Pacific Water Shrew

Sorex bendirii

Original[1] prepared by Pontus Lindgren

Species Information

Taxonomy

Shrews belong to the Soricidae family, of which there are 13 species in Canada and nine species in British Columbia. The Pacific Water Shrew (*Sorex bendirii*), also referred to as the Marsh Shrew (Pattie 1973; Maser and Franklin 1974; Whitaker and Maser 1976; McComb et al. 1993) and Bendire's Shrew (Cowan and Guiguet 1973; Banfield 1974), has three subspecies, of which only *S. bendirii bendirii* is found in British Columbia.

Description

The Pacific Water Shrew is the largest shrew in the province (Nagorsen 1996) and the largest species of the *Sorex* genus in North America (Maser 1998). Nagorsen (1996) states that this shrew has an average length of 154 mm, of which 70 mm is tail, and weighs an average of 13.2 g. It has velvety dark chocolate brown fur that is only slightly paler on its ventral surface than its dorsal surface. The Pacific Water Shrew molts; however, the summer pelage is very similar in colour to the winter pelage (Banfield 1974). The tail is unicoloured and, like the body, is also dark brown. Adapted for its semi-aquatic lifestyle, it has a row of stiff fringe hairs on the toes of its hind feet. While submerged, this shrew maintains its body temperature with an insulating layer of air trapped within its fur, giving the shrew a silvery appearance while in the water (Calder 1969; Nagorsen 1996). In addition to being able to dive, air bubbles trapped beneath the feet provide enough buoyancy to enable this shrew to run on the surface of the water for up to 5 seconds. The Pacific Water Shrew is active during all hours of the day and throughout the year (Maser 1998).

The Common Water Shrew (*S. palustris*) is similar to the Pacific Water Shrew in several ways; it too is a large shrew, inhabits the Lower Mainland, lives close to water, has fringe hairs on its hind feet, can dive, and can run for short distances on top of water. However, within British Columbia, these shrews are often separated by elevation; the Common Water Shrew is usually found within habitats above 850 m while the Pacific Water Shrew typically inhabits areas below 850 m (Nagorsen 1996). Where these species do occur together, a Common Water Shrew can be distinguished by its bicoloured body and tail (dark above and pale below) which differs from the solid dark colouration of the Pacific Water Shrew.

Distribution

Global

The Pacific Water Shrew is found within the coastal lowlands of the Pacific Northwest, from northern California to southern British Columbia (Nagorsen 1996).

British Columbia

Within British Columbia, the Pacific Water Shrew is restricted to the extreme southwest corner, occupying the Lower Fraser Valley. It has been observed as far east as the Chilliwack River and Agassiz and as far north as the north shore of Burrard Inlet (Nagorsen 1996).

Forest regions and districts

Coast: Chilliwack, Squamish

Ecoprovinces and ecosections

COM: EPR, SPR

GED: FRL

1 Volume 1 account prepared by L. Darling and K. Paige.

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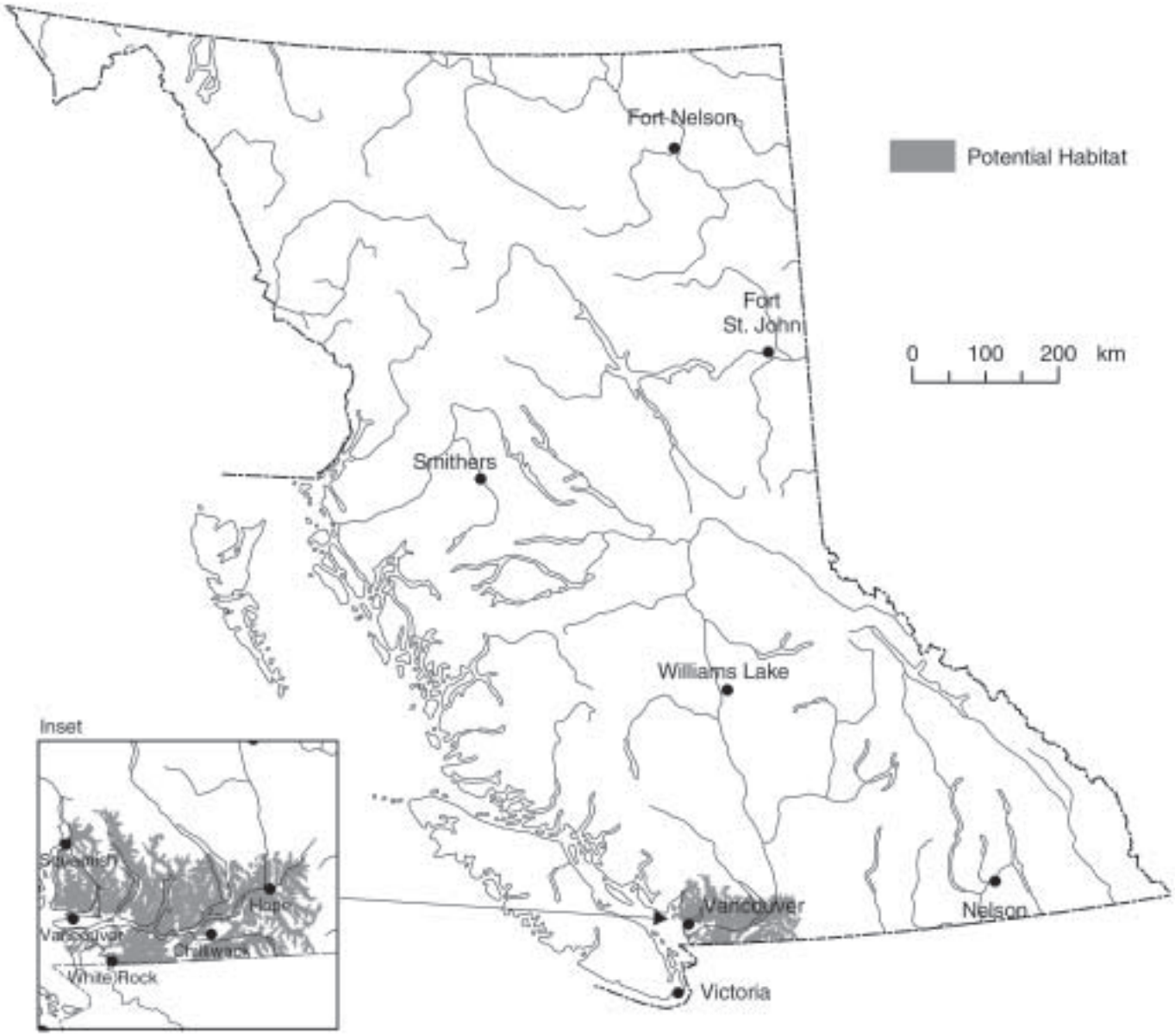
(Sorex bendirii)



Note: This map represents a broad view of the distribution of potential habitat used by this species. The map is based on several ecosystem classifications (Ecoregion, Biogeoclimatic and Broad Ecosystem Inventory) as well as current knowledge of the species' habitat preferences. This species may or may not occur in all areas indicated.

Biogeoclimatic units

CDF: mm

CWH: dm, ds1, ms1, vm1, xm1

Broad ecosystem units

CD, CH, CR, CW, FR, RS, WL

Elevation

Up to 850 m but is generally believed to inhabit areas below 600 m (Nagorsen 1996)

Life History

Diet and foraging behaviour

All shrews are insectivorous. Whitaker and Maser (1976) reported the Pacific Water Shrew as the most specialized feeder of the five species of shrews studied in western Oregon, with 25% of stomach contents consisting of aquatic prey. Unidentified insect larvae, slugs, and snails, Ephemeroptera naiads, unidentified invertebrates, and earthworms were the foods most frequently consumed by this shrew. Pattie (1969) observed that captive shrews immobilize their prey with several rapid bites along the length of the body. Prey animals appear to be located by sound and by exploring the forest floor and rotten logs with their sensitive vibrissae (whiskers) and flexible snout. These tactile senses also appear to be used when locating prey animals under water. Dives for prey can last up to several minutes (Pattie 1969). Although prey will be seized underwater, food is always consumed on land.

Reproduction

Very little is known about the breeding biology of the Pacific Water Shrew and no studies have been conducted in British Columbia. In other parts of its range, young are born in March with an average litter size of three or four (Nagorsen 1996) and a gestation period of about 3 weeks (Beneski and Stinson 1987). These shrews likely do not become sexually mature until they have overwintered; however, females may mature during their first summer. The Pacific Water Shrew is an early breeder, with pregnant females captured as early as February (Beneski and Stinson 1987). A pungent odour originating from scent glands located on the flanks of males may function as a form of communication between sexes during the breeding season (Maser 1998). Shrews do not survive their second winter and may not survive their first (Nagorsen 1996). Pacific Water Shrews are assumed to survive only one overwinter period and have an average life expectancy of 18 months (Nagorsen 1996).

Home range

Very little is known about the home range size of the Pacific Water Shrew as removal methods used to sample this animal preclude such estimates. Harris (1984) reports a home range size of 1.09 ha; however, no sources for this estimate are provided.

Although a few Pacific Water Shrews have been captured considerable distances from water, probably related to juvenile dispersal (Maser and Franklin 1974), this shrew's affinity for slow-moving streams and marshes is well documented (Pattie 1973; Maser and Franklin 1974; Whitaker and Maser 1976; McComb et al. 1993; Zuleta and Galindo-Leal 1994; Nagorsen 1996; Maser 1998). In addition, both McComb et al. (1993) and Zuleta and Galindo-Leal (1994) report that capture rates are inversely related to distance from streams, and that most Pacific Water Shrews were found within 50 and 25 m of streams, respectively.

Movements and dispersal

Because of the removal methods used to sample the Pacific Water Shrew, very little can be said about the movements of this shrew. Young are assumed to disperse to suitable habitat after leaving the nest (Maser 1998).

Habitat

Structural stage

4: pole/sapling
5: young forest
6: mature forest
7: old forest

Important habitats and habitat features

Literature on habitat use by the Pacific Water Shrew is limited to only a few studies, most of which were conducted in Oregon and Washington. Two studies in Oregon report this shrew to be more abundant within mature and old forests (Corn and Bury 1991; Gilbert and Allwine 1991). Other studies in Washington describe this shrew to be equally, or more abundant, within young forests (Aubrey et al. 1991; West 1991). In a recent study conducted within the Lower Mainland, Zuleta and Galindo-Leal (1994) found three Pacific Water Shrews within widely separated habitats, ranging from deciduous to coniferous dominated sites with moderate to high canopy closure. It appears as though moist, coastal forests that border streams and skunk-cabbage marshes with an abundance of shrubs and coarse woody debris and extensive canopy closure are more important features than age of the forest (Nagorsen 1996). Likewise stream size may not be important but speed of water movement is likely important.

This semi-aquatic insectivore (25% of diet is aquatic invertebrates) requires access to slow-moving creeks and/or wetlands to forage. In addition to the aquatic food source, this shrew readily consumes terrestrial invertebrates found throughout the forest floor, especially within a well-developed litter layer and decomposed coarse woody debris. Forested riparian habitats typically provide both a well-developed forest floor as well as an abundant supply of coarse woody debris, making this habitat preferred foraging habitat for several species of insectivores (Nagorsen 1996).

Conservation and Management

Status

The Pacific Water Shrew is on the provincial *Red List* in British Columbia. It is considered *Threatened* in Canada (COSEWIC 2002).

Summary of ABI status in BC and adjacent jurisdictions (NatureServe Explorer 2002)

BC	WA	OR	CA	Canada	Global
S1S2	S5?	S4	S3S4	N1N2	G4

Trends

Population trends

Data on population trends of the Pacific Water Shrew are limited because of its rarity and the removal methods used for sampling this species. Although this species has probably never been abundant within any part of its global range, typically making up <1% of all small mammal captures (Aubrey et al. 1991; Corn and Bury 1991; Gilbert and Allwine 1991; West 1991), in British Columbia, fewer individuals have been documented recently than a century ago (Zuleta and Galindo-Leal 1994). Over the past 40 years, only 15 specimens have been collected and only eight extant occurrences have been identified, although more probably exist (Nagorsen 1996; CDC 2001). Because of the well-documented rarity of this shrew and the rapid degradation of critical riparian habitat resulting from urban sprawl and forestry operations throughout the Lower Mainland, the Pacific Water Shrew is undoubtedly experiencing a decline in population size within British Columbia (Galindo-Leal and Runciman 1994).

Habitat trends

Human developments, particularly urban and agricultural developments, have reduced or isolated much of the suitable riparian habitat for this shrew. During the past century, the aggregate channel length of small rivers and streams in Vancouver has been reduced from 120 to 20 km (Galindo-Leal and Runciman 1994). Approximately 15% of the streams in the Lower Fraser Valley have been lost and 71 % are considered threatened or endangered (Fisheries and Oceans Canada 1998). Additional habitat has likely been lost to industrial forest removal, although no studies have quantitatively assessed this type of development.

Threats

Population threats

Pacific Water Shrews are found in naturally low numbers (Aubrey et al. 1991; Corn and Bury 1991; Gilbert and Allwine 1991; West 1991), are habitat specialists (Nagorsen 1996), and within British Columbia, are found at their most northerly distribution (Zuleta and Galindo-Leal 1994). Consequently, this shrew is particularly vulnerable to the loss or isolation of its preferred riparian habitat. An indirect human-caused threat to the population may be increased predation by domestic cats. The impact of the increase in coyotes over the range of this species is not known.

Habitat threats

Urban and agricultural developments pose the most significant threat to the habitat and survival of the Pacific Water Shrew in British Columbia. The limited distribution of this shrew in British Columbia coincides with the largest urban centre in the province (Lower Mainland). The dissection of the Lower Mainland by roads, highways, and power lines has created a fragmented landscape of isolated habitat patches, which may not be large enough to support a viable population of Pacific Water Shrew (Galindo-Leal and Runciman 1994). Even when patches appear to be large enough, edge effects may render the habitat unsuitable for a habitat specialist like the Pacific Water Shrew. Examples of edge effects particularly detrimental to the habitat of this shrew are loss of canopy closure resulting in decreased security cover (Galindo-Leal and Runciman 1994; Nagorsen 1996); increased human-related disturbance, which can penetrate up to 70 m from an edge (Matlack 1993); and increased predation by domestic cats on small animals, of which 80% of captures are shrews (Fitzgerald 1988). Although some studies indicate that this shrew may be able to cope with edge effects (e.g., Zuleta and Galindo-Leal [1994] captured this shrew within isolated, small habitats, and one, 20 m from a busy public street), no studies have addressed the long-term consequences of edge effects on this species.

Forest harvesting has received little attention with respect to Pacific Water Shrew because most of this species range coincides with urban areas, not Crown land. However, industrial forest removal potentially threatens Pacific Water Shrew habitat in Canada because Pacific Water Shrews have been captured in several locations on or near Crown land (Galindo-Leal and Runciman 1994). These locations include the Chilliwack River Valley (four occurrences), Sumas Mountain (eight occurrences), and several watersheds located north of the Lower Mainland and Fraser River (Coquitlam River area, one occurrence; Seymour River area, four occurrences; Alouette River area, one occurrence).

Water quality is also of concern. Because this shrew spends a considerable amount of time foraging for aquatic invertebrates (Pattie 1969; Whitaker and Maser 1976), changes in water quality caused by agricultural runoff, residential septic fields, erosion, and industrial waste can have detrimental effects on its food source as well as the habitat of the Pacific Water Shrew (Galindo-Leal and Runciman 1994).

Legal Protection and Habitat Conservation

The Pacific Water Shrew is protected, in that it cannot be killed, collected, or held in captivity without special permits, under the provincial *Wildlife Act.*

Several occurrences are protected within regional and provincial parks including Mount Seymour Provincial Park (3508 ha), Cultus Lake Provincial Park (656 ha), Aldergrove Lake Regional Park (250 ha), and Pacific Spirit Regional Park (763 ha).

The results based code recommendations for biodiversity and riparian areas may conserve several beneficial attributes of Pacific Water Shrew habitat where implemented. Where landscape level planning can address maintenance of landscape connectivity, particularly along natural features such as streams and rivers, or can address natural vegetative species composition and requirements for coarse woody debris retention, then the recommendations may partially address this species requirements.

Riparian management recommendations may in some cases partially address the requirements of this species. Current riparian management recommendations for streams and wetlands vary depending on the size and classification of the aquatic feature. General recommendations include minimizing windthrow risk; maintaining wildlife trees; and conserving stream channel shape, bank stability, water quality, as well as guidelines for minimizing detrimental effects of range, roads, and culverts. Where these recommendations are applied they may contribute to the maintenance of this species' habitat.

Protected areas or special resource management zones created for other species overlapping in distribution with the Pacific Water Shrew (i.e., Spotted Owl, tall bugbane, Coastal Giant Salamander) may afford additional protection.

Although these habitat provisions provide several beneficial recommendations for the habitats of the Pacific Water Shrew, these provisions are not sufficient to ensure the conservation of this rare taxon. In addition the range of this species overlaps with private land.

Identified Wildlife Provisions

Sustainable resource management and planning recommendations

Landscape level planning within the Chilliwack and Squamish forest districts should promote connectivity among remnant patches of suitable low elevation riparian habitat by restoring forest habitat along watercourses and wetlands. Whenever possible, large buffer widths around riparian areas should be maintained to compensate for the fragmentation that is occurring.

Wildlife habitat area

Goal

Protect current and historical habitat of the Pacific Water Shrew.

Feature

Establish WHAs at current or historical sites where suitable habitat still exists.

Size

Generally between 5 and 45 ha but ultimately depends on the area of suitable habitat.

Design

It is recommended that the WHA extend the entire length of the stream or wetland and include at a 30 m core area and a 45 m management zone on each side of the stream or around wetland/wetland complex. Measurements of slope distance should be consistent with the *Riparian Management Area Guidebook*. Where slopes exceed 60%, the WHA should extend to the top of the inner gorge

The WHA should include suitable riparian and aquatic habitats. Wetlands, streams, or other suitable riparian habitats (e.g., Skunk-Cabbage marshes) within 1 km should also be included wherever possible to increase the effectiveness of the WHA. Because of the linear shape of the species home range, the management zone is necessary to minimize potential detrimental edge effects which tend to be more pronounced within long thin habitats.

General wildlife measures

Goals

1. Maintain hydrological regime.
2. Maintain water quality and physical integrity of riparian habitat.
3. Maintain or promote microclimate and structural elements known to be preferred by this species (i.e., good ground cover of evergreen shrubs, large amount of coarse woody debris, abundance of fine litter, and moderate to high levels of canopy closure from coniferous, deciduous, or mixedwood forests).
4. Minimize edge effects.

Measures

Access

- Do not construct roads unless there is no other practical option.

Harvesting and silviculture

- Do not harvest or salvage within the core area.

- Use partial-harvesting systems in the management zone that maintain 70% basal area. Partial harvesting within the management zone should promote natural microclimate and structural elements such as multi-layered canopies, wildlife trees, and coarse woody debris.
- Restrict activities that may alter the vegetation, hydrology, stream structure, or soils, particularly the upper soil layers.

Pesticides

- Do not use pesticides.

Recreation

- Do not establish recreational trails or sites within a WHA.

Additional Management Considerations

When operating immediately adjacent to WHAs, consider the following recommendations:

- apply as many of the silviculture practices required within the WHA management zone, particularly practices that minimize edge effects and promote the retention of the forest litter layer, coarse woody debris, and wildlife trees (future coarse woody debris);
- minimize impacts of forest activities by harvesting one side of a stream at a time;
- extend green-up specifications within riparian and nearby habitats to allow this area to better recover prior to harvesting adjacent areas;
- employ partial cutting systems to reduce edge effects near riparian areas; and
- incorporate larger riparian buffers.

Because of the rapid urban development that coincides with the distribution the Pacific Water Shrew in British Columbia, much of this shrew's habitat has been destroyed or fragmented (Galindo-Leal and Runciman 1994; Zuleta and Galindo-Leal 1994; Nagorsen 1996). It is important to consider this species within urban planning and stewardship programs.

Information Needs

1. Using live-trapping methods, determine basic demographic parameters (i.e., home range size, movement patterns, ability to recolonize areas) and a better understanding of habitat preferences and limitations are needed.
2. Effects of habitat fragmentation on this shrew, and investigating the impact of domestic cat predation.

Cross References

Bull Trout, Coastal Giant Salamander, Coastal Tailed Frog, Keen's Long-eared Myotis, Marbled Murrelet, Sandhill Crane, tall bugbane

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