

COSEWIC
Assessment and Update Status Report

on the

Townsend's Mole
Scapanus townsendii

in Canada



ENDANGERED
2003

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA



COSEPAC
COMITÉ SUR LA SITUATION DES
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AU CANADA

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COSEWIC Assessment Summary

Assessment Summary – May 2003

Common name

Townsend's mole

Scientific name

Scapanus townsendii

Status

Endangered

Reason for designation

There are only about 450 mature individuals in a single Canadian population with a range of 13 km², adjacent to a small area of occupied habitat in the USA. Threats to the population include trapping by pest removal companies and property owners. The habitat has been degraded through fragmentation and urbanization. There is no evidence of decline over the last 10 years. It is uncertain whether immigration across the international border may rescue the Canadian population.

Occurrence

British Columbia

Status history

Designated Threatened in April 1996. Status re-examined and uplisted to Endangered in May 2003. Last assessment was based on an update status report.



COSEWIC Executive Summary

Species information

There are six species of moles in Canada. The two found in British Columbia are townsend's mole (*Scapanus townsendii*) and the coast mole (*S. orarius*), both restricted to the Lower Mainland.

Distribution

Townsend's mole is found throughout most of California, Oregon and Washington in the United States. Its range extends into Canada for several kilometres near Huntingdon. *Scapanus townsendii townsendii* (Bachman) is the subspecies found in British Columbia.

Habitat

Townsend's moles are fossorial and typically inhabit lowland areas. In Canada they are found in pastures, farmland and lawns. They prefer medium-textured silt loam soil with good humus content and are also found in open forests and light sandy soils.

Biology

Townsend's mole averages 205 mm in total length (range 179-237 mm), making it North America's largest mole. The body is cylindrical with short, soft gray fur of constant length. Its diet consists mainly of soil invertebrates but it also eats some plant roots. The nonfunctional vestigial eyes detect light but no images. It has an acute tactile sense based on the vibrissae in its snout. Townsend's mole has few natural enemies.

Population sizes and trends

There are estimated to be about 450 adult Townsend's moles in Canada. It has been suggested that the numbers of moles in the Pacific northwest have increased in the past several hundred years because of the creation of more farmland habitat from diking wetland meadows and the introduction of large species of earthworms. Alternatively, control by professional mole trappers, trapping by property owners, intensive agricultural practices, the loss of farmland through urban sprawl and habitat fragmentation may contribute to lower population numbers.

Limiting factors and threats

The amount of available habitat for Townsend's mole in Canada appears limited to 13 km² near Huntingdon/Abbotsford. Threats to their habitat include farming and urban development. Professional mole trappers are sometimes hired to trap Townsend's mole.

Special significance of the species

In Canada, Townsend's mole reaches the northernmost limit of its range. Though small in numbers the population may be significant in maintaining the genetic diversity of a species

Existing protection or other status designations

Townsend's mole is on the British Columbia Ministry of Environment Red List (Endangered/Threatened), where it has a Subnational Rank of S1 (critically imperiled due to population size <1,000). It was previously listed as a Schedule B species under the B.C. Wildlife Act, identifying it as a nuisance or pest that can be trapped or killed to protect property, but it is now protected under Schedule A.

The global status of the Townsend's mole as determined by the Association for Biodiversity Information is G5 – secure (common, typically widespread and abundant).

Most mole habitat is protected through the Agricultural Land Reserve, but some of its range is on private property and is unprotected.



COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) determines the national status of wild species, subspecies, varieties, and nationally significant populations that are considered to be at risk in Canada. Designations are made on all native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fish, lepidopterans, molluscs, vascular plants, lichens, and mosses.

COSEWIC MEMBERSHIP

COSEWIC comprises representatives from each provincial and territorial government wildlife agency, four federal agencies (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biosystematic Partnership), three nonjurisdictional members and the co-chairs of the species specialist groups. The committee meets to consider status reports on candidate species.

DEFINITIONS

Species	Any indigenous species, subspecies, variety, or geographically defined population of wild fauna and flora.
Extinct (X)	A species that no longer exists.
Extirpated (XT)	A species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A species facing imminent extirpation or extinction.
Threatened (T)	A species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk (NAR)**	A species that has been evaluated and found to be not at risk.
Data Deficient (DD)***	A species for which there is insufficient scientific information to support status designation.

* Formerly described as “Vulnerable” from 1990 to 1999, or “Rare” prior to 1990.

** Formerly described as “Not In Any Category”, or “No Designation Required.”

*** Formerly described as “Indeterminate” from 1994 to 1999 or “ISIBD” (insufficient scientific information on which to base a designation) prior to 1994.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list.



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**Update
COSEWIC Status Report**

on the

Townsend's Mole
Scapanus townsendii

in Canada

2003

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SPECIES INFORMATION

Name and classification

Moles belong to the Order Insectivora, Family Talpidae, which also includes shrew-moles and desmans. New World moles are in the Subfamily Talpinae. There are six species of moles in Canada. The two found in British Columbia are Townsend's mole (*Scapanus townsendii*) and the coast mole (*S. orarius*), both of which are restricted to the Lower Mainland.

There are two subspecies of Townsend's mole. *S. t. townsendii* (Bachman) is found throughout the range, including in British Columbia. *S. t. olympicus* (Yates and Johnson) occurs at high elevations in the Olympic Mountains of Washington State.

Description

Townsend's mole averages 205 mm in total length (range 179-237 mm), making it North America's largest mole; in comparison, to the coast mole averages 162 mm. Tail length averages 38 mm (31-45), and mean hind foot length is 25 mm (23-29). Males weigh about 138 g (121–164) and females 113.5 g (96-122) (Nagorsen 1996). Townsend's mole and the Pacific coast mole are similar in appearance, but Townsend's mole is larger.

The body is cylindrical with short, soft gray fur of constant length (rather than the typical underfur with longer guard hairs found in other mammals). The fur can bend easily in any direction, enabling the mole to back up in tight tunnels. The autumn moult in October gives the coat a darker grey colour than the lighter grey of the spring moult in April (Banfield 1974).

The snout and feet are pink with little fur. The nostrils are located dorsally on the naked snout. The dental formula is: $\frac{3}{3} \frac{1}{1} \frac{4}{4} \frac{3}{3}$. The front limbs are broad, rotated ventrally and shovel-like with long strong claws adapted for digging tunnels in soil. The hind feet are small with short claws. The eyes are small, hidden by fur and usually concealed by hairless eyelids (Banfield 1974). The vestigial eyes of Townsend's mole can detect light intensity but no images.

Moles are rarely seen but are evident from molehills produced when moles excavate underground tunnel systems.

Nationally significant populations

The population around Huntingdon-Abbotsford, BC, is the only one in Canada.

DISTRIBUTION

Global range

Townsend's mole is found in the Pacific coast region of northern California, Oregon and Washington in the United States. Its range crosses the Canadian border for several kilometers into the Lower Mainland of British Columbia at Huntingdon. Its range largely overlaps that of the American shrew-mole (*Neurotrichus gibbsii*). Large parts of its range also overlap that of the coast mole.

Scapanus townsendii olympicus is restricted to elevations above 1,000 m in the rugged terrain of the Olympic Mountains in Washington State (Carraway et al. 1993). The global range of Townsend's mole is presented in Figure 1.

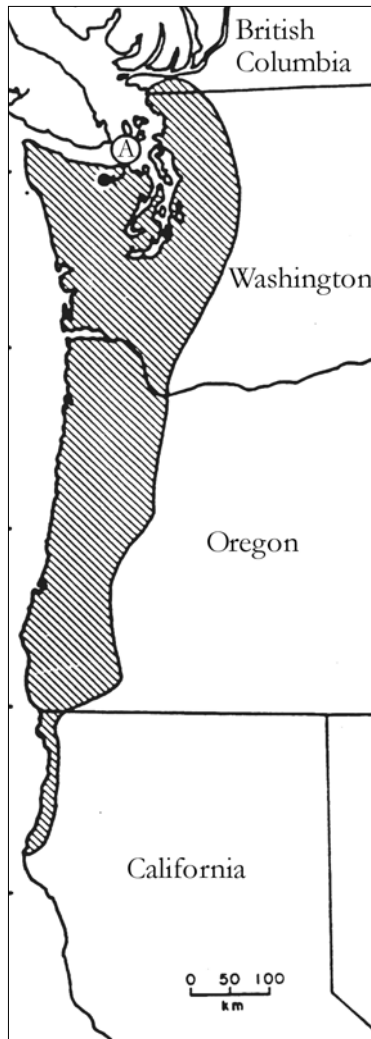


Figure 1. Global distribution of *Scapanus townsendii* (based on Sheehan and Galindo-Leal 1996, after Hall 1981). *S. t. townsendii* range indicated by shading, *S. t. olympicus* with the letter A.

Canadian range

Townsend's mole is found just inside Canada at the American border at Huntingdon, British Columbia, and at a second nearby location east of Abbotsford (Figure 2).

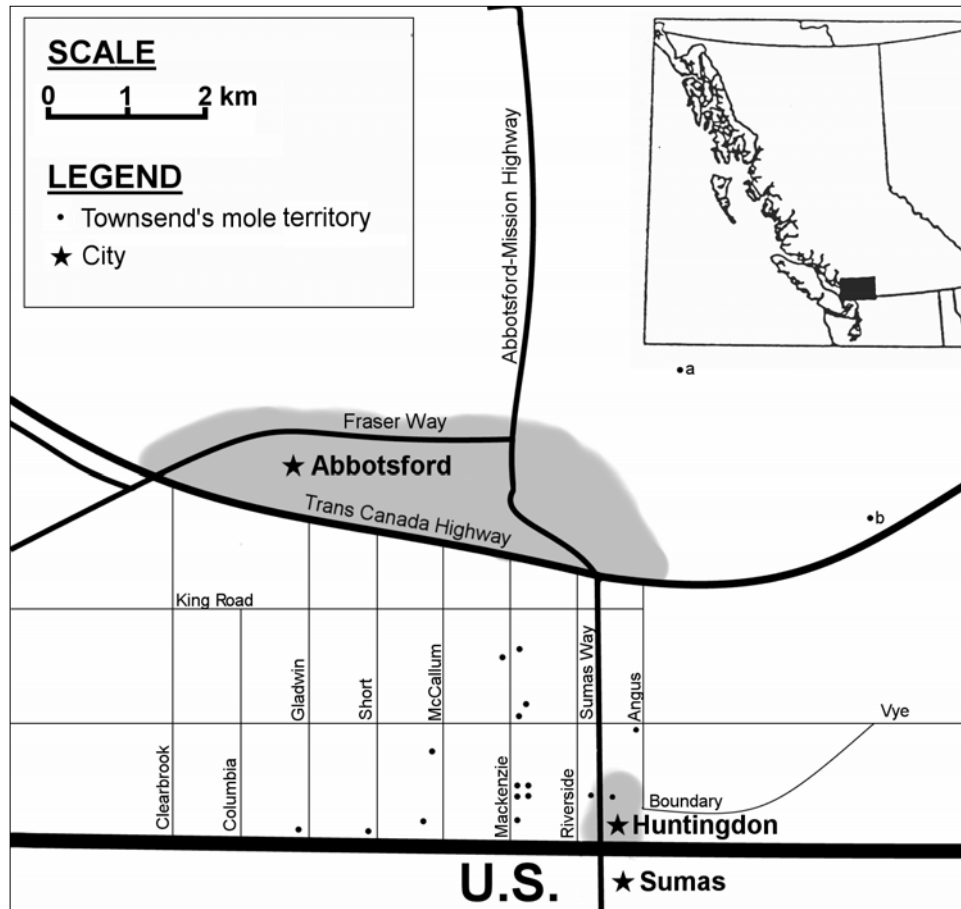


Figure 2. The distribution of *Scapanus townsendii townsendii* in 2002 near Huntingdon and Abbotsford (city areas are shaded) in Canada based on a recent field survey that located 16 territories by molehills visible from the road (indicated as black dots above the U.S. border). The area searched was between the Trans-Canada Highway to the north, the U.S. boundary to the south, Clearbrook Road to the west and Boundary/Whatcom Road to the east. There were 137 territories of the coast mole in the same area. A Townsend's mole was caught by a trapper in November 2001 east of Abbotsford at Lakeview golf course (a) and another at Marshall Road (b).

HABITAT

Habitat requirements

Townsend's mole is found in medium-textured silt loam soil with good humus content as found in fields, meadows, lawns and other grassy habitats, preferring manured pastures and hayfields (Pedersen 1963, Giger 1973, Nagorsen 1996) where earthworms are abundant (Edwards and Lofty 1972). About 30 km² of silt loam soil

exists in the Fraser Valley (Figure 3), although all but about 13 km² has undergone urban development (Sheehan and Galindo-Leal 1996). Townsend's mole will also venture into open forests and light sandy soils (Dalquest 1948, Johnson and Yates 1980, Nagorsen 1996). Population densities vary considerably in different habitats according to the availability of earthworms. Numbers are lowest in gravelly soils and highest in manured pastures and hayfields (Pedersen 1963, van Zyll de Jong 1983).

It typically inhabits low lying pastures, farmland and lawns. This habitat extends from the Fraser Valley across the border into Washington State (see aerial photographs in Appendix showing contiguous farmland and residential development and lowland habitat extending to Nooksack, Wa.). The grass cover supports a greater biomass of its preferred food, the large earthworm *Lumbricus terrestris*, than do to arable land and forests (Gorman and Stone 1990). The grass insulates the ground from frost that decreases earthworm numbers (Edwards and Lofty 1972). Grassland soils are also highly structured and better suited to support an underground network of tunnels.

Townsend's mole seems to prefer moister soil than the coast mole (BC Ministry of Environment, Lands and Parks 2001). The habitat requirements and food requirements for Townsend's and coast moles appear to be similar, and it is not readily apparent why Townsend's mole is not found throughout the same range as the coast mole in Canada.

Population trends

It has been suggested that the numbers of Townsend's and coast moles in the Pacific northwest have increased in the past several hundred years. This is likely due to more farmland created by diking wetland meadows and the availability of the larger introduced species of earthworms (Glendenning 1959, Schaefer 1978). However, new habitat is no longer being created. On the contrary, mole trapping, intensive agricultural practices, the conversion of farmland through urban sprawl and habitat fragmentation may all contribute to lower mole population numbers.

Protection/ownership

The habitat in which moles occur in Canada is largely privately owned. The land between Riverside and Angus Roads, which holds 3 of the 16 territories recently located, has undergone urban development. The remainder of the range is in the Agricultural Land Reserve (ALR) and is somewhat protected from development (British Columbia Agricultural Land Commission 1996). However, intensive agriculture kills moles and land is constantly removed from the ALR. Townsend's mole is considered an agricultural pest, and may be trapped in residential areas where it destroys lawns. It is protected by the BC Red List Schedule A.

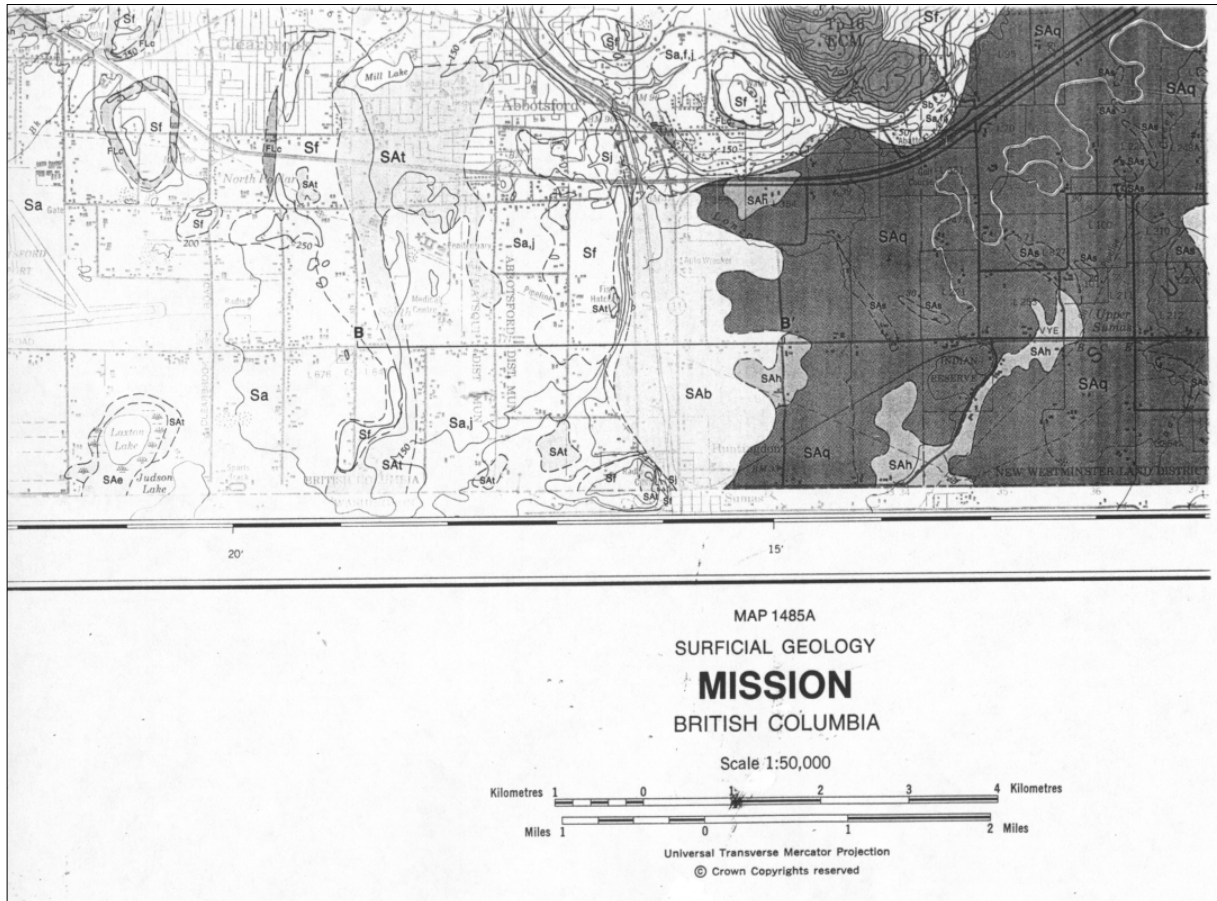


Figure 3. Soil map of the Huntingdon-Abbotsford region (Geological Survey of Canada, 1976, map 1485A, Surficial Geology, Mission, BC). Note the distribution of Sab soils right of center (organic sediments overlain by up to 1 m of silt loam, silt and sand), the location of most Townsend's mole records around Huntingdon. The two records east of Abbotsford are in Saq silt to clay soil overlaying Fraser River Sediments.

BIOLOGY

General

Townsend's moles are fossorial, adapted for digging tunnels and a life underground. The vestigial eyes of Townsend's mole can only detect light intensity. It has an acute tactile sense from the vibrissae and its snout. The senses of smell and hearing are probably not well developed. Because of their small size and consequently high metabolic rate, they consume large amounts of soil invertebrates and some plant matter. Townsend's moles breed in the first year of life and produce an average of 3 young per year during a 3-4 year lifespan. They are solitary and territorial with densities of 0.42-12/ha, depending upon the quality of the habitat. They have few natural predators.

Reproduction

Male Townsend's moles with enlarged testes are found as early as November (Moore 1939, Pedersen 1963). Females are in breeding condition from early December to late February, at which time embryos are found (Pedersen 1963). Mating in Oregon populations peaks through January into early February (Pedersen 1963). Breeding in Canada is probably later because of the latitudinal gradient.

The young are born and raised in an underground nest during late March or early April. The nest, constructed just before parturition (Pedersen 1963), is built of coarse grass, lined with thin grass, in a chamber about 20-23 cm in diameter and 15 cm high. The nest is 15-20 cm below ground, connected to one of the deeper main tunnels in an elevated part of the territory, presumably to prevent flooding (Kuhn et al. 1966, Pedersen 1966, Caraway et al. 1993). Larger hills 30-45 cm high and 70-130 cm in diameter may identify the nest site, or there may be several smaller hills in a cluster or a single large hill at the base of a fencepost (Pedersen 1963, Kuhn et al. 1963).

The nesting chamber has 3-11 or more lateral entrances and is connected to a main tunnel immediately below the nest chamber to facilitate escape. Nests are sometimes reused for more than one breeding season (Pedersen 1966, Caraway et al. 1993, Nagorsen 1996). Lining the nest with moist grass is thought to be a deliberate effort to generate heat in the nest through fermentation (Kuhn et al. 1966, Pedersen 1966). Disturbed nests are usually abandoned unless there are already young present, in which case the mother will sometimes return (Pedersen 1963, Kuhn et al. 1966).

Moles produce one litter per year of 1-4 young with an average of 2.9. Females have 8 mammae. The gestation period is 4-6 weeks (Yates and Pedersen 1982). Newborns weigh about 5 g and are naked for their first 22 days, after which they develop a plush coat of short fur that is complete by 30 days when pups weigh 60-80 g. The young remain in the nest for 30-36 days, dispersing in May and June. Moles can breed in the winter following their birth (Pederson 1963, van Zyll de Jong 1983).

Survival

Townsend's moles probably have similar survival rates to coast moles, about three breeding seasons (Sheehan and Galindo-Leal 1996). The mole's fossorial lifestyle protects it from many predators. Male moles looking for mates and dispersing young may travel above ground at night and may be caught by predators of small mammals. Some young animals are killed on highways. Nursery nests may be trampled by cattle.

Winter flooding in lowland areas can kill many moles. In one report, 62 were killed in a severe January flood in Oregon (Giger 1973).

Physiology

The atmosphere of mole runs is high in carbon dioxide and low in oxygen. Schaefer and Sadleir (1979) determined that for coast moles carbon dioxide reached a maximum tunnel concentration of 5.5%, while the oxygen minimum was 14.3%. The rarified atmosphere is particularly problematic given that moles are working hard underground, sometimes moving up to 20 times their body weight in 15 minutes (Schaefer 1978).

The European mole is known to have adapted its circulatory system to its environment. The serological composition of the blood is also adaptive with increased hemoglobin, similar to that of humans acclimatized to high altitudes (Dabrowski and Skoczen 1962, Quillam et al. 1971). Townsend's mole likely has similar adaptations.

Movements/dispersal

Townsend's moles are territorial. They restrict their movements to a distance of approximately 38 m in length in suitable habitat and 116 m in poorer habitats, with a shorter width. A cluster of hills with a gap before the next cluster clearly defines a territory (Sheehan and Galindo-Leal 1996). Coast moles may move from open agricultural fields occupied in the summer to sodded grasslands in October (Glendenning 1959).

Longer distances (13-856 m) are traveled above ground by dispersing young in late spring and summer, the dispersal distance appears dependent on habitat quality rather than population density (Giger 1973). Townsend's moles are good swimmers and can cross small water-filled ditches and streams (Moore 1939, Giger 1973).

Dispersal of young occurs through communal tunnels and above ground. Many juveniles are killed on roads and are eaten by owls (Pedersen 1963, Campbell 1983).

Moles displaced 100-200 m by natural flooding reoccupy their original territories when the water subsides. Those relocated artificially for distances up to 450 m also return to their territories (Giger 1973).

The habitat of Townsend's mole in Canada is continuous with a small area of habitat in the United States.

Nutrition and interspecific interactions

Townsend's mole primarily eats soil invertebrates. Most of its diet (average 76%, range 55-86%) consists of earthworms (Wight 1928, Whitaker et al. 1979). Another 8% of the diet consists of insects and their larvae and other invertebrates such as centipedes, millipedes, slugs and snails. Shrews and mice have also been found in stomach contents. The remaining 16-38% consists of vegetable matter – bulbs, vegetables and grass roots (Wight 1928, Moore 1933, Pedersen 1963, Whitaker et al.

1979). The latter distinguishes it from the Pacific coast mole, which consumes exclusively animal matter. It also makes Townsend's mole a pest in agricultural and residential areas because it eats bulbs and roots and can cause considerable damage to tulips, iris, potatoes and carrots. Townsend's mole does not require free water due to the high moisture content of its diet.

Mole tunnels operate as an elaborate pit trap system in which moles forage for invertebrates. Larger earthworms such as *Lumbricus terrestris* of the Family Lumbricidae that form a major part of Townsend's mole's diet were introduced from Europe to the Pacific Northwest about 200 years ago. Moles likely ate more insect larvae in the past (Schaefer 1984). The dentition is similar to that of shrews that eat more insect larvae with tough chitinous exoskeletons. In a single day, Townsend's mole regularly consumes 33-66% of its body mass in food (Cahalane 1947, from Carraway et al. 1993), and it has been known to eat 1.4 times its body mass in one day (Nagorsen 1996).

Predation on Townsend's mole is minimal and mainly on dispersing young (van Zyll de Jong 1983). They are sometimes caught by weasels (*Mustela* spp.), rubber boa (*Charina bottae*) (released pets), Great Horned Owl (*Bubo virginianus*), Barn Owl (*Tyto alba*), Red-tailed Hawk (*Buteo jamaicensis*) and coyote (*Canis latrans*), and pets such as dogs and cats. Cows may be attracted to the nests by the smell of the fresh grass used as a lining, and may trample young in underground nests (Pedersen 1963).

The tunnels of Townsend's mole are often communal and are used by mice and voles that may carry Hantavirus. This has been identified as a concern when handling moles (BC Ministry of Environment, Lands and Parks 2001).

Behaviour/adaptability

Townsend's mole tunnels are of four basic types (Pedersen 1963), including a permanent system 10-20 cm deep used to move around the territory and more abundant shallower tunnels 1-10 cm deep used for feeding. Most earthworms occur in the top 7.5 cm of soil for most of the year (Edwards and Lofty 1972). Occasionally Townsend's moles will construct tunnels up to 3 m deep to pass under roadways and other obstructions, or to find earthworms during hot, dry periods. During the breeding season and dispersal, moles may dig temporary tunnels just below the surface while looking for mates.

The mole digs with its front paws. The excavated material is pushed to the surface where it forms hills on the surface above the subterranean runways. The size of molehills vary. Small hills may indicate repair to existing tunnels whereas larger hills are indicative of new tunnels. An average size for hills of Townsend's mole is 17 cm high and 43 cm in diameter with the diameter of the vertical tunnel shaft being 5 cm. The digging behaviour of Townsend's mole can be distinguished from that of the coast mole by greater mole mound heights, widths, tunnel diameters and volumes for Townsend's mole (Sheehan and Galindo-Leal 1996).

The density of Townsend's moles in British Columbia is unknown. In Oregon there may be 12/ha in good habitat and 0.4/ha in poor habitat. There may be as many as 805 molehills/ha in good habitat at some times of the year (Yates and Pedersen 1982).

Although information about daily activity is not available, it is probably similar to that of the coast mole that has an 8 hour rhythm characterized by 4 hours of activity followed by 4 hours of sleep (Schaefer 1982). Various researchers report observing the Townsend's mole to be active throughout a 24-hour period (Pedersen 1963, Giger 1973, Sheehan and Galindo-Leal 1996).

POPULATION SIZES AND TRENDS

Based on the information available, 28 specimens collected since 1927 (Table 1) and locations of 16 territories located to produce this status update, the population appears stable in the Huntingdon area. It may even have expanded slightly toward Abbotsford. The latter population was discovered only after intensive trapping, and moles may have been there undetected until 1995. Townsend's moles were caught in fall 2001 at the Ledgeview Golf Course and Marshall Road sites east of Abbotsford (Sheehan pers. com.) and hills were found at these sites in May 2002 during the current study. Intensive trapping further east may reveal a wider Canadian range.

Table 1. Townsend's mole specimens collected in Canada and catalogued in Canadian museums (after Sheehan and Galindo-Leal 1996).

Location	Year	Number
Village, Huntingdon	1927	5
Village, Huntingdon	1980	1
Racey Farm, Huntingdon	1930	3
Racey Farm, Huntingdon	1934	1
Racey Farm, Huntingdon	1935	1
Racey Farm, Huntingdon	1942	1
Racey Farm, Huntingdon	1944	1
Racey Farm, Huntingdon	1945	1
Racey Farm, Huntingdon	1946	2
Racey Farm, Huntingdon	1947	1
Racey Farm, Huntingdon	1949	1
Racey Farm, Huntingdon	1976	3
Racey Farm, Huntingdon	1981	1
Racey Farm, Huntingdon	1995	1
Marshall Road, Abbotsford	1995	1
Lakeview Golf Course, Abbotsford	1995	1
Lakeview Golf Course, Abbotsford	1995	2
Total		27

Townsend's mole is less common than the coast mole that shares its range in Canada. Of 25 individuals collected during 1,308 trap-nights at 22 sites, 3 were Townsend's moles and 22 were coast moles (Sheehan and Galindo-Leal 1996). That study used live traps, that often jam or are avoided, so the number of moles caught is not a reliable estimate of population size.

Estimates of Townsend's mole densities in other areas range from 0.42-12/ha (Pedersen 1963, Kuhn et al. 1966, Giger 1973). As Townsend's mole is at the northern edge of its range, the lower density estimate of 0.42/ha (or 42/km²) is more realistic (Nagorsen 1996). Sheehan and Galindo-Leal (1996) report a crude estimate of 700 adults in Canada. This is based on a suitable amount of habitat of 13 km² within Townsend's mole's range around Huntingdon-Abbotsford and a density of 0.5 moles/ha for a total of 650 that they rounded up to 700. The current study confirmed that the density remains low and found no reason to revise this estimate. Mature adults may represent about 60-70% of the total population, so 420-490 adult Townsend's mole may occur in Canada. With an average of 3 young born per female and a 1:1 ratio of males to females, we would expect 3/5 of the population to be young. However, the proportion of juveniles is likely lower because not all adults reproduce, juvenile mortality is high during dispersal and adults survive an average of 2-3 years.

Reliable estimates of population size are difficult because of the fossorial nature of moles. Townsend's moles may be more abundant in pastures fertilized with solid cow manure, which improves conditions for earthworms (Pedersen 1963).

Field work conducted on November 18, 2001, and January 3, 2002, relied on molehill sizes and tunnel diameters to distinguish Townsend's mole territories from those of the coast mole, which are smaller (hill size of 30 x 11 cm and tunnel diameter of 3.6 cm). These characteristics are reliable according to Sheehan and Galiano-Leal (1997), and recommended by the Resources Inventory Committee (BC Ministry of Environment, Lands and Parks 2001).

Of 18 mole territories in Huntingdon between the International Boundary, Riverside Road, Vye Road and Angus Road, three appeared to be those of Townsend's moles, a ratio of 6:1 coast moles to Townsend's moles that is consistent with the live trap results obtained from the earlier live trap study. There were 16 Townsend's mole territories located from roadside searches during the present study. This appears to represent a slight expansion of the range from that reported by Sheehan and Galindo-Leal (1996). There were 137 coast mole territories found in the same area and outside the perimeter of the range of the Townsend's mole in the current study. In 1995 Townsend's moles were caught with live traps on Marshall Road and at Ledgeview Golf Course (Sheehan and Galindo-Leal 1996), and were caught with scissor traps in the same area in fall 2001 (Sheehan pers. com.). They appear to be excluded from the urbanized centre of Abbotsford.

About 30 km² of silt loam soil exists in the Fraser Valley, some around Mission where no Townsend's moles have been found. The Huntingdon/Abbotsford area potentially has about 20 km² of this habitat, although some has been developed for housing and roads. Sheehan and Galindo-Leal (1996) estimate that the Townsend's mole is found in an area of 13 km². Additional contiguous suitable habitat occurs south in a band of lowlands associated with Johnson Creek and the Sumas and Nooksack Rivers in Washington State (Appendix D). This lowland area is about 4 km wide and extends from the border southwest 9 km to Nooksack (representing 36 km² of available habitat) and beyond. A search in May 2002 found no hills of Townsend's moles in the city of Sumas. Three territories were located in a pasture along Highway 546 southwest of Huntingdon. However, hill construction is most active during winter.

Townsend's moles may be prevented from access to the habitat north and east around Mission by the City of Abbotsford and the Fraser River, which lie between Mission and Huntingdon. The silt loam soil extends into Washington State.

Coast moles will very quickly re-invade cleared areas. It took 9 successive years of trapping a 60 ha field before the numbers of coast moles dropped appreciably (Glendenning 1969). However, a field cleared of Townsend's moles was re-invaded by coast moles and Townsend's moles failed to re-establish themselves (Pedersen 1963).

LIMITING FACTORS AND THREATS

The amount of available habitat for Townsend's mole in Canada is likely limited to 20 km² around Huntingdon/Abbotsford (Sheehan and Galindo-Leal 1996). Threats are primarily from habitat degradation through farming and urban development. Townsend's mole is considered an agricultural pest and farmers remove it from their cultivated fields and pastures. The constant tilling and application of fertilizers and pesticides on farms growing vegetables, berries and flowers create soils with poor structure and less earthworm biomass. Pesticides and farm equipment may kill moles directly.

Urban development threatens to fragment farmland habitat. Three 1:15,000 air photos are provided in the Appendix showing Huntingdon and Sumas Way going north to Abbotsford from 1972, 1983 and 1996. The habitat loss due to urban development is clear, as is the impact of the Agricultural Land Reserve (ALR) in containing the development to a narrow corridor; the farmland outside the developed areas is all in the ALR. The ALR lands are subject to changes in provincial governments and priorities

The compound average annual population change for the Fraser Valley Regional District that includes Abbotsford and Huntingdon from 1976-1996 was 3-4% compared with the provincial average of 2% (www.bcstats.gov.bc.ca (a)). Projected population growth for the region from 1996-2016 is 1-2% compared with a provincial expected average of 1.4% (www.bcstats.gov.bc.ca (b)). Such population growth will result in a loss of mole habitat outside the ALR.

The average farm around Huntingdon/Abbotsford is 25 ha (British Columbia Ministry of Economic Development 1986). Farmland in the area is lost to housing, although the moles may still survive in the lawns of residential development if not actively persecuted. The Lower Fraser Valley has 300,000 ha in the Agricultural Land Reserve, of which 29,000 were expected to be lost by the year 2000 (Moore 1990). Townsend's moles may be restricted to fewer fields and be subjected to the negative impacts of species relaxation and numerous extinction vortices (Saunders et al. 1991).

SPECIAL SIGNIFICANCE OF THE SPECIES

In Canada Townsend's mole is only found around Huntingdon-Abbotsford in the Fraser Valley. It is at the northernmost limits of its range. Marginal populations are instrumental in maintaining the genetic diversity of a species (Scudder 1993).

EXISTING PROTECTION OR OTHER STATUS

Originally on the Blue List (Sensitive/Vulnerable) provincially, Townsend's mole's status was upgraded by the British Columbia Ministry of Environment to the Red List (Endangered/Threatened) to acknowledge its limited range (Munroe 1993).

Some mole habitat is protected through the Agricultural Land Reserve (ALR), created in 1974 to protect 135,000 ha of farmland in the Fraser Valley from Development (British Columbia Ministry of Agriculture, Fisheries and Food 1995). Although this designation provides some protection, 6% of the land has already been withdrawn from the ALR (Moore 1990). Huntingdon is in the southern part of the ALR in that region and is separated from the northern part around Clayburn and Matsqui Prairie by non-ALR land, the City of Abbotsford.

The global status of Townsend's mole as determined by the Association for Biodiversity Information is G5 – secure (common, typically widespread and abundant), because it is not at risk in California, Oregon or Washington (BC Ministry of Environment, Lands and Parks 2001). The Province of British Columbia considers Townsend's mole Threatened and has placed it on its Red List where it has a Subnational Rank of S1 (critically imperiled due to extreme rarity or population size <1,000, making it especially vulnerable to extinction).

SUMMARY OF STATUS REPORT

Townsend's mole is at the northern edge of its range in Canada. A small, apparently stable population exists near the international boundary close to Huntingdon and Abbotsford. Moles are found in silt loam soils, preferring pastures and open farmland. A small number of specimens has been collected over 80 years with no dramatic change in distribution. Urbanization and the possibility of changes in the

Agricultural Land Reserve pose a threat in the long term. The distribution range in the United States is continuous with the population in Canada, but the population south of the border is probably very small and faces the same development threats as the Canadian moles, decreasing the potential for a rescue effect.

Townsend's mole is considered a pest and is often removed or killed if causing property damage. Most of the habitat of Townsend's mole is private property but some is protected through the Agricultural Land Reserve.

Townsend's mole is almost completely fossorial and has few natural enemies. It feeds mainly on earthworms. The relatively low reproductive rate appears to afford adequate recruitment for new or vacated habitat.

TECHNICAL SUMMARY

Scapanus townsendii

Common name: Townsend's mole

French common name: Taupe de Townsend

Range of occurrence in Canada: British Columbia

Extent and Area information	
• extent of occurrence (EO)(km ²)	20
• specify trend (decline, stable, increasing, unknown)	stable
• are there extreme fluctuations in EO (> 1 order of magnitude)?	no
• area of occupancy (AO) (km ²)	13
• specify trend (decline, stable, increasing, unknown)	stable
• are there extreme fluctuations in AO (> 1 order magnitude)?	no
• number of extant locations	2
• specify trend in # locations (decline, stable, increasing, unknown)	stable
• are there extreme fluctuations in # locations (>1 order of magnitude)?	no
• habitat trend: specify declining, stable, increasing or unknown trend in area, extent or quality of habitat	declining
Population information	
• generation time (average age of parents in the population) (indicate years, months, days, etc.)	1 yr
• number of mature individuals (capable of reproduction) in the Canadian population (or, specify a range of plausible values)	420-490
• total population trend: specify declining, stable, increasing or unknown trend in number of mature individuals	stable
• if decline, % decline over the last/next 10 years or 3 generations, whichever is greater (or specify if for shorter time period)	
• are there extreme fluctuations in number of mature individuals (> 1 order of magnitude)?	
• is the total population severely fragmented (most individuals found within small and relatively isolated (geographically or otherwise) populations between which there is little exchange, i.e., ≤ 1 successful migrant / year)?	no
• list each population and the number of mature individuals in each	
• specify trend in number of populations (decline, stable, increasing, unknown)	
• are there extreme fluctuations in number of populations (>1 order of magnitude)?	
Threats (actual or imminent threats to populations or habitats)	
- urban development, trapping by professional pest control companies	
Rescue Effect (immigration from an outside source)	
• does species exist elsewhere (in Canada or outside)?	weak
• status of the outside population(s)?	yes
• is immigration known or possible?	unknown
• would immigrants be adapted to survive here?	yes
• is there sufficient habitat for immigrants here?	yes
Quantitative Analysis	
	n/a

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Tim Sheehan provided valuable information on the distribution of Townsend's mole around Abbotsford and commented on the manuscript.

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BIOGRAPHICAL SUMMARY OF THE CONTRACTOR

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Tim Sheehan, Consultant, Abbotsford, British Columbia. Also, with Carlos Galindo-Leal, author of the 1996 COSEWIC Status Report on Townsend's mole. (tel: 604-857-0220).

COLLECTIONS EXAMINED

Tim Sheehan provided 3 Townsend's moles caught east of Abbotsford during February 2001.

Appendices

A. British Columbia Land Data. Aerial photographs 1:15,000 of Huntingdon and vicinity. 1950 - BC5072:278.



B. British Columbia Land Data. Aerial photographs 1:15,000 of Huntingdon and vicinity. 1983 - BC83014:172.



C. British Columbia Land Data. Aerial photographs 1:15,000 of Huntingdon and vicinity. 1996 - 30BCC96085:156.



D. United States Department of the Interior, Geological Survey. 1994.
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