Tiger Salamander

Ambystoma tigrinum

Original prepared by Mike Sarell

Species Information

Taxonomy

The Tiger Salamander, *Ambystoma tigrinum*, belongs to the family Ambystomatidae (mole salamanders). Six subspecies are currently recognized (Green 1999), although as many as 10 have been proposed (Collins 1981). The taxonomy of Tiger Salamanders is uncertain and further taxonomic research may differentiate *A. tigrinum* into several different species. The "Blotched" Tiger Salamander (*A. tigrinum melanostictum)* occurs in British Columbia (Green 1999).

Description

Terrestrial adults are large (14–22 cm snout-vent-length [svl]) and robust with small eyes, a broad rounded snout, 13 costal groves, two tubercles on underside of feet, and no parotid glands. Colour pattern and markings are extremely variable but may be yellow or whitish mottling on a darker brown, grey, or black background. Larvae (8–38 mm svl) have large heads and gills that are longer than the length of the head (see Corkran and Thoms 1996). Fully aquatic adults (paedogens) can be extremely large with very robust gill apparatus. Only the Long-toed Salamander (*Ambystoma macrodactylum*) is sympatric with Tiger Salamanders in British Columbia and is easily differentiated by its much smaller size, a long third toe on the hind feet, and an irregular green-yellow stripe along the back, on a dark background.

Distribution

Global

The "Blotched" Tiger Salamander is widely but patchily distributed across southern Canada (Alberta, British Columbia, Saskatchewan) and the western United States (Washington, Oregon, Idaho, Montana, North and South Dakota, Wyoming, Nebraska, Colorado, Utah; Schock 2001).

British Columbia

In British Columbia, Tiger Salamanders occur in the southern Okanagan, north to Peachland; in the lower Similkameen, west to Keremeos; and in the Sidley and Kettle River valley, east to Christina Lake (Orchard 1991; Sarell and Robertson 1994; Sarell 1996; Sarell et al. 1998). This relatively small distribution in three drainages is weakly linked north of the international boundary, but is contiguous throughout its range to the south in Washington State (Leonard et al. 1993; Sarell 1996). Tiger Salamanders may occur in the southern part of the East Kootenay Trench. A disjunct population (possibly introduced) was found very close to the border in Eureka, Montana (J. Reichel, pers. comm.).

Forest region and districts

Southern Interior: Arrow Boundary, Okanagan Shuswap

Ecoprovinces and ecosections

SIM: SFH(?[1])
SOI: OKR, NOB, NOH, SOB, SOH, STU(?)

Biogeoclimatic units

BG: xh1
IDF: dk1, dk2(?), dm1, xh1
ICH: dw(?), mk1(?), mw2(?), xw
PP: dh1, dh2(?), xh1, xh1a

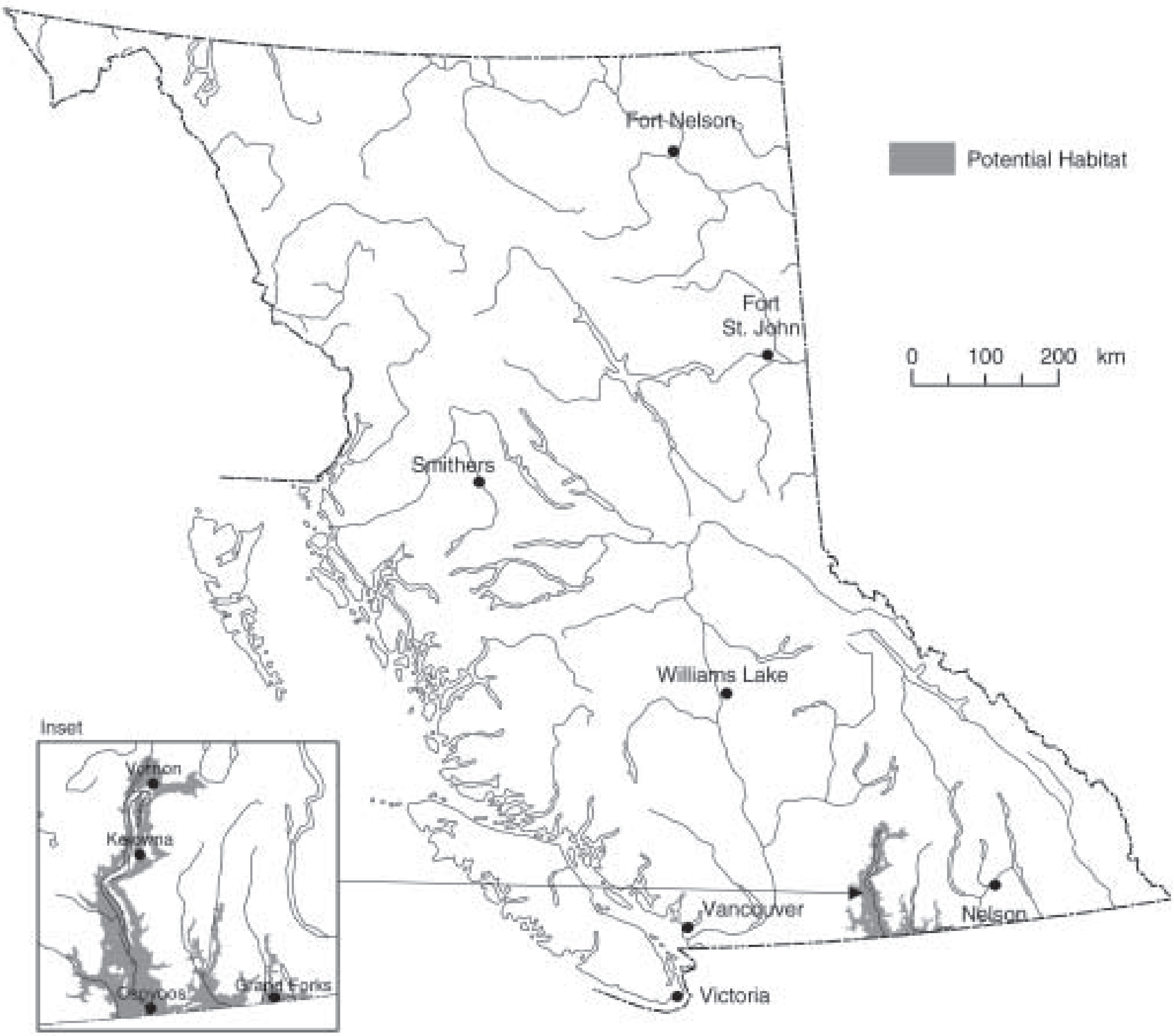
Broad ecosystem units

Terrestrial: AB, BS, CF, CR, DF, DP, OV, PP, RO, SS
Aquatic: LS

1 (?) Indicates that the range extent has not been determined.

Tiger Salamander

(Ambystoma tigrinum)



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.

Elevation

Tiger Salamanders have been found from valley bottoms (300 m) up to 1250 m in British Columbia (Orchard 1991). Populations at higher elevations are usually found in areas with well-developed soils and a grasslands component.

Life History

Diet and foraging behaviour

Terrestrial adults are usually only seen travelling on land and at breeding ponds. Little is known of their terrestrial, subterranean, foraging behaviour. It is likely that much of the terrestrial foraging occurs in burrows, where arthropods and other invertebrates are encountered. Prey is known to consist of a large variety of invertebrates and occasionally small vertebrates. Aquatic forms (larvae, neotenes, and paedogens) prey on aquatic invertebrates and small vertebrates. A small percentage of terrestrial and aquatic morphs are cannibalistic, ensuring that under extreme conditions there will be sufficient food to perpetuate the species (Collins and Cheek 1983).

Reproduction

Reproduction occurs from March through August. Sexual maturity is generally reached in the first year, but can be delayed (neotony). In early spring, adult Tiger Salamanders congregate at aquatic breeding sites. Females deposit several hundred eggs, although more than 5000 can be produced by very large females in some subspecies (Bishop 1943; Rose and Armentout 1976). Eggs are deposited singly but they may be deposited over a small area. Females often attach eggs to submerged vegetation, rocks, or twigs in shallow water (<1 m deep). This usually occurs in April or May. Most terrestrial adults have left the breeding site by the end of May or June. Larvae hatch in 2–3 weeks and may metamorphose and leave the water at 3–4 months, usually during fall rains. Growth rates vary between ponds (Richardson et al. 2000a, 200b). Neotony can occur under certain conditions, usually related to water chemistry (low iodine concentrations), food availability, and temperature. Paedogensis occurs when the larval form is retained and sexual maturity reached. This usually occurs in permanent water bodies, without fish. Paedogens have been documented at two sites in British Columbia and there is some evidence for the possibility of a third site (Sarell 1996).

Site fidelity

It is not known how philopatric individuals are to specific breeding sites but this species regularly breeds at several sites in the south Okanagan. Breeding site fidelity is unlikely if a breeding site is dry and another is detected or found. This tendency would follow that of the California Tiger Salamander (*Ambystoma californiense)* in which the majority of the population return to their natal pond but 20% were found to travel to new ponds (Trenham 1998).

Home range

Home range is not known but evidence suggests it is very limited (Richardson et al. 2000b). Richardson et al. (2000a) found that during the summer, Tiger Salamanders generally did not move far daily or even weekly, often remaining within a 5 m radius, but occasionally moving 10–100 m. The largest recorded movement was 250 m. This information was derived from individuals implanted with radio transmitters. Other observations of terrestrial adults have found them more than 1 km from possible breeding sites (Sarell 2000). The California Tiger Salamander has been found to usually return to their natal ponds; however, about 20% of the population venture to other ponds within 800 m (Trenham 1998). This information suggests a larger home range for at least some of the population.

Movements and dispersal

Movements and dispersal often coincide with specific environmental conditions, particularly temperature and rainfall (Loredo and Van Vuren 1996; Richardson et al. 2000b). Terrestrial adults migrate from terrestrial habitats to aquatic breeding sites in late winter or early spring (March and April). Richardson et al. (2000a) found that during the summer, Tiger Salamanders did not move >150 m from breeding locations in 1998 and not more than 500 m in 1999 (Richardson et al. 2000b). Semlitsch

(1998) found that adult salamanders from six species in the genus *Ambystoma* were found an average of 125.3 m from the edge of aquatic habitats. However, adult salamanders also have been found more than 1 km, and up steep slopes, from the nearest, potential breeding site (Sarell and Robertson 1994; Sarell 2000). Newly metamorphosed individuals emigrate from ponds to terrestrial habitats in August and early September, during heavy night rains.

Habitat

Structural stage

Tiger Salamanders likely prefer a structural stage of 2 (herb) and 3 (shrub/herb) but certainly use other structural stages where the forests are open and soils are suitable.

Important habitats and habitat features

Aquatic

The Tiger Salamander breeds in a variety of temporary and permanent aquatic habitats. In the south Okanagan many of these are small and frequently alkaline. Water depth, emergent vegetation, and an absence of predatory fish species are important characteristics of breeding sites (Orchard 1991). Tiger Salamanders typically lay their eggs in shallow, warm water that is <1 m deep. Emergent vegetation provides cover, a supply of invertebrates, and substrate for attaching eggs, but is not characteristic of all breeding sites.

Aquatic habitats that retain water until late July or August provide consistent breeding over those water bodies that dry prior to larvae metamorphosing. Neotenes (extended larval morphs) and paedogens (aquatic gilled adults) require permanent water bodies that do not freeze solid during the winter and preferably lack predatory fish. These water bodies provide nuclei for populations, especially during extended droughts.

Ephemeral water bodies (e.g., White Lake) provide extensive breeding opportunities during wet years, replenishing populations after dry years. Ephemeral ponds also permit range expansions during wet years. These small and shallow water bodies are especially important where deep lakes have been stocked with predatory fish.

Terrestrial

Important terrestrial habitats include riparian habitats adjacent to aquatic breeding sites, open sagebrush grasslands, and open forests. Tiger Salamanders spend most of their lives in underground refuges, such as small mammal burrows, particularly those of Great Basin Pocket Mouse (*Perognathus parvus*) and pocket gophers (*Thomomys talpoides*) (Vaughan 1961; Richardson et al. 2000b). The northern distribution of the Tiger Salamander in North America appears to be closely linked to the distribution of pocket gophers (Sarell 1996). Rodent burrows may be the limiting factor in terrestrial habitats as they provide abundant opportunities to gain subterranean access, have an abundance of prey, and provide adequate retreat depth for overwintering. Tiger Salamanders also retreat under coarse woody material or dig burrows (Semlitsch 1983). These retreats are used during the day or for short periods during the active season, and may be important during critical times, particularly juvenile dispersal (Richardson et al. 2000a).

Conservation and Management

Status

The Tiger Salamander is on the provincial *Red List* in British Columbia. In Canada, the southern mountain population is designated as *Endangered* (COSEWIC 2002).

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

AB	BC	ID	MT	WA	Canada	Global
S4	S2	S5	S5	S3	N5	G5

Trends

Population trends

Population size and trend are not known. Populations may fluctuate significantly between years and annual recruitment is highly variable (Semlitsch 1983; Richardson et al. 2000b). In dry years, shallow ponds may dry up early and result in total reproductive failure. This has been observed at many sites in British Columbia (Orchard 1991; Sarell and Bryan 1993).

Anecdotal information strongly suggests that Tiger Salamanders in British Columbia are declining (Orchard 1991). Forty-one historic breeding sites were known in British Columbia of which about 16 still had successful breeding (Sarell 1996).

Habitat trends

In British Columbia, Tiger Salamanders occupy habitat that is greatly desired and impacted by people. The highest rate of habitat loss has been in the south Okanagan, primarily due to residential and agricultural developments. The expanse of roadways and increased traffic extend this influence into unsettled habitats. To a lesser extent, off-road traffic, invasive species, and concentrated livestock use appears to impair the suitability of relatively natural habitat (Orchard 1991; Sarell 1996; Schock 2001).

In the late 1980s it was calculated that about 10% of ecosystems in the south Okanagan remained relatively undisturbed (Redpath 1990). About half the riparian habitat in the south Okanagan Valley has been lost to urban or agricultural development over the last 50 years (Cannings et al. 1999). Human population growth, roads, and volume of traffic in the south Okanagan are expected to continue to increase.

Road-use statistics of Highway 97 in the south Okanagan record a range of 2872 to 20 017 vehicles per summer day (1–14 vehicles per minute) during the season when Tiger Salamanders are active (MOTH 1999). Despite lower traffic volumes at night, even the lowest level of two vehicles per minute provides very little chance of a Tiger Salamander successfully crossing the road.

Most known Tiger Salamander sites are on or surrounded by private land or rangeland. Some important habitats have been acquired by The Nature Trust of BC and BC Parks. Breeding habitats have been unintentionally created through the development of water impoundments and waste water lagoons.

Threats

Population threats

In British Columbia, populations in the valleys are extremely prone to heavy losses due to extensive land uses and high levels of traffic. It is quite possible that much of the Okanagan range will be lost and the remaining undeveloped and secured lands could be significantly impacted by road traffic. Lakes that support paedogenic populations continue to be managed for introduced fish. Paedogens maintain this species range during prolonged droughts.

Although Rainbow Trout (*Oncorhynchus mykiss*) are sympatric, most breeding sites are void of fish. Introduction of trout for sport fisheries is a major threat to Tiger Salamander populations in British Columbia. Predatory fish may compete for prey and feed on Tiger Salamander eggs and larvae (Orchard 1992). At least five major breeding populations in British Columbia have been lost or significantly impacted by fish stocking programs (Orchard 1991; Sarell 1996). This does not include the oxbows along the Okanagan River that are now teeming with non-native fish such as bass. Introduced fish can also carry and spread diseases that native amphibian species have little or no defence against.

Pesticides, fertilizers, and other contaminants are known to impact Tiger Salamanders (Power et al. 1989). Because they prey on a variety of invertebrates and vertebrates, Tiger Salamanders are sensitive to bioamplification (concentration of contaminants). Pesticides can result in direct and indirect effects that impact growth and development, reproduction, behaviour, as well as habitat and food quantity and quality (Bishop 1992). Even some inactive ingredients in pesticides, such as dispersants or wetting agents in herbicides, can impact gill respiration in tadpoles (Seburn and Seburn 2000).

Runoff from nitrate fertilizers can reduce the fitness of individuals by reducing activity and feeding, and increasing deformities in larvae of some amphibians (Seburn and Seburn 2000).

Infectious diseases have been found in Tiger Salamanders (Seburn and Seburn 2000; Davidson et al. 2000). Mass mortality at four lakes in Utah occurred from bacteria (Worthylake and Hovingh 1989). Chytrid fungus (genus *Batrachochytrium*) and *Ranavirus* have also been implicated in the declines or die-offs of Tiger Salamanders (Schock 2001). In British Columbia, a larval population experienced a die-off although it is not known what caused the event.

Habitat threats

The loss, alteration, and fragmentation of suitable habitat due to urban and agricultural development have been extensive in the south Okanagan. About half of the riparian habitat in the south Okanagan Valley has been lost to urban or agricultural development over the last 50 years (Cannings et al. 1999). Irrigation practices or water control systems, which lower water levels, can also impact Tiger Salamanders by stranding eggs, larvae, and neotenes. Irrigation developments also have enabled the conversion of terrestrial habitats into agricultural production.

Impacts from livestock grazing include soil compaction, trampling of wetland banks or edges and burrows, loss of riparian vegetation, and increased nutrient input to water (Orchard 1991; Richardson et al. 1998). If water quality is reduced at breeding sites due to livestock grazing, mass die-offs of Tiger Salamanders may occur due to increases in *Acinetobacter bacterium* (Worthylake and Hovingh 1989). Nutrient loading can also lead to dramatic increases of other pathogens or toxic levels of nitrites, especially during dry years (Worthylake and Hovingh 1989; Bishop 1992). Soil disturbances around the pond can also increase the rate of infilling and eventual loss of breeding habitat (Harvey et al. 2000). Heavy livestock use near the ponds can cause the collapse of small mammal burrow entrances, needed for aestivation (Harvey et al. 2000). Overall, the effects of livestock grazing are much less than many other anthropogenic effects, given the apparent reproductive and survival success in many areas that are grazed. The extent of the effects are probably linked to the intensity and timing of grazing. It is very unlikely that many Tiger Salamanders are trampled above ground, given that livestock do not travel much at night, when the salamanders are above ground.

Roads that intersect aquatic breeding and terrestrial habitats can result in increased road mortality during seasonal migrations. Richardson et al. (1998) reported up to 50 road mortalities on one day near one breeding site during September migrations. Mortalities from vehicle traffic may be one of the most significant effects, beside outright loss of habitats (Seburn and Seburn 2000). Prolonged and heavy all-terrain vehicle traffic may also significantly reduce habitat suitability.

Periodic drought is a natural limiting factor for Tiger Salamander populations (Orchard 1991). Annual and seasonal variations in precipitation and ground water flows may result in some ponds or wetlands drying up completely prior to metamorphosis of larvae. Human use of water for agricultural purposes may further reduce water levels and exacerbate these impacts.

The eggs of some amphibian species are vulnerable to increased UV radiation, resulting in reduced hatching success. Tiger Salamanders may be sensitive to the impacts caused by increased UV-B radiation (Seburn and Seburn 2000).

Legal Protection and Habitat Conservation

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

Tiger Salamanders require the protection of aquatic breeding habitat and nearby terrestrial habitats. Prior to the recent designation of some provincial parks, only 6% (4599 ha) of suitable Tiger Salamander habitat in the south Okanagan was currently designated as conservation lands (MELP 1998). Approximately 58% (42 241 ha) of suitable habitat is on Indian Reserves or private land and 36% (26 346 ha) was found on Crown land. Key areas that are afforded some protection are the White Lake Basin, South Okanagan Grassland Provincial Park, and the South Okanagan Wildlife Management Area.

Identified Wildlife Provisions

Sustainable resource management and planning recommendations

Maximize connectivity between known or suitable aquatic breeding sites, terrestrial foraging, and overwintering habitats by reducing agricultural and residential developments, as well as managing the impacts from traffic through these areas.

Wildlife habitat area

Goal

Maintain or recover the integrity of breeding and terrestrial habitats, ensuring the connectivity between these habitats is unimpeded.

Feature

Establish WHAs at breeding sites where breeding is known to occur.

Size

Most WHAs will be between 5 and 25 ha; however, the size of the WHA will ultimately depend on the size and number of wetlands included and area of suitable upland habitat.

Design

The WHA should include a core area and may include a management zone. The core area should include the aquatic breeding site(s) and suitable uplands within ~250 m to protect most of the aestivation habitat. A management zone may be included to capture high quality habitat or to provide connectivity between populations.

General wildlife measures

Goals

1. Minimize disturbance during the breeding season.
2. Minimize road mortality.
3. Maintain water quality.
4. Maintain water levels.
5. Minimize soil disturbance and trampling of burrows.
6. Maintain important habitat features (i.e., small mammal burrows, riparian and emergent vegetation, and non-compacted soils).
7. Maintain or remediate riparian and aquatic habitats to a properly functioning condition.

Measures

Access

- Do not construct roads, deactivate temporary road structures, and close roads during critical times, as recommended by MWLAP. Drift fences and culverts may be required by the statutory decision maker for locations where road mortality is extensive.

Harvesting and silviculture

- Do not harvest. When approved, selective harvesting methods are preferred.
- Minimize ground disturbances and do not scarify harvested areas.
- Do not place landings within core or management zone.
- Do not stock above natural densities so that open forest and grassland openings are maintained, as per a NTD4 fire maintained ecosystem.
- Salvage harvesting should follow the same guidelines as stated above.

Pesticides

- Do not use pesticides.

Range

- Plan livestock use in the core area to meet objectives described in general wildlife measures goals. Exclusion fencing may be required by the statutory decision maker to meet objectives.
- Do not place livestock attractants within WHA.

Additional Management Considerations

Minimize road traffic.

Prohibit fish stocking in WHAs or any fishless water body.

Ensure all-terrain vehicles do not have access to critical habitats and prevent incompatible recreation activities.

Ensure irrigation intake lines are screened.

Ensure breeding sites do not experience water extraction to the point that reproduction is impaired.

Maintain integrity of riparian areas of adjacent permanent and non-permanent wetlands.

Encourage private land stewardship where important habitats extend beyond Crown lands.

Information Needs

1. Determine the range and biogeoclimatic limits of the species.
2. Identify critical habitat feature requirements.
3. Determine the effects of contaminants and threats from infectious diseases.

Cross References

Badger, Burrowing Owl, Great Basin Spadefoot, Sandhill Crane

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