Chrome Is	?	?	?	?	?	54	93	90	?	79	59	78	141	80	67	122	171	220	212	?	134
Sisters Is.	?	?	?	?	14	41	?	88	?	70	69	51	?	?	?	?	?	?	?	?	?

8 Helliwell-specific Food/cover Life Requisites and Habitat-uses

Habitat use	Significant food/cover life requisites.
Living as adult during non-breeding season	Food, Security habitat
Mating, egg-laying and rearing young (Reproducing)	Food, Security habitat
Living as fledglings	Food, Security habitat

Table 4. Food/cover life requisites rated for Pelagic cormorant in Helliwell Provincial Park.

Food/cover life requisite	Habitat-use	Months	TEM/MEM unit-type suitable as habitat component
Food	Living as adult during non-breeding season	September – March	Subtidal Marine Ecosystem: Rock substrate; <60m
Food	Reproducing	April – August	Subtidal Marine Ecosystem: Rock substrate; <60m
Security habitat	Living during non-breeding season	September – March	Roosting: Intertidal Marine Ecosystem: Cliffs; high or medium; steep; eroding or with caves other: all marine areas
Security habitat	Reproducing	April – August	Nesting: Intertidal Marine Ecosystem: Cliffs; high or medium; steep; eroding or with caves other: all marine areas

8.1 Living as adult during non-breeding season

8.1.1 Food

Pelagic Cormorants forage near the sea surface along the coasts of Hornby and Denman Islands. Habitual roost sites on ledges or caves of eroding cliffs are used along the coasts and long strings of cormorants fly from these sites in the morning, returning at dusk. The preferred food of Pelagic cormorants are non-schooling fish of rocky reefs and bottoms near preferred roosting sites. Primary winter feeding areas include the waters around Ford Cove and Norris Rocks (Ilsa Ravolzins, Amanda Heath pers. comm. 2000) and the waters along the cliffs on the south shore of St. John Point and Flora Islets (Burger *et al.* 1997).

8.1.2 Security habitat

Roost sites in the Helliwell vicinity are steep inaccessible cliffs, ferry docks, and navigational buoys. Most of the Helliwell Park cormorant nest and roost site is situated along the south shore of St. John Point where there are high (>5 m), steep (> 35˚) cliffs with overhanging tops. A portion of the cliffs may be accessible to determined terrestrial predators, possibly opossums.

8.2 Reproducing

8.2.1 Food

Breeding cormorants forage within 10 km of colony locations (Ainley and Boekelheide 1990). In addition to the nesting site on St. John point there are Pelagic cormorant nesting sites on Sisters Islets and Chrome Island that are both within 10 km of marine waters within Helliwell Park. Potential feeding areas within the park include the numerous small rocky reefs in Lambert Channel (map XX; Barny French reef, Scallop reef, Savoie rocks, Maude reef, Red Snapper reef and 9 Fathom rocks), the reefs surrounding Toby Islet, Heron and Norris Rocks, the reef at Nash Bank, Cape Gurney reef, the coastline from Tribune Bay to St. John Pt. and the rock wall and reefs extending from St. John Pt to south of Flora Islet.

8.2.2 Security habitat

Nest and roost sites in Helliwell and adjacent areas are similar habitat (see above).

Assumptions

Reproductive Habitat rating assumptions:

1. Only cliffs that are immediately adjacent to and facing coastal waters will be rated as possible habitat..
2. Cliffs higher than 5 m (moderate or high) will be rated up to high for reproducing habitat.
3. Steep (>35˚) cliffs with narrow ledges or caves will be rated up to high for reproducing habitat, whereas less steep or terraced cliffs will be rated low to nil for reproducing habitat.
4. Vegetated cliffs will be rated nil to moderate for reproducing habitat.
5. Sea caves with steep high walls (greater than 5 m) and narrow ledges will be rated moderate to high for reproducing habitat

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Species Account for Harlequin Duck, *Histrionicus histrionicus*

Species data

Common Name:	Harlequin Duck
Scientific Name:	*Histrionicus histrionicus*
Species Code:	B-HADU
BC Status:	Yellow-listed S3
Identified Wildlife Status:	Not listed
COSEWIC Status:	Not listed

Project data

Area:	Helliwell Provincial Park, Hornby Island
Ecoprovince:	Georgia Depression
Ecoregions:	Georgia – Puget Basin
Ecosections:	Strait of Georgia
BGC Units:	CDFmm
Map Scale:	1:5000

1 Ecology and General Habitat Requirements

The Harlequin duck is a small sea duck found inhabiting nearshore marine waters of the north Pacific and north Atlantic. Populations are considered endangered in eastern North America and of special concern in western North America (Goudie *et al.* 1994). However, in a few regions of its range, notably coastal British Columbia and the Aleutian Islands, it may be very abundant. The Harlequin duck moves onto the coast after it has completed breeding in inland areas along the rocky shores of mountain streams. Goudie (1996) estimated the overwintering population of Harlequin ducks in the Strait of Georgia at about 16,500 birds although unpublished census data from M.S. Rodway and H.M. Regehr suggest that the overwintering population my be closer to 10,000 birds (H.M. Regehr pers. comm. 2001). Two critical times for the Harlequin duck in the area of Helliwell Park are:

- during the spring herring spawn, when a large portion of the total population of Harlequin ducks overwintering in the Strait of Georgia are found along the Hornby Island shores. An estimate of the spring population concentrated over herring spawn at Hornby Island yielded 2948 males and 2282 females in the spring of 1995 (Goudie 1996).
- and during the late summer when a portion of the population returns to the coast to for their post-breeding moult.

2 Ecology and Habitat Requirements

2.1 Habitat

Harlequin ducks feed close the closest to shore and in the shallowest water of all of the diving ducks. For the most part Harlequins tend to stay within 50-60 m of the shore and feed in water averaging 1.1 m deep (Savard 1988). Palmer (1976) gives potential diving depths of 2-4 meters. The diving depths On the BC coast, Harlequins frequent the water adjacent to rocky shores and in and around kelp or eelgrass beds (Campbell *et al.* 1989, Savard 1988, Vemeer 1983, Morgan 1987). They may significant amounts of time

"hauled out" or "roosting" on submerged rocks and ledges n the intertidal zone (Goudie 1996). Individual birds tend to have high site fidelity.

2.2 Food

The principal food species of the Harlequin duck in the Hornby Island region are epibenthic molluscs (snails, limpets, chitons) and crustaceans (shrimp, crabs, barnacles, echinoderms), fish eggs, and marine plants. The principal food items vary by season. A recent study of Harlequin duck feeding behaviour in the Hornby Island area found that the most frequently observed prey items switched from snails (predominately *Littorina scutulata*) during the winter months to herring spawn during the early March period when herring spawn in large numbers in the region, and crabs (predominately *Hemigrapsus nudus*) during the late summer moult period (M.S. Rodway, unpub. data). Harlequin ducks also feed on polychaete worms especially in the spring months when they were the third most abundant species in the diet of Harlequins in the Hornby Island region (*ibid.*). Marine plants, such as *Fucus* spp. and *Zostera* spp., were observed in the diet of Harlequin ducks especially during the March period when they were feeding on herring spawn (*ibid.*). It is thought that these plants were ingested incidentally to the herring spawn (*ibid*.). Feeding studies indicate that Harlequin ducks are opportunistic feeders, feeding on those epibenthic prey species that are most abundant in the limited depth range to which they can dive. The seasonal variation in prey may be related to the seasonal abundance of that prey item (e.g. herring in spring and crabs in August when the young of the year are becoming available) and the lack of daytime low tides during the winter months.

2.3 Reproduction

The western North American population of Harlequin ducks breed in the mountainous areas of Alaska, BC and the mid-western US; the eastern population breeds from southern Baffin Island to central Quebec and eastern Labrador (Bellrose 1976). Nesting sites are typically along the rocky shores of mountain streams.

3 Distribution

3.1 Provincial Range

Harlequin ducks winter along the Pacific coast from southern Alaska to central California and on the Atlantic coast from Labrador to New Jersey (Bellrose 1976). In BC they common to locally very common migrants, summer visitants and fairly common to locally common in winter (Campbell *et al.* 1989).

3.2 Distribution in Project Area

The population of Harlequin ducks in the Hornby Island area is estimated at a maximum of about 5,400 birds during the period of the spring herring spawn. An aggregation of 4-5,000 birds was observed over the spring herring spawn along the Hornby Island shores in 1995 (Goudie 1996); this is the largest recorded concentration of Harlequin ducks in the world. A recent census of the overwintering population estimated that 600-700 Harlequin ducks are present in the Hornby Island region (unpublished census data from M.S. Rodway and H.M. Regehr). In the park area large numbers of Harlequin ducks are frequently seen roosting on the intertidal rock platforms found along the north-east shore of St. John point. Other sites where Harlequin ducks are commonly seen include Ford Cove and Norris Rocks.

4 Helliwell-specific Food/cover Life Requisites and Habitat-uses

Habitat use	Significant food/cover life requisites.
Living as adult during non-breeding season	Food, Security habitat
Post breeding moult	Food, Security habitat
Mating, egg-laying and rearing young (Reproducing)	N/A

Table 5. Food/cover life requisites rated for Harlequin Ducks in Helliwell Provincial Park.

Food/cover life requisite	Habitat-use	Months	TEM/MEM unit-type suitable as habitat component
Food	Living as adult during non-breeding season	September – April	Subtidal Marine Ecosystem: Rock substrate; < 4m; semi-protected/semi-exposed marine areas
Food	Moulting	June – September	Subtidal Marine Ecosystem: Rock substrate; < 4m; semi-protected/semi-exposed marine areas
Security habitat	Living during non-breeding season	September – April	Roosting: Intertidal Marine Ecosystem: Rock Platform, ; semi-protected/semi-exposed marine areas
Security habitat	Moulting	June – September	Moulting: Intertidal Marine Ecosystem: Rock Platform, ; semi-protected/semi-exposed marine areas

4.1 Non-breeding season

4.1.1 Food

Harlequin ducks forage in shallow, semi-protected, rocky coastal regions coasts of Hornby and Denman Islands. The preferred food species are epibenthic molluscs and crustaceans such as snails, limpets, chitons, shrimp, crabs, barnacles, echinoderms and algae. Herring spawn is seasonally an important food source. The primary feeding area within the park are along the coastline from St. John's Point to Whaling Station Bay, and around Flora Islet and Reef.

4.1.2 Security habitat

Roost sites in the Helliwell vicinity are on the rocky intertidal platform beaches.

4.2 Moulting Period

After mid-June male Harlequins desert their mates and begin to congregate for their post-nuptial moult at favourable feeding places that are frequently on the coast (Bellrose 1976). It is thought that the birds come back to the same sites year after year (Savard 1988). During this period the ducks are especially vulnerable as they are flightless, concentrated and probably have high energy demands (*ibid*.).

4.2.1 Food

Food is the same as for non-breeding period. Herring spawn is not present during this period.

4.2.2 Security habitat

Non-breeding and moulting sites in Helliwell and adjacent areas are similar habitat (see above). Concentrations have been observed around Flora Islet, Phipps Point, Collishaw Point, Tralee Point, Heron

Rocks, St. John Point, Grassy Point, Cape Gurney, and the Anderson shoreline (Savard 1988, Goudie 1996, H.M. Regehr pers. comm. 2001).

4.3 Assumptions

Feeding Habitat rating assumptions:

1. Only coastal waters < 4 m will be rated as possible feeding habitat.
2. Rock platform shores with bedrock, cobble or boulders will be rated high; sand, mud or silt substrates will be rated medium-low.
3. Semi-protected or semi-exposed shores will be rated high, protected and exposed shore will be rated moderate.
4. The presence of kelp or eelgrass will be rated as high..
5. The seasonal presence of herring spawn will be rated as high.

Roosting Habitat assumptions:

1. Only intertidal rock platforms shore-zone types will be rated as possible roosting habitat.
2. Semi-protected or semi-exposed shores will be rated high, protected and exposed shore will rated moderate

5 References

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