COSEWIC
Assessment and Update Status Report

on the

Western Chorus Frog
Pseudacris triseriata

in Canada

Carolinian population
Great Lakes/St. Lawrence – Canadian Shield population

NOT AT RISK – Carolinian population
THREATENED – Great Lakes/St. Lawrence – Canadian Shield population
2008

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

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Western Chorus Frog — Photo by Andy Clay.

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COSEWIC
Assessment Summary

Assessment Summary – April 2008

Common name
Western Chorus Frog – Carolinian population

Scientific name
Pseudacris triseriata

Status
Not at Risk

Reason for designation
Although there are ongoing losses of habitat and breeding sites due to urban and suburban expansion and changes in agricultural practices, declines in abundance are not appreciable in southwestern Ontario, no significant trends have been detected and the species remains abundant in many areas.

Occurrence
Ontario

Status history
The species was considered a single unit and designated Not at Risk in May 2001. Split into two populations in April 2008. The Carolinian population was designated Not at Risk in April 2008.

Assessment Summary – April 2008

Common name
Western Chorus Frog – Great Lakes/St. Lawrence – Canadian Shield population

Scientific name
Pseudacris triseriata

Status
Threatened

Reason for designation
Ongoing losses of habitat and breeding sites for this small frog due to suburban expansion and alteration in farming practices have resulted in losses of populations and isolation of remaining habitat patches. Populations in Quebec are documented to have declined at a rate of 37% over 10 years and are expected to continue to decline. Despite there being some areas where chorus frogs remain evident, surveys of populations in Ontario indicate a significant decline in abundance of 30% over the past decade.

Occurrence
Ontario, Quebec

Status history
The species was considered a single unit and designated Not at Risk in May 2001. Split into two populations in April 2008. The Great Lakes/St. Lawrence – Canadian Shield population was designated Threatened in April 2008.

COSEWIC
Executive Summary

Western Chorus Frog
Pseudacris triseriata

Carolinian population
Great Lakes/St. Lawrence – Canadian Shield population

Species information

The Western Chorus Frog, *Pseudacris triseriata,* is a small tree frog about 2.5 cm long and weighing about 1 g when adult. It has three dark lines along its back and one larger line on each flank. Its ground colour can range from brown to grey to olive. The species is easily detected during spring because of its creaking call that resembles the sound of a fingernail stroked along a plastic comb. It is a secretive species and thus rarely seen outside the breeding season.

Distribution

In Canada, *P. triseriata* is found in the lowlands of southern Ontario and south-western Quebec. A significant genetic distinction in terms of mitochondrial DNA sequences has been identified between *P. triseriata* from southwestern Ontario and those from elsewhere in Ontario and Quebec. Thus two designatable units are recognized among Canadian populations, corresponding to the **Carolinian** and **Great Lakes/St. Lawrence – Canadian Shield** faunal provinces, respectively.

Habitat

Pseudacris triseriata requires both terrestrial and aquatic habitats in close proximity. Terrestrial habitat consists mostly of humid prairie, moist woods, or meadows. For reproduction and tadpole development, this species requires seasonally dry, temporary ponds that are devoid of predators such as fish.

Biology

Pseudacris triseriata generally live no more than 1 year and usually breed in the first spring after metamorphosis. The breeding season is from early-March to mid-May. It takes approximately 2 months for tadpoles to change into froglets, which grow very quickly and are mature at the end of the summer. Mortality is high at all life stages and survival of a population depends on the recruitment of new individuals through reproduction and/or immigration each year. Thus to overcome years with poor reproduction, breeding ponds must be sufficiently connected to enable immigration or emigration.

Population sizes and trends

The sizes of *Pseudacris triseriata* populations are generally unknown though they are expected to fluctuate widely in size. One site was estimated to contain about 2,000 individuals. Losses of populations, at a rate of about 37% over 10 years, have been documented in Quebec since the 1950s. From 1995 through 2006, population numbers throughout the **Great Lakes/St. Lawrence – Canadian Shield** faunal province in Ontario are estimated to have declined significantly at a rate of about 3.5% per year, which equals 30% decline over 10 years. In many cases when population numbers have declined due to change in land use, the populations have not recovered. There is no detectable, significant trend among **Carolinian** populations of this species.

Limiting factors and threats

Most populations of Western Chorus Frogs use land that is also deemed valuable for development. For urban construction or industrial agriculture, the land is drained and filled, resulting in the direct loss of individuals in a population, eliminating the temporary ponds required for breeding, and significantly altering the quality of the remaining terrestrial habitat. This results in smaller, isolated habitat patches. *Pseudacris triseriata* has limited abilities to cope with habitat fragmentation and reduced habitat quality. The frogs have relatively low dispersal ability and relatively high site-fidelity to natal ponds. Like other pond-breeding amphibians, there are expected to be large fluctuations in population size from year to year; thus if a natural decrease in population size coincides with a reduction in habitat quality, local extinction is more likely to result.

Habitat destruction is so rapid in suburban areas of southwestern Quebec that populations there may be extirpated from known sites in less than 25 years. The loss of habitat in agricultural landscape is less rapid but, as observed in southwestern Quebec between 1950 and 1990, changes that intensify agricultural practices can produce rapid and catastrophic declines in Western Chorus Frog populations.

Special significance of the species

Pseudacris triseriata is a good flagship species for promoting awareness of healthy environments as it is easily heard in spring and its presence indicates the maintenance of natural habitats even in developed areas. In Quebec, it has become a symbol for protection of species at risk and their habitat, especially in suburban areas.

Existing protection or other status designations

In 2001, COSEWIC considered *P. triseriata* as a single unit and designated the species as “Not at Risk”. In Ontario, outside of wildlife protection areas, *P. triseriata* is not protected by any legislation. In Quebec, despite a legal designation of ‘Vulnerable’ in 2000, no Western Chorus Frog habitat is currently protected under species-at-risk legislation.

COSEWIC HISTORY

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. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS (2008)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* 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. Definition of the (DD) category revised in 2006.

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The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

Update
COSEWIC Status Report

on the

Western Chorus Frog
Pseudacris triseriata

in Canada

Carolinian population
Great Lakes/St. Lawrence – Canadian Shield population

2008

TABLE OF CONTENTS

List of figures

List of appendices

SPECIES INFORMATION

Name and classification

Pseudacris triseriata (Wied-Neuwied 1838), family Hyldae, is called the “Western Chorus Frog” in English and "Rainette faux-grillon de l’ouest” in French (Crother *et al*. 2001, Desrosiers *et al.* 1995, Desroches and Rodrigue 2004). The species has been known by many different common names in previous literature such as “striped chorus frog”, “swamp cricket frog”, “swamp tree frog”, “striped bush frog” and “western striped frog”, (Wright and Wright 1949), “midland chorus frog” (Cook 1984) and, in French, “rainette faux-criquet” and “rainette faux-grillon” (Desroches and Rodrigue 2004). Wright and Wright (1949) mention a “Western Chorus Frog”, *Pseudacris occidentalis*, and conclude that it probably does not exist. The common name is now universally associated with *P. triseriata*.

The taxonomy of chorus frogs has been subject to repeated change over the last half centrury. Wright and Wright (1949) and Smith and Smith (1952) considered *“triseriata”* to be one of four subspecies of *P. nigrita* along with *maculata* (boreal chorus frog), *ferarium* (upland chorus frog), and *kalmi* (New Jersey chorus frog). In the 1950s, the species name *“triseriata”* was applied to more northerly and western forms whereas “*nigrita*” was restricted to a southeast North American species (Conant 1958; Conant and Collins 1998). Most recently, various subspecies have been elevated to the species level on the basis of differences in breeding calls and morphology (Platz and Forester, 1988; Platz 1989). Though still not universally accepted (Conant and Collins 1998; Harding 2000), the Western Chorus Frog, *P. triseriata,* is considered a monotypic species in the definitive list by Crother *et al*. (2001).

Morphological description

Pseudacris triseriata (Fig. 1) is a small tree frog, with males ranging in snout-to-vent length (SVL) from 18.7 – 32 mm (average 24.7 mm) and females 19.5-37.5 m (average 25.6 mm) (Wright and Wright 1949). Adults have an average mass of 1 g (Desroches and Picard, personal observation). The body is slightly elongated, described as resembling the shape of a small pear (Desroches and Rodrigue 2004), with a narrow and pointed head. The toes are long with very small terminal toe-pads. The skin is finely granular (Wright and Wright 1949; Cook 1984; Desroches and Rodrigue 2004). The ratio of the tibia length to the snout-to-vent length is a criterion used to distinguish among chorus frog taxa (Wright and Wright 1949; Smith and Smith 1952; Powell *et al*. 1998; MacCulloch 2002; Desroches and Rodrigue 2004). In *P. triseriata*, the average tibia/SVL ratio is less than 47.0 (Smith and Smith 1952) and was 43.7 for a population from south shore of Montreal, Quebec (Desroches and Picard, personal observation), 41.5 for some Ottawa specimens, and 39.5 for Philipsburg, Quebec (Bleakney 1959). Differences between ratios may be due in part to measurements being taken on live specimens (south shore of Montreal) versus preserved specimens (Ottawa and Philipsburg).

Figure 1. Western Chorus Frog (*Pseudacris triseriata*). Photo credit: Andy Clay.

The colouration of *P. triseriata* varies from brown to grey to olive. A dark spot or stripe is present between the eyes and it is often fused with the middle dorsal stripe. The most striking marks on the body are the three dark longitudinal lines on the dorsum, which are the basis for the specific epithet *"triseriata"*. These lines either may be continuous or broken into segments. Two additional dark lines are present on the sides of the body, from the tympanum to the groin. A dark mask covers the sides of the face from the nostrils across the eyes to behind the tympanum, which usually extends to the lateral dark lines, giving the appearance of a dark stripe ranging from the tip of the head to the groin. The upper lip is pale (Wright and Wright 1949; Cook 1984; MacCulloch 2002; Desroches and Rodrigue 2004). Albino individuals have been reported (Ackroyd and Hoffman 1946; Corn 1986).

Males have a vocal sac, which appears as a dark flap on the throat when relaxed, and as a yellow balloon when expanded (Conant and Collins 1991). In females, there is no difference in colour and texture between the throat and the belly (Desroches and Rodrigue 2004). During the breeding season, a nuptial pad is present on the inner side of the first finger of the male (Whitaker 1971), but this is hard to see in the field. Juveniles are about 7.5 - 11 mm SVL at metamorphosis, and are similar in colouration and form to the adults (Whitaker 1971; Wright and Wright 1949).

Tadpoles are dark, 10 - 23 mm in total length, and the tail musculature is bicoloured dark above and light below. The caudal fin is clear with some stellate-shaped melanophores. The eyes are at the margins of the head, near the sides, as for other tree frogs. There are two upper rows of teeth and three lower rows, and papillae are present along the posterior margin of the oral disk (Wright and Wright 1949; Altig 1970; Desroches and Rodrigue 2004). Detailed descriptions of eggs and tadpoles, as well as their development, are given in Wright and Wright (1949) and Whitaker (1971).

The call of *P. triseriata* is readily recognizable. It is described as a vibrating chirp (Wright and Wright 1949), a prolonged rubbing similar to the sound generated by a fingernail sliding on a metallic comb (Cook 1984), or a “cre-ee-ee-ee-eek” rising in pitch and frequency as it progresses (Harding 1997). The call is a one-second trill of short, dry, ascending notes, repeated at regular intervals (Desroches and Rodrigue 2004). The call resonates and can be heard from almost a kilometre away in favourable weather conditions (Wright and Wright 1949). Calling occurs throughout the day and night during the breeding season, with a lull in the hours after midnight (Schueler 2004). Calls of a few individuals may be heard during the summer and fall, from July to October (Schueler 2004), and calls have been heard as late as November in Ontario (Dale, 1928).

It is possible to confuse the trilled agonistic, or territorial, call of the spring peeper, *Pseudacris crucifer*, with the call of *P. triseriata.* Spring peepers breed at the same time as the chorus frogs in early spring yet are much more widespread and abundant. In a chorus of *P. crucifer*, the trilled territorial calls may be heard occasionally and are so qualitatively different from that species’ usual “peep” that an unsuspecting listener may think it comes from a chorus frog. The trilled calls of the two species can be distinguished from one another by a trained listener as *P. crucifer*’s call is more musical (Schueler 2001a) and always heard from amidst a chorus of peeps. Nevertheless, it is probable that some records of *P. triseriata* based only on auditory evidence are erroneous.

Genetic description

Moriarty and Cannatella (2004) presented genetic evidence that the widespread morphologically delimited clade of chorus frogs consisting of *triseriata, maculata, ferarium,* and *kalmi* was polyphyletic. At the time, Moriarty and Cannatella (2004) had only one sample of *P. triseriata* from Canada (from eastern Ontario), which clustered with northern Ontario *'maculata'* rather than with a Michigan *P. triseriata* sample. Recently, though, on the basis of 2.4 kb of 12S and 16S rRNA mitochondrial DNA sequences from additional samples, Moriarty-Lemmon *et al*. (2007) have found further evidence that the chorus frogs of southwestern Ontario constitute a different genetic lineage than chorus frogs elsewhere in Ontario and in Quebec (Fig. 2) based on analysis of mitochondrial DNA. Populations north and east of a line from about Goderich on Lake Huron to Hamilton on Lake Ontario, which have long been considered *P. triseriata*, have mitochondria that genetically resemble those of populations of *P. maculata* rather than western populations of *P. triseriata*. To affirm the identity of chorus frogs in Quebec, E. Moriarty-Lemmon (personal communication) first confirmed that a frog from

Boucherville, Quebec, had mtDNA like that of *P. maculata*. Subsequently, S. Noël, N. Tessier and F.-J. Lapointe (personal communication) found the same among frogs from five populations in the Montérégie and Outaouais regions of Quebec.

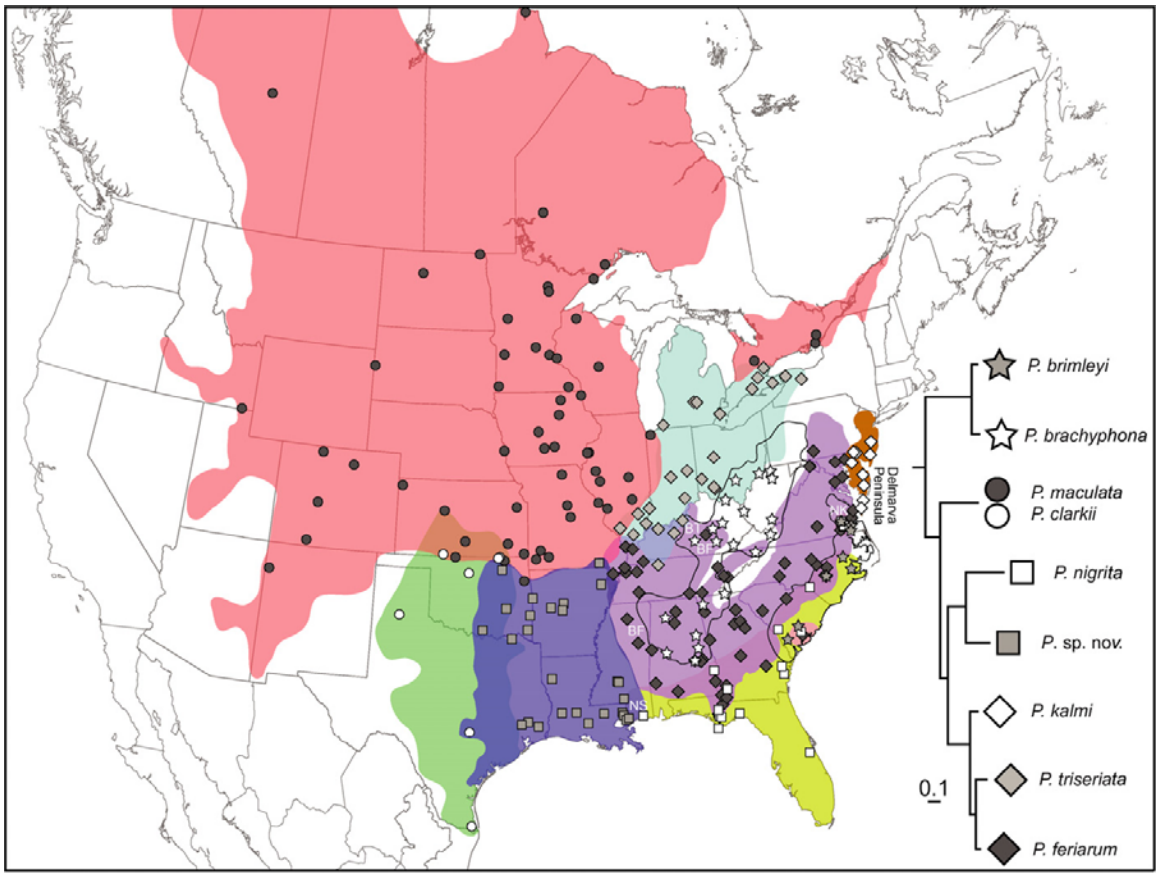

Figure 2. Subdivisions in the distribution of the striped chorus frog complex, genus *Pseudacris*, of North America based on mitochondrial DNA sequence markers. The tree diagram is a Bayesian analysis indicating probabilistic relationships of the mitochondrial DNAs of these frogs and a nomenclature suggested by the originators of these data. Note the presence of two, distinct, mitochondrial "races" in southern Ontario with a postulated boundary between them corresponding to the division between the Great Lakes/St. Lawrence – Canadian Shield and Carolinian faunal provinces. Note also the complete geographic range disjunction between frogs carrying the "*maculata*" type mitochondrial genome from the Great Lakes/St. Lawrence – Canadian Shield region of central Ontario and southern Quebec vs. western Canada and northern Ontario. Source: Moriarty-Lemmon *et al*. (2007).

There are other known incidences of different mitochondrial lineages within the same amphibian species. Fowler's Toad, *Bufo fowleri*, has at least three, genetically distinct mitochondria, one of which is similar to that of the Southern Toad, *Bufo terrestris*, while another is similar to that of the American toad *Bufo americanus* (Masta *et al*. 2002, Smith and Green 2004). These occur in different populations yet there is no question that all individuals studied, whatever mitochondrial DNA they possess, are all Fowler's Toads. Spotted Salamanders, *Ambystoma maculatum,* Bullfrogs, *Rana catesbeiana*, and Spring Peepers, *P. crucifer*, have also been shown to exhibit more than one distinct mitochondrial lineage (Austin *et al*. 2002, 2004, Zamudio and Savage

2003). A boundary line between mitochondrial lineages exists in southern Ontario in all three of these species.

Therefore the taxonomic conclusion by Moriarty-Lemmon *et al*. (2007) that populations of chorus frogs in Canada outside of southwestern Ontario are in fact members of the species *P. maculata* rather that *P. triseriata* is probably premature. Nuclear genes have not been assayed directly and the morphological differences between *P. maculata* and *P. triseriata,* which are well studied (Platz and Forester, 1988; Platz 1989), apply to populations of both species (Desroches and Rodrigue 2004) despite their evident mitochondrial similarity. It suffices that the mitochondrial DNA data demonstrate that within Canadian populations currently known as *P. triseriata*, there are two, distinct mitochondrial lineages in definable parts of its range, similar to the situation in some other species Moriarty-Lemmon *et al*. (2007) also inferred, on the basis of one sample, that mixing between individuals of the two lineages of *P. triseriata* populations may have occurred around Guelph, Ontario.

Designatable units

Bleakney (1959) found slight measurable differences between the morphology of *P. triseriata* from Ontario and Quebec. The discovery of the significant genetic difference between *P. triseriata* from southwestern Ontario and those from elsewhere in Ontario and Quebec by Moriarty-Lemmon *et al*. (2007) indicates that these two portions of the Canadian population are much more distinct than previously considered. Therefore, two designatable units should be recognized among Canadian Western Chorus Frogs, corresponding to the **Carolinian** and **Great Lakes/St. Lawrence – Canadian Shield** faunal provinces, respectively (Fig. 2). These prospective DUs also demonstrate different degrees of vulnerability to extinction, as reported in the sections on Habitat and Population Sizes and Trends in this report.

DISTRIBUTION

Global range

Pseudacris triseriata, as currently understood, is widespread (Fig. 3) and occurs from southwestern to northeastern North America, between the range of the Boreal Chorus Frog (*P. maculata*) to the northwest, and the Upland Chorus Frog (*P. ferarium*) to the southeast. In the United States, *P. triseriata* is found in the central and northeastern states, from Kansas and Oklahoma to Michigan, northern New York and formerly northern Vermont (Conant and Collins 1998). It also occurs in a disjunct area in the southwestern United States, although these populations appear to possess mitochrondria that are genetically more similar to those of *P. maculata* (Moriarty-Lemmon *et al*. 2007).

Canadian range

In Canada, *P. triseriata* is found only in southern Ontario and southwestern Quebec (Fig. 4) (Cook 1984; Conant and Collins 1998; MacCulloch 2002; Desroches and Rodrigue 2004). It is widespread in southern Ontario (MacCulloch 2002) from the United States border north to Georgian Bay, south of Algonquin Park in the Frontenac Axis, and up the Ottawa Valley to the vicinity of Eaganville (Oldham and Weller 2002). In Quebec, *P. triseriata* is restricted to the Outaouais region along the Ottawa River between Gatineau and Île du Grand Calumet (the Outaouais group) and the Montérégie region south of the St. Lawrence River, including Île Perrot, in the south-western part of the province (Bider and Matte 1991). Bleakney (1959) suggested that further range expansion of *P. triseriata* to the north and east was restricted due to mountains, proglacial lakes and wide rivers such as the Ottawa and the St. Lawrence Rivers. There are some Quebec records from outside of the species' acknowledged range (Bider and Matte 1991, 1996) which are erroneous and result from the misidentification of tadpoles of other species or confusion about localities (Desroches 2003).

Most data establishing the distribution of Western Chorus Frogs come from auditory surveys recording the presence of calling frogs. The call of *P. triseriata* is loud and can be detected from long distances. This method has been used for most recent surveys in Ontario and Quebec and is reasonably effective for identifying the presence of the species. Auditory surveys indicate hundreds or, perhaps, thousands of sites where *P. triseriata* has been detected in Canada, although this is highly likely to be an overestimate. The trilled territorial call of the spring peeper (*P. crucifer*) can be confused with the normal call of *P. triseriata* and, as a result, the number of records for each species may not be accurate and may result in an overestimate of the number of Western Chorus Frog localities (de Solla *et al.* 2005, Schueler 2001a, J.P. Bogart, personal communication). Since most call surveys in Canada are done by volunteers, mistakes like this are to be expected. Several records from the Algoma region of Ontario are based solely of records of calls but no specimens of Western Chorus Frogs have ever been collected from there. Furthermore, particular populations of frogs will breed opportunistically in any of a potentially high number of different temporary ponds, each of which may be recorded individually in a survey. Thus auditory survey information should not be taken to indicate that there are thousands of populations.

Figure 3. Distribution of *Pseudacris triseriata* in North America (adapted from Conant and Collins 1998).

The species was introduced to Newfoundland in 1963, and from 1978-1981, and in spite of local success initially, the populations did not ultimately persist (Maunder 1983; 1997). Approximately 9% of the species' global range is in Canada (based on the map by Conant and Collins 1998).

HABITAT

Habitat requirements

Pseudacris triseriata is primarily a lowland, terrestrial species, found on the ground or on low bushes and herbage (Wright and Wright 1949; Cook 1984), and is a poor climber (Desroches *et al.* 2002). Bleakney (1959) noted a negative relationship between slope, which encourages the formation of streams rather than ponds, and the presence of *P. triseriata*. Weller and Palermo (1976) recorded observations of *P. triseriata* at altitudes up to 305 m in Ontario.

Pseudacris triseriata has been associated with grassy habitats (Bleakney 1959), but recent surveys and observations show the species uses many types of terrestrial habitat (Whiting, 2004). In summer and fall, during the non-breeding season, individuals can be found in marshes and damp places (Wright and Wright 1949), wooded areas near water (Whitaker 1971), and fallow lands and woods near breeding sites (Desroches and Rodrigue 2004). Other habitats include woodlands, meadows, and cultivated lands (MacCulloch 2002). Despite its aquatic habitat during the breeding season, *P. triseriata* is a poor swimmer (Wright and Wright 1949; Mélançon 1961). *Pseudacris triseriata* selects terrestrial habitats more on the basis of their proximity to breeding ponds than on the basis of habitat type, although with that priority satisfied, they prefer moist, open habitats (Wright and Wright 1949; Bleakney 1959; Cook 1984; McLeod and Gates 1998; Whiting 2004). *Pseudacris triseriata* hibernates in terrestrial habitats under rocks, logs, leaf litter, loose soil, or animal burrows, but hibernation sites are sometimes flooded (Carpenter 1953; Cochran 1989). On one occasion a hibernating individual was dug up from a depth of 2 cm in water-saturated soil in a shrubby habitat, 150 m from a breeding pond (Desroches and Picard, personal observation).

Pseudacris triseriata is the only prairie grassland amphibian to have extended its distribution as far as Quebec. Bleakney (1958) suggested that the creation of pastures and grassland through farming may explain this extension. In Canada, many chorus frog localities show evidence of agriculture, forestry, or other human disturbance (Weller and Palermo 1976; Daigle 1997). *Pseudacris triseriata* seems to have had more success in agricultural landscapes than other anurans such as the Spring Peeper (Kolozsvary and Swihart 1999).

Pseudacris triseriata usually breeds in small or shallow aquatic habitats, mostly temporary ponds and wetlands that become dry in the summer. These habitats contain fewer predators than permanent waters, but the trade-off is that tadpoles are more susceptible to mortality from drying (Skelly 1995). Western Chorus Frogs are very rarely found in permanent ponds (Skelly 1996). Tadpoles are found in water as deep as 40 cm, but are most abundant in water 11 - 22 cm deep (Whitaker 1971). Breeding habitats include ditches, marshes, flooded fields and pastures, temporary ponds and pools, and swamps (Wright and Wright 1949; Bleakney 1959; Weller and Palermo 1976; Conant and Collins 1998; Desroches and Rodrigue 2004; St. Hilaire 2005). *Pseudacris triseriata* is associated with open-canopy ponds (Skelly *et al.* 1999). In Quebec, the size

of aquatic breeding habitats varies from 100 - 60000 m^2 in the Outaouais (St. Hilaire 2005) and 10 – 1000 m² in the Montérégie (Picard and Desroches 2004). *Typha*, *Phalaris*, and *Carex* are generally found in breeding habitats along with other herbaceous plants (Desroches and Picard 2004; St. Hilaire 2005). Partially submerged shrubs and trees are often present in breeding habitats (Picard and Desroches 2004).

Habitat trends

There is a dramatic difference in the decline of Western Chorus Frog habitat and populations between the Great Lakes/St. Lawrence – Canadian Shield and Carolinian portions of the species' Canadian range. While a decline in Western Chorus Frog occurrence has also been recorded in some areas of southwestern Ontario, the pattern of decline that has been observed in Quebec since the 1950s is catastrophic and has led to considerably greater research effort in Quebec than in Ontario.

Great Lakes/St. Lawrence – Canadian Shield DU – The present distribution in Quebec consists only of fragments of the distribution observed by Bleakney (1958; 1959). In the Outaouais area in Quebec, the species is present in 40 localities totalling around 100 km² along a 100 km strip north of the Ottawa River (Fig. 4), but absent from the northernmost localities in the Gatineau River Valley where they previously were found (St. Hilaire *et al.* 2005). Many populations around the urban agglomeration of Aylmer-Hull-Gatineau disappeared in recent decades because of residential development, and many others are now significantly isolated from other populations (D. St. Hilaire personal communication). Since 1993, the species has disappeared from 30% of the sites where it had been heard in the Outaouais Region, mainly in urban areas (D. St. Hilaire personal communication). All the known breeding habitats of the species in the Outaouais Region are located in urban or agricultural areas (St. Hilaire and Belleau 2005).

In the Montérégie of southwestern Quebec, the species was historically widespread through the region south of the St. Lawrence River and east to the Appalachian Mountains (Bleakney 1958; 1959). In the early 1990s, surveys affirmed that the species had disappeared from the area east of the Richelieu River and persisted only in fragments south of Montreal and on Île Perrot (Daigle 1992; 1994; 1997). Since 1999, *P. triseriata* has disappeared from the southernmost part of this area and now persists only on Île Perrot and in a few areas within a 20 km long band on the south shore of Montreal between Beauharnois and Boucherville (Picard and Desroches 2004). No habitat connectivity exists among the nine Western Chorus Frog populations that remain within approximately 50 km^2. They are also separated from other parts of the species' range, located on the other side of the St. Lawrence River in eastern Ontario, by about 60 km. The Montérégie group has been extirpated from about 90% of its former range based on maps by Bleakney (1958; 1959), Daigle (1992; 1994; 1997) and Picard and Desroches (2004). This is a rate of about 37% over 10 years. The Montérégie habitat continues to disappear as more agricultural land is developed for residential use. A complete survey of the range showed that about 10% of the remaining Western Chorus Frog ponds were completely destroyed or significantly

altered in a single year (Picard and Desroches 2004). At this rate, Western Chorus Frog habitat may be eliminated from the region in 10 to 25 years (Picard and Desroches 2004). The decline is currently running at a rate of ca. 5.4%/year (A. Branchaud, personal communication).

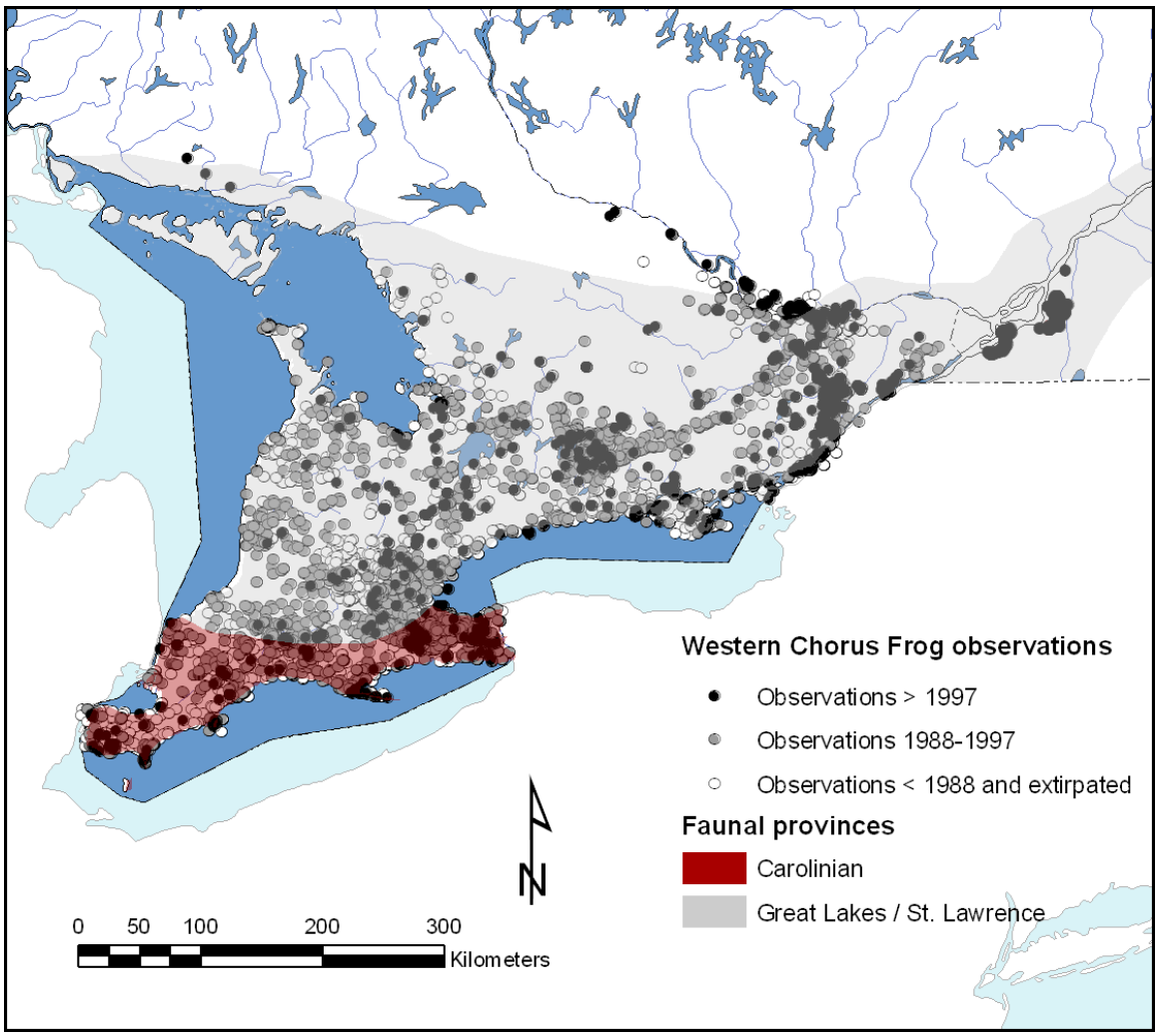

Figure 4. Distribution of *Pseudacris triseriata* in Canada, showing faunal provinces corresponding to recognized Designatable Units (source data: Oldham and Weller 2002, St. Hilaire *et al*. 2005, Picard and Desroches, 2004, Ontario Herpetofaunal Summary, Sébastien Rioux).

In Ontario, habitat destruction and fragmentation have occurred in most urban areas within the species' range (Oldam and Weller 2002), although there are few historic surveys from extreme eastern Ontario. Conditions in eastern Ontario, though, are comparable to the Montérégie and therefore chorus frog populations in that area may have suffered declines similar to those seen in adjacent Quebec populations. While the disappearance of populations is observed in many other parts of Ontario (Seburn and Seburn 2001) and Quebec (Daigle 1997; St. Hilaire 2005 p.4), little is known about the habitats because most surveys or records are auditory, and the condition of the habitat may never even be seen by the observer.

Carolinian DU – The southwestern Ontario distribution at this time has not drastically changed in recent years. In the past, the relative stability of the southwestern Ontario portion of the Canadian population has overshadowed the losses observed in eastern Ontario and, particularly, in Quebec.

Habitat protection/ownership

Less than 10% of Western Chorus Frog sites in Canada are in protected areas such as parks or reserves (Bonin and Galois 1996; Oldham personal communication 1998). Most Western Chorus Frog localities are on private lands. A conservation plan is underway with the city of Longueuil, and may enable the protection of more than 40% of Western Chorus Frog ponds in the Montérégie (Audet and Montpetit 2005). However, many of the protected areas do not contain buffer zones around the pond and/or are not linked to other suitable habitat through corridors. Because this protection is only through municipal zoning, it is not certain that it will be permanent. In the Outaouais area of Quebec, only 10.5 % of *P. triseriata* breeding ponds are located on protected lands, either operated by the National Capital Commission (9.1%), or by the Nature Conservancy of Canada (1.4%) (D. St. Hilaire personal communication). There is no explicit official protection of chorus frog habitat in Ontario.

BIOLOGY

Life cycle and reproduction

Pseudacris triseriata breeds from early March to mid-May (Wright and Wright 1949; Whitaker 1971; Kramer 1973). In Canada, its breeding period is concentrated in April, sometimes beginning as early as the end of March, with calling sometimes continuing until mid-May (Francis 1978; Bishop *et al.* 1997; Lepage *et al.* 1997; Desroches and Rodrigue 2004). Western Chorus Frogs in sites at higher altitudes may breed 2 weeks later than those at lower elevations (Gorham 1959). The breeding season is short and lasts 2 or 3 weeks at a given site (Desroches and Rodrigue 2004). Western Chorus Frogs are among the first species to call in the spring, sometimes when the snow is still melting, and before breeding ponds are completely free of ice (MacCulloch 2002; Desroches and Rodrigue 2004). Males call from the water, usually with only the head or the anterior portion of the body emerged. Satellite males are often

present close to calling males, presumably to intercept females attracted by the calls (Roble 1985). As usual in pond-breeding frogs, the operational adult sex ratio in breeding ponds is biased in favour of males because males stay in the ponds longer than females (Whitaker 1971). In a population from Quebec, the sex ratio in the pond was about 1.5:1 in favour of males (Whiting 2004).

Females deposit a total of 373 - 1500 eggs (mean = 642 eggs) in small irregular masses each containing 12 - 245 eggs (Wright and Wright 1949; Whitaker 1971; Kramer 1978; Hecnar and Hecnar 1999). The eggs adhere to submerged vegetation or sink below the surface of the water (Pack 1920; Whitaker 1971; Desroches and Rodrigue 2004). Egg masses may also be attached to dead grass stems or twigs (Hecnar and Hecnar 1999). Sometimes egg-laying occurs in a compact area, resulting in communal egg deposition (Smith 2002). Egg-laying is generally in shallow water (3-15.5 cm) (Hecnar and Hecnar 1999). After eggs are laid there is no parental care (Harding 1997). Tadpoles hatch 3 to 27 days later, depending on water temperature, but most often in less than 15 days (Whitaker 1971; Desroches and Rodrigue 2004). The lower the water temperature the longer tadpoles take to develop. Tadpoles metamorphose and emerge from the water after 40 to 90 days, typically in June (Wright and Wright 1949; Whitaker 1971; Whiting 2004). Tadpoles may require more than 3 months to complete their development in some habitats (Smith 1983a).

Juveniles grow rapidly and sex can be distinguished by the throat colouration at the end of their first summer. Breeding size is reached by the end of their first growing season (Whitaker 1971; Whiting 2004). Individual male calls have been reported in the fall near breeding habitat or as far as 100 m from breeding habitat (Whitaker 1971; Cochran 1989).

Mortality/survival

Pseudacris triseriata is generally a short-lived species. Life span is usually 1 year and, occasionally, 2-3 years (Whiting 2004). For eggs, mortality is high and variable and may result from the absence of fertilization, predation, or other uncertain causes (Kramer 1978). Tadpole mortality is also high and unpredictable. The major cause of mortality for tadpoles is pond drying (Smith 1983a). Juvenile mortality is probably high also (Caldwell 1987).

In consequence, population turnover is essentially annual in *P. triseriata* (Whiting 2004), with most of the breeding frogs being new individuals from year to year. Whiting (2004) reported more than 97% annual turnover. Adult survivorship after breeding was about 14% per year in a study in Michigan (Smith 1987). No more than 2.6% of the survivors of a breeding season have been observed in the following breeding season (Whiting 2004). Survival after the breeding season is higher in females (Whiting 2004). Reported survivorship from metamorph to adult stage varies from 1% - 19% (Smith 1987; Whiting 2004) and is highly variable among years and sites. Larger metamorphs become larger adults; increased body size increases survivorship and the probability that individuals will reproduce at 1 year of age (Smith 1987). Females are bigger at maturity than males (Smith 1987); it is more likely that they grow faster than males

rather than take an additional year to reach sexual maturity. Western Chorus Frogs that metamorphose late or at a small size are unlikely to breed at all since they rarely survive until the next breeding season (Smith 1987). Most adults reach their mature size at the end of their first growing season (Whitaker 1971; Whiting 2004), and only breed once in their life (Whiting 2004).

Interspecific interactions

Predators – *Pseudacris triseriata* has many potential predators including insects, leeches, salamanders, fishes, snakes, and birds. Each life stage and microhabitat presents different threats. Egg masses have been found dead and observed to contain chirinomid (midge) larvae; however, it is unclear whether the larvae were the cause of death or simply scavengers (Kramer 1978). Eggs and tadpoles are preyed upon by larvae of *Ambystoma* salamanders and adults of the red-spotted newt, *Notophthalmus viridescens* (Walters 1975; Sredl and Collins 1991). Tadpoles are also prey for dragonfly larvae (Smith 1983a; b). In a breeding pond in Quebec, many confirmed or potential tadpole predators were found: predaceous diving beetles (*Dytiscus sp.*), the giant water bug (*Lethocerus americanus*), and leeches (St. Hilaire personal communication 2005). The size of the tadpole will largely influence how susceptible the individual is to predation. Larger tadpoles are not as vulnerable as eggs and smaller tadpoles to predation by Blue-spotted Salamanders (*Ambystoma laterale*) or small dragonfly nymphs (Smith 1983a).

Pseudacris triseriata very rarely uses permanent ponds for breeding and development (Hecnar 1997; Hecnar & M'Closkey 1997). Permanent ponds are home to a great density and diversity of predators including fishes (Skelly 1996) whereas fishes are usually absent from temporary ponds (Whitaker 1971; Skelly 1997). Fishes are probably significant predators of tadpoles (Whitaker 1971). In spite of the low tendency of *P. triseriata* to use ponds that are also used by fishes, small fish species like the fathead minnow (*Pimephales promelas*) and the brook stickleback (*Culaea inconstans*) that prey on eggs or small tadpoles have been found in breeding ponds in Quebec (St. Hilaire 2005) In captivity, central mudminnows (*Umbra limi*) ate tadpoles of *P. triseriata* (Whitaker 1971).

Western Chorus Frog adults have both aquatic and terrestrial predators. Predaceous diving beetles, as adults or larvae, and the giant water bug, prey on adults (J.F. Desroches personal communication). Some snakes are predators of *P. triseriata*: the Common Garter Snake (*Thamnophis sirtalis*), the Northern Water Snake (*Nerodia sipedon*), Butler's Garter Snake (*Thamnophis butleri*), and probably Ribbon Snakes (*Thamnophis sauritus*) (Whitaker 1971; Catling and Freedman 1980; Wassersug and Sperry 1977). Some birds such as the Gray Jay (*Perisoreus canadensis*) and the American Robin (*Turdus migratorius*) will prey upon adult chorus frogs if the opportunity arises (Matthews and Pettus 1966; Tordoff 1980).

Food – Western Chorus Frog tadpoles eat filamentous and non-filamentous algae (Whitaker 1971). Metamorphs feed on small invertebrates such as beetles, mites, and other small arthropods (Whitaker 1971). During summer and fall, Western Chorus Frogs eat a variety of small invertebrates such as ants, spiders, slugs, and snails (Whitaker

1971). In captivity, adults can survive for months on a diet of small *Tenebrio* larvae and houseflies (*Musca domestica*). The diet of *P. triseriata* is comprised of terrestrial invertebrates rather than aquatic invertebrates (Whitaker 1971), which reflects the species' terrestrial habits. The size of prey increases with the body size of the individual, and larger individuals may prefer to eat fewer large prey as opposed to numerous small prey (Christian 1982). The species is not a specialist consumer and food availability is likely not a limiting factor for populations.

Co-occurrence with other species – *Pseudacris triseriata* commonly occupies and breeds at the same ponds and at the same time as the Spring Peeper *P. crucifer* (Whitaker 1971). Spring Peepers call mostly at night whereas Western Chorus Frogs often call both at night and during the day (Whitaker 1971, Schueler 2004). Within *Pseudacris*, the *crucifer* clade is the sister-group to the trilling frog clade to which the Western Chorus Frog belongs (Moriarty and Cannatella, 2004). There is no evidence of competitive exclusion between tadpoles of these two species (Whitaker 1971; Smith and Van Buskirk 1995). Western Chorus Frog tadpoles grow faster and metamorphose earlier than Spring Peeper tadpoles (Smith and Van Buskirk 1995; Skelly 1995; 1996; 1997). Nevertheless, Spring Peeper populations are not significantly affected by co-occurrence with Western Chorus Frog populations (Smith and Van Buskirk 1995). The relative abundance of the two species is highly variable but generally in most temporary ponds, Western Chorus Frog tadpoles are more abundant than Spring Peeper tadpoles (Skelly 1996). Other anurans, including the Gray Tree Frog (*Hyla versicolor*), the American Toad (*Bufo americanus*), the Northern Leopard Frog (*Rana pipiens*) and, particularly, the Wood Frog (*Rana sylvatica*), are often sympatric (Whitaker 1971; Weller and Palermo 1976; Desroches *et al*. 2002; Picard and Desroches 2004; Whiting 2004; St. Hilaire 2005). The breeding seasons and breeding sites of the Spring Peeper, the Wood Frog, and the Northern Leopard Frog may all overlap with those of *P. triseriata* in Canada (Picard and Desroches 2004; St. Hilaire 2005). Other anurans breed later in the spring or during summer.

In Newfoundland, where *P. triseriata* was introduced but did not persist, interactions with the Wood Frog were suspected as the cause of extinction (Maunder 1983). However, in Quebec the Wood Frog is the species most commonly found in sympatry with *P. triseriata* and no negative interactions have been observed in correlation with this association (Picard and Desroches 2004).

Parasites – *Pseudacris triseriata* is the host of protozoans, digeneans, nematodes, and trematodes (Whitaker 1971; Bolek and Coggins 1989). In Quebec, a 37.8% prevalence of chytridomycosis (a fungal infection) was recorded in the Montérégian population but no associated morbidity or mortality was observed (Ouellet *et al.* 2005). Chytridomycosis appears to be enzootic for the Montérégian population of *P. triseriata* (Ouellet *et al.* 2005).

Physiology

In spring, *P. triseriata* is active at cold air and water temperatures. Males call at air temperatures as low as -1°C (S. Hecnar personal communication). *Pseudacris triseriata* is freeze-tolerant at subzero temperatures during hibernation (Storey 1990, Storey and Storey 1986, 1987).

Movements/Dispersal

The home ranges of Western Chorus Frog individuals include their breeding pond and the surrounding terrestrial habitat. The ranges of individuals overlap both spatially and temporally (Kramer 1974). Observed home ranges vary from 641 m² to 6024 m², with a mean of 2117 m² (Kramer 1974).

Pseudacris triseriata does not disperse widely. In a study with frogs tagged with Co^{60}, most individuals remained within 100 m of their breeding pool; the greatest straight line distance moved was 213 m (Kramer 1973). In another study (Whitaker 1971), all individuals captured in the summer were located within approximately 200 m from potential breeding sites. In a study by Kramer (1973), some individuals travelled 195 m from one pond to another in 25 days or less. Recorded daily rates of movements for *P. triseriata* are less than 42 m/day, with an average of 3.5 m/day (Kramer 1973). These values are based upon straight-line distances between the sites of capture and recapture, and it is very likely that they are underestimates of the true distance travelled. After the introduction in Newfoundland, the Western Chorus Frog range limit expanded less than 1 km over 16 years, despite adjacent habitat that was apparently appropriate (Maunder 1983).

In the breeding season, migrations to ponds begin as the air temperature rises above 5°C (Whiting 2004). In Quebec, 67% of the adult breeders originated more than 50 m from the pond (Whiting 2004). Adults stay an average of 20 days in the pond during the breeding season (Desroches and Picard, personal observation). Juveniles leave the pond between June and October (Whiting 2004). Juveniles frequently disperse up to 50 m from their natal pond (Whiting 2004), and have been caught with drift fences as far as 200 m from the breeding pond, mostly in July and August (Desroches *et al.* 2002). After the breeding period, *P. triseriata* is active mostly between dusk and dawn, when it moves through vegetation to feed (Kramer 1973). During daylight hours, *P. triseriata* is inactive and hidden, in 91.3% of cases in leaf litter and other dead vegetation (Kramer 1973; Cochran 1989). In the fall (September-October), individuals were observed at the edge of a dried temporary pond and others as far as 75-100 m from the nearest wetland (Cochran 1989). This observation, in addition to the early arrival of Western Chorus Frog adults at breeding ponds in the spring, suggests that adults hibernate near breeding sites.

POPULATION SIZES AND TRENDS

Search effort

In Canada, before the 1950s, *P. triseriata* was known to be present in many localities in Ontario (Logier and Toner 1943; 1955) and, based on specimens in the Canadian Museum of Nature collection collected from 1905-1927, a few additional sites just north of Gatineau in Quebec. Surveys from the 1950s extended the known Canadian range to include eastern Quebec, to the Lake Champlain area near the United States border, and to the Appalachian Mountains in the Eastern Townships (Bleakney 1954; 1959). The Bleakney surveys also found Western Chorus Frog populations north to the Wakefield area in the Outaouais, Quebec, about 20-25 km NNW of Gatineau, in the Gatineau River Valley (1958). The frog was absent in Quebec from the island of Montreal, its north shore, and east of the Appalachian Mountains (Bleakney 1959). Years later, populations were observed in northern locations in the Parry Sound District of Ontario (Weller and Palermo 1976). Surveys were also conducted in Ontario and Quebec in the late 1980s, mostly by volunteers for the purpose of mapping (Bider and Matte 1991; Oldham and Weller 2002).

Surveys have been recently conducted in Quebec to properly evaluate the status of the species (Daigle 1992; 1994; Picard and Desroches 2004; St. Hilaire and Belleau 2005). The much larger Ontario range has not been systematically surveyed, and the large body of irregularly gathered data has not been coherently analysed. There are, however, many regions of the province in which the species is clearly or apparently declining, such as Ontario east of Ottawa, the Ottawa Valley in Renfrew County, in and around Toronto, and particularly along Lake Huron (Seburn and Seburn 2001; Schueler in preparation). However, there exists one case, in Essex County, Ontario, where a population of Western Chorus Frogs was observed where they had not been found previously (Johnson 1983). Many northern parts of the historic range have no recent records at all.

Although the Ontario Herpetofaunal Summary (OHS) database contains good distribution data for Western Chorus Frogs from the mid-1980s to mid-1990s, the OHS project has had little funding or support since then and therefore there are few recent records in the database (Mike Oldham, personal communication). This means that distribution or abundance trends cannot be made based on OHS data. All pertinent OHS data were provided in 2006 to Fred Schueler for incorporation into this report.

The Western Chorus Frog is not a species currently tracked by the Ontario Natural History Information Centre and therefore there is no relevant information in that database or among its network of contributors to aid in assessment of this species (Mike Oldham, personal communication).

The Marsh Monitoring Program (MMP) has been examining trends in calling amphibian occurrence indices since 1995 (Weeber and Vallianatos 2000; Crewe *et al*. 2005) with an extensive network of amphibian survey routes (Fig. 5). These provide the most comprehensive, quantitative assessment of population trends in *P. triseriata* in Canada. Unlike other surveys, such as the Ontario Backyard Frog Survey, the MMP has been able to consistently monitor a large number of survey routes in a manner largely unaffected by the turnover of volunteer personnel. In the MMP analyses, trends in station occupancy are assessed first on a route-by-route basis in terms of annual proportion of stations with each species present (Appendix 1). These route level trends are then combined for an overall assessment of trend for each species. Indices are scaled to correct for overdispersion before transformation for regression analyses. The overall effect of year as a class variable or as a continuous variable is tested using likelihood ratio tests (SAS Institute Inc. 1999) to compare deviance of these models to models with no year variable. For each year, 95% confidence limits around each annual index are calculated. Annual percent change (trend) in occurrence is estimated as well as the associated upper and lower extremes of the 95% confidence limits. Because amphibian indices are derived based on presence or absence of a species at a station, logistic (or binary) regression is used to evaluate year-to-year variance of annual indices and overall direction of trends in occurrence across years (Fig. 6).

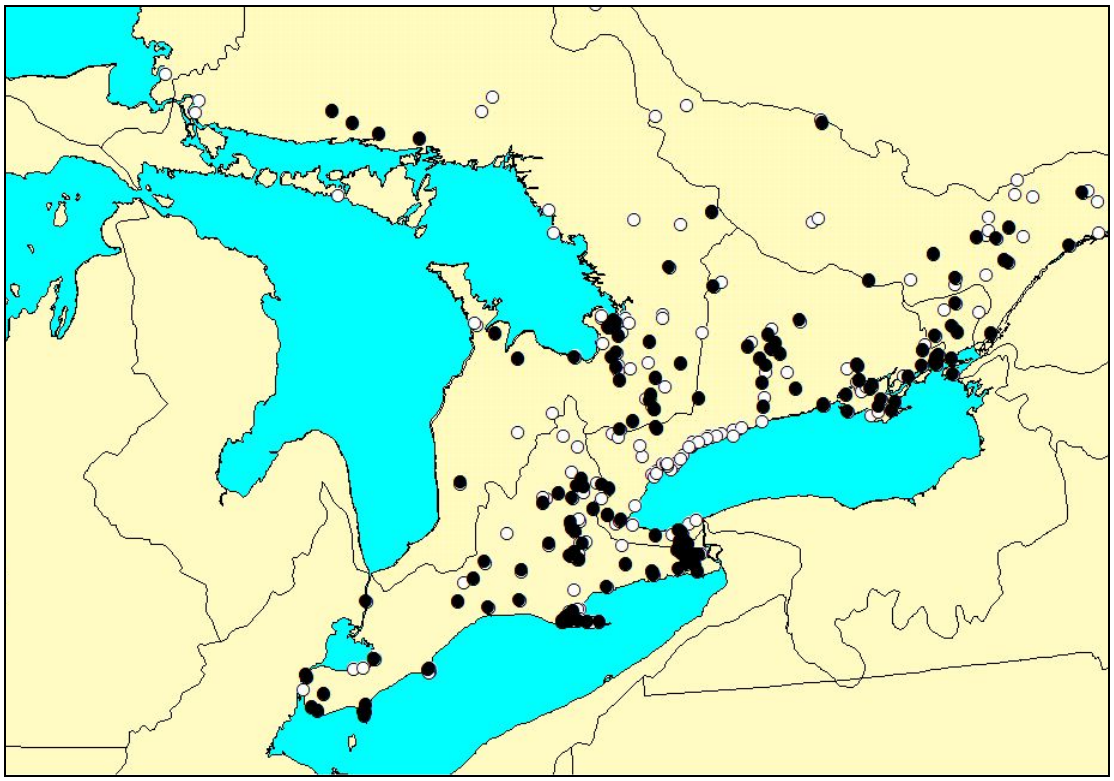

Figure 5. Marsh Monitoring Program sites in Ontario surveyed from 1995-2006 for the presence (closed circles) or absence (open circles) of *Pseudacris triseriata*. (Source: Steve Timmermans).

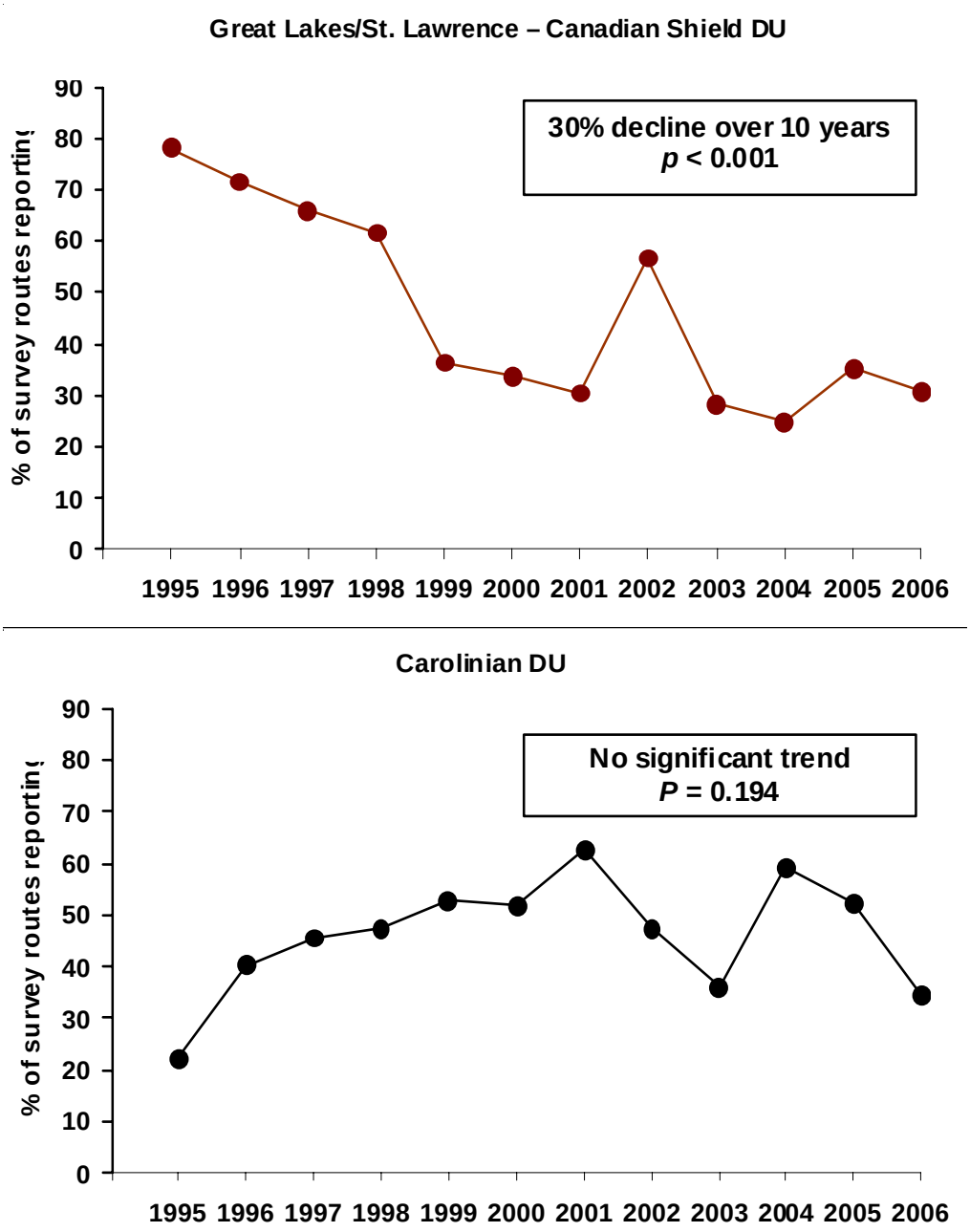

Figure 6. Population trends in *Pseudacris triseriata* Designatable Units (Fig. 4) based on data from the Marsh Monitoring Program. (Source: Steve Timmermans).

The Ontario Backyard Frog Survey (OBYS) tracked frog calls from 1994 to 2001 (de Solla, *et al*. 2006, S. de Solla, personal communication). Like the MMP, the OBYS sought to discern possible temporal trends in occurrence but was unable to provide estimates of population size. For the analysis by de Solla *et al*. (2006), survey localities were assorted into three zones: southern Ontario (<43^0 N latitude), central Ontario (43^0N to 45^0N latitude), and northern Ontario (>45^0 N latitude). This treatment is inadequate with reference to Western Chorus Frogs; virtually all the OBYS records of the species north of 45^0N latitude are outside the confirmed range of the species. From the OBYS data supplied, by de Solla, the 45 sites reporting chorus frogs within its known range could be assorted into northern (i.e. Great Lakes/St. Lawrence – Canadian Shield) vs. southern (i.e. Carolinian) localities (Fig. 7) in a manner similar to the treatment of the Marsh Monitoring Program data (Appendix 1). The OBYS data, though, are not robust. The OBYS relies on individual observers at point locations. If an individual drops out of the program, that listening post is lost from the survey. This is acknowledged by de Solla *et al*. (2006) as a severe limitation for the OBYS compared to the Marsh Monitoring Program. De Solla *et al.* (2006) recommend that other monitoring programs emulate the MMP and recruit volunteers to continue monitoring existing survey locations when they become vacant. Due to the nature of the OBYS data, de Solla *et al*. (2006) could only compare common survey locations across years, resulting in small sample sizes over time periods of limited duration. Thus only years for the periods 1996 – 1998 and 1999 – 2001, incl. could be compared for the occurrence of Western Chorus Frogs (Fig. 7).

Abundance

There are no known estimates for the number of Western Chorus Frog individuals. Auditory surveys are not accurate for estimating population size, chorus intensity merely serving to increase detectability (de Solla *et al*. 2005, 2006). For *P. triseriata*, this is particularly so because its call is so strong; the species can be recorded as being more prominent in an area than other species, such as the Wood Frog (*Rana sylvatica*), Leopard Frog (*Rana pipiens*), or Pickerel Frog (*Rana palustris*), that have weaker calls. Consequently, call surveys may produce an overestimation of the relative abundance of the species (Francis 1978; Bishop *et al.* 1997, P. Labonté, personal communication).

A study in 2001-2002 of a 0.4 hectare site in Quebec used a mark-recapture method to evaluate the size of the breeding population at about 2,000 individuals (Desroches and Picard, personal observation) but, as this is the only estimate for population size for this frog, it is not known if this is typical. There is great variation in effective population size for pond-breeding amphibians, both among years and among populations (Pechmann *et al*. 1991; Green 2003) and therefore breeding populations of *P. triseriata* are very likely to have abundances both much higher and much lower than 2,000. Coupled with uncertainty over the number of populations, at this time, therefore, the data do not exist to give even a crude estimate of Western Chorus Frog abundance in Canada.

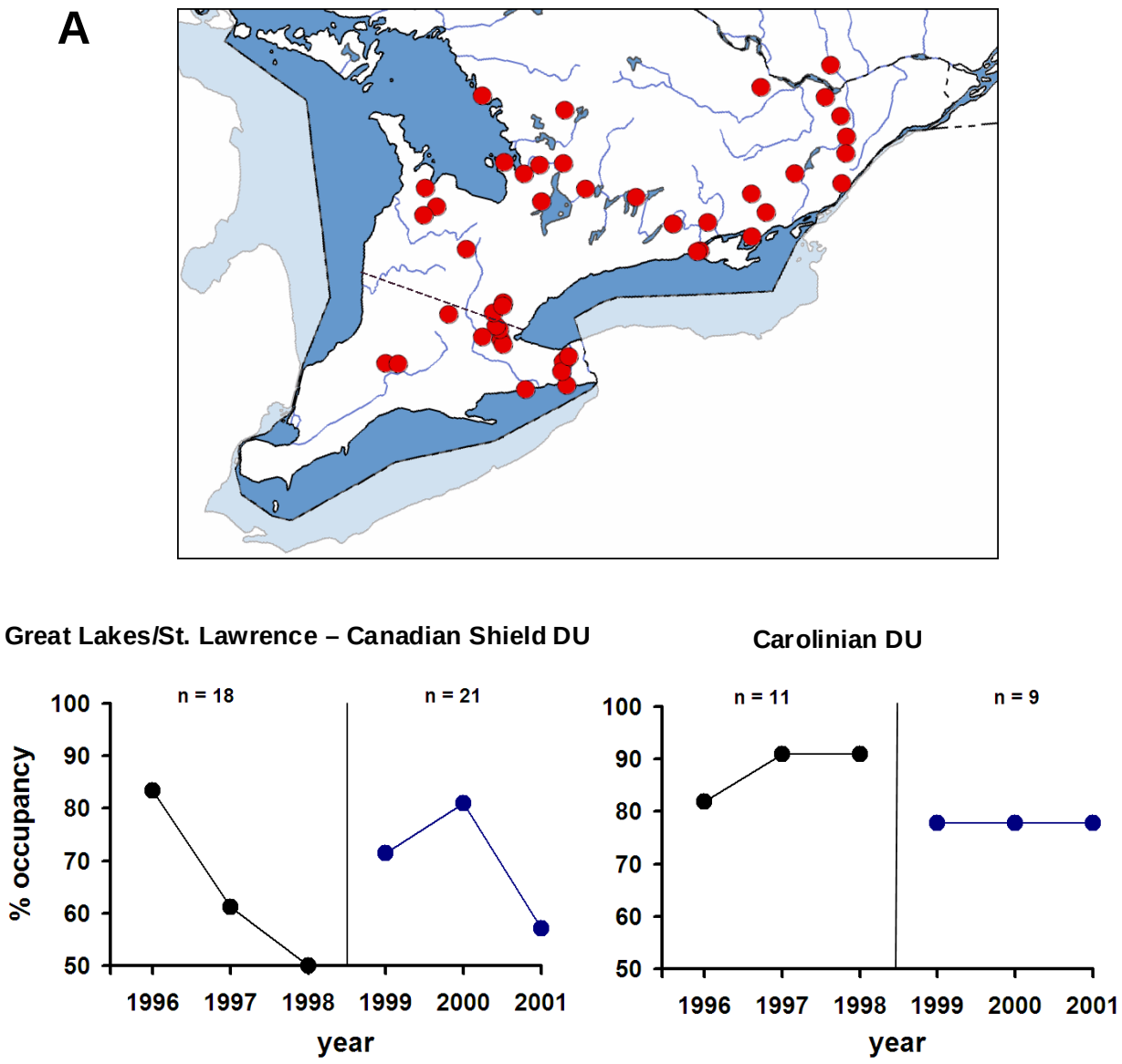

Figure 7. Population trends in *Pseudacris triseriata* Designatable Units (Fig. 4) based on data from the Ontario Backyard Frog Survey. A) localities reporting the presence of Western Chorus Frogs. The dashed line separates the Carolinian DU to the south from the Great Lakes/St. Lawrence – Canadian Shield DU to the north. B) percent site occupancy for shared sites during the two time periods of the survey (Source for data: Shane de Solla).

Fluctuations and trends

Great Lakes/St. Lawrence – Canadian Shield DU – Participants from Quebec, eastern Ontario, Vermont, and New York at the 2001 First Annual International Conference on North-eastern *Pseudacris triseriata* in Kemptville, Ontario, affirmed that there is not one region in the lower Great Lakes or St. Lawrence basin where Western Chorus Frog populations could confidently be regarded as stable (Schueler, 2001b).

The outlook for *P. triseriata* populations in Quebec and much of eastern Ontario is most unfavourable. Declines in habitat and population occurrence have been observed over the last several decades. In 1958, when Bleakney conducted surveys for *P. triseriata*, he found that the species had a continuous distribution through eastern Ontario and southern Quebec, occupying all available habitats. While declines have been observed in Ontario, the present range corresponds to that observed by Bleakney. The same can not be said for the range in Quebec. Bleakney (1958) observed that, "during the spring breeding season, this species is abundant and can be heard in nearly every pond and ditch". The present situation for the species is quite different.

Since Bleakney's surveys (Bleakney 1958, 1959) in southwestern Quebec, a drastic decline of *P. triseriata* has been observed. Despite intensive searches in 1992 to 1993, no populations of Western Chorus Frogs were observed east of the Richelieu River (Daigle 1992; 1994; 1997) and the species is presumed absent. Most of the places where *P. triseriata* remains in Quebec are threatened by human activities: residential and industrial development near cities and heavy agriculture in more rural areas (Daigle 1997) where the hydrology has been modified by drainage programs (Labrecque 1987; Daigle 1992). The area south of Montreal and west of Lake Champlain, where *P. triseriata* was first found in 1988 (Bider and Matte 1991), suffered a decline to extinction by 2000; habitat destruction and drainage of wetlands are likely the causes (Picard and Desroches 2004). At this time, *P. triseriata* can be found in only two areas in Quebec: the Montérégie south of the island of Montreal, and the Outaouais region north of the Ottawa River.

When first recorded from the Montérégie area of Quebec, the species was considered very common. Bleakney (1959) stated that, "on a quiet evening, at the west end of Montreal Island, one can hear the chorus of *triseriata* from across the river on Île Perrot". Recent surveys have found that the species now occurs in isolated populations along a 20 km-wide band south of the St. Lawrence River and on Île Perrot, totalling a little more than 800 breeding ponds (Desroches and Picard 2004). *Pseudacris triseriata* was observed to still be very common on Île Perrot in the 1960s (Bider and Matte 1996) and between 1975 and 1980 (Bider and Matte 1991). Presently, housing projects are threatening the population; only 67% of previously occupied ponds had calling frogs in 2004 and in those cases only a few individuals were calling (Desroches and Picard 2004). From April to August 2004, 5% of *P. triseriata* breeding ponds in the Montérégie were destroyed and many others were disturbed. The annual decline of breeding ponds suitable for *P. triseriata* is 10%, a rate that ensures that the species will be extirpated from the Montérégie in 10 to 25 years if effective conservation efforts are not made (Picard and Desroches 2004). In some areas this destruction reached 25% of located ponds (Picard and Desroches 2004). Most breeding habitats for the species are small, temporary ponds, which are relatively easy for farmers or developers to fill or drain compared to larger, permanent ponds (Picard and Desroches 2004).

In the Outaouais region of Quebec, the species' distribution is on a narrow strip about 100 km long west to east (St. Hilaire 2005). Surveys done in the past decade found 217 breeding habitats used by 40 populations (St. Hilaire and Belleau 2005). The

species is apparently now absent on the Precambrian Shield north of Gatineau (St. Hilaire 2005; St. Hilaire *et al.* 2005). Since the first surveys in 1993, *P. triseriata* disappeared from 30% of the sites, mostly those in the urban area of Aylmer-Hull-Gatineau (D. St. Hilaire personal communication). Many sites where the species is found are owned for future residential or industrial developments (St. Hilaire *et al.* 2005). The known breeding habitats of Western Chorus Frogs in the Outaouais are distributed about equally between urban areas and agricultural lands (St. Hilaire and Belleau 2005).

In the early 1900s, *P. triseriata* was considered common in the Ottawa area (Patch 1918). In easternmost Ontario, the species was not surveyed until April 1990, when *P. triseriata* was first recorded by W. Weller at 20 sites from Long Sault on the St. Lawrence, northeast towards Alexandria. In 2001, when reassessed at the same sites under appropriate conditions, *P. triseriata* was not detected (D. Seburn personal communication). In 2007 all 20 sites were visited, and *P. triseriata* was heard at the one that had been missed in 2001, though again not at any of the others (D. Seburn personal communication). The same was true for sites reassessed in 1997 around Casselman, east of Ottawa; in 1990 *P. triseriata* was detected and when reassessed in 1997, the species was not detected (F. Schueler personal observations, Schueler, 2006). A decline in the number of populations was also noted between Bishops Mills and Kemptville, in Grenville County, during 1979 to 1993, as well as for a transect from Kemptville to north of Brockville during 1992 to 2000; the most significant disappearances were reported in the northern half of the transect where suburban development was the predominant reason for habitat change (Schueler 2001c, 2006).

Helferty (2002) called *P. triseriata* one of the "species that has been extirpated or are in severe decline in Toronto….significantly negatively associated with either residential or industrial land-use, or both". At least eight populations known 20 years ago in and around the Toronto area are now gone (Johnson 1983; B. Johnson personal communication). In a 1994 auditory survey of 53 stations along the Lake Ontario waterfront from Burlington to Trenton, *P. triseriata* was heard at only 7 stations, all in the eastern half of the transect (Schueler *et al.* 1995; Karstad *et al*. 1995).

Reports from the 1940s from Oxford County, Ontario, classify the species as the most common of all tree frogs, found in every small pool in early spring (Milnes 1946). Likewise, in the Bruce Peninsula in the 1960s, the species was considered the most abundant amphibian (Toner 1964). This has changed. On the Bruce Peninsula, the species was reduced to one small population from 1984 to 1992, which has since declined and has not been heard in recent years (F. Schueler, personal observations). Seburn and Seburn (2001) found a contiguous area of potential absences stretching from Elgin County located above Lake Erie, to Lake Huron and the Bruce Peninsula, based on records in the Ontario Herpetological Summary (OHS). Surveys on the Stratford Plain in Lambton and Huron Counties at 34 ponds each year from 1992 to 2005 detected Western Chorus Frogs at only 2 ponds (Hecnar and Hecnar 2002), and no Western Chorus Frog populations were found in ponds in the Grey-Bruce and Bruce Peninsula ponds from 1992 to 1994.

More optimistically, stable, or at least widespread populations have been noted in western Lanark and the adjacent Frontenac county (T. Mosquin and B. Wigney personal communication), in Wolford Township south of Merrickville (S. Hamill personal communication), and around the Ontario Power Generation Lennox power plant on Lake Ontario, southwest of Kingston (W. Weller personal communication). From 1995 to 2005 in the Peterborough area, north of Lake Ontario, *P. triseriata* was commonly heard and widespread in the southern agricultural portions of the county. Populations were much more localized northward on the Precambrian Shield where forest cover is more extensive (M. Oldham personal communication).

Crewe *et al*. (2005, 2006) report trends in *Pseudacris triseriata* and other species from the Marsh Monitoring Program from 1995 to 2003 in terms of Great Lakes basins in the USA and Canada. A significant decline ($P < 0.0001$) of 3.2%/year was estimated in the occurrence of *P. triseriata* in the Lake Huron basin. A significant decline ($p = 0.0241$) of 2.8%/year was also estimated for the Lake Ontario basin. However, Steve Timmermans analysis of the Marsh Monitoring Program data (Appendix 1) specifically of the Great Lakes/St. Lawrence – Canadian Shield populations (n = 694) in Ontario for 1995 – 2005 (Fig. 6) demonstrates a significant decline in occurrence of *P. triseriata* in this region over the last 11 years (3.5%/year; $p < 0.0001$). This corresponds to a 30% decline over 10 years. The Ontario Backyard Frog Survey likewise gives results consistent with declines in occurrences among common survey sites in this region for the periods 1996 – 1998 and 1999 – 2001, incl. (Fig. 7).

Additional anecdotal information from James Bogart, David Bree, George Bryant and James Kamstra (all personal communications to Michael Oldham) indicates that the species has declined or disappeared from the Greater Toronto area, southern Durham County, the Muskoka region and the vicinity of Guelph, although it has still been noted near Collingwood and in Prince Edward County. Tys Theysmeyer of the Royal Botanical Gardens (personal communication) notes that it is extirpated from Cootes Paradise in Hamilton, Ontario, but it likely still present upstream.

Carolinian DU – Surveys done in southern Ontario in the late 1970s concluded that *P. triseriata* was a widespread and abundant species (Francis 1978). During the 1970s *P. triseriata* was regarded as omnipresent within the agricultural areas of southern Ontario (F. W. Schueler and A. Karstad personal observations) and in the early-1980s to mid-1990s *P. triseriata* was one of the most commonly heard early-spring-calling amphibians, even in areas such as the extensively deforested regions of Essex, Kent, and Lambton counties where other widespread amphibians (including the Wood Frog and Gray Treefrog, *Hyla versicolor*) were largely absent (M. Oldham personal communication). From 2004 to 2005, Wayne Weller found that *P. triseriata* was quite abundant all through the Niagara peninsula, in the surrounding countryside of the Ontario Power Generation's Lambton Generating Station on the St. Clair River located south of Sarnia, and by the Nanticoke Generating Station on Lake Erie located east of Port Dover. In ponds in the Essex Plain physiographic region, no net change in the turnover of *P. triseriata* was found from 1992 to 1994, with occurrence at 15.5 - 16.5% of ponds over 3 years (Hecnar 1997). These were likely underestimates of

occurrence in all ponds because the survey was primarily of semi-permanent to permanent ponds rather than ephemeral ponds. Hecnar's impression regarding patterns of incidence in extreme southwestern Ontario is that Western Chorus Frogs are common in the western half of Essex County particularly in the Ojibway Prairie Complex, west Windsor, LaSalle, and along utility rights-of-way. They also persist in some isolated suburban sites in and surrounding Windsor. They rapidly become less common east or north of Windsor in southwestern Ontario (S. Hecnar personal communication). There exists one case, in Essex County, Ontario, where a population of Western Chorus Frogs was observed where it had not previously been observed (Johnson 1983).

The Marsh Monitoring Program (Crewe *et al*. 2005) detected a slight but non-significant (p = 0.237) increasing trend at 1.14%/year in the Lake Erie Basin from 1995 - 2003. Steve Timmermans' analysis of the Marsh Monitoring Program data (Appendix 1) specifically of the Carolinian populations (n = 124) in Ontario for 1995 – 2005 (Fig. 6) similarly demonstrates no significant change in the occurrence of *P. triseriata* in this region over the last 11 years (p < 0.1944). The Ontario Backyard Frog Survey data also show no evidence of change in occurrences among common survey sites in the Carolinian region for the periods 1996 – 1998 and 1999 – 2001, incl. (Fig. 7).

Additional anecdotal information from Jon McCracken, James Kamstra, Mary E. Gartshore, Bob Curry, Allen Woodliffe, Jane Bowles, Paul Pratt, Dave Martin and Linda Wladarski (all personal communications to Michael Oldham) indicates that the species is generally widespread and fairly common in the Carolinian region.

Rescue effect

The Canadian distribution of *P. triseriata* is split by large rivers into three major groups: Ontario, Outaouais (Quebec), and Montérégie (Quebec) (Fig. 4). The Outaouais populations are separated from Ontario by the Ottawa River and from the Montérégie by the St. Lawrence River. The Montérégie group is separated from Ontario by the St. Lawrence River and for the Île Perrot population of the Montérégie group, by the Outaouais River. No exchanges are likely possible between these three groups. Exchanges with U.S. populations are also unlikely since the Great Lakes, the St. Lawrence River, or the St. Clair River form most of the border between Canadian and American populations, and the Vermont populations, which at one time were contiguous with those in Quebec, are evidently extirpated (Andrews and Ferguson 2001). The Ontario populations are likely somewhat isolated from each other by natural barriers such as rivers and hilly areas, as well as cities, drainage, and other human disturbances, but the lack of surveys precludes precise statements of subdivisions of the Ontario range. The genetic division between eastern and southwestern Ontario populations (Moriarty-Lemmon *et al*., 2007) is not coincident with any clear geographic barrier although it does align with the northern edge of the Carolinian zone in Canada.

LIMITING FACTORS AND THREATS

Limiting factors

As a lowland and savannah species, Western Chorus Frogs use land that is also used by humans. It has been suggested that 19th century agricultural practices in lowlands enabled the range expansion of *P. triseriata* (Bleakney 1958). Now, however, as the land is used more intensely for urban construction or industrial agriculture, and temporary ponds are often drained and/or filled, there have been direct losses of individuals and populations, elimination of breeding sites and significant alteration of the quality of the remaining terrestrial habitat. As a result, habitat areas for populations are smaller and have decreased connectivity to additional habitat.

Pseudacris triseriata has a number of characteristics that make it difficult for populations to recover from habitat fragmentation and reduced habitat quality. In particular, they have relatively low mobility, and high site-fidelity to their natal ponds (Conant and Collins 1991). This makes the probability of finding new habitat low if the existing habitat has been destroyed or severely modified. In addition, reductions in the effective population size of pond-breeding frogs occur through natural fluctuations that can range between 1 to 2 orders of magnitude between seasons (Pechmann *et al*. 1991; Green 2003); since recruitment is sensitive to habitat quality (Gill *et al.* 1983; Pechmann *et al.* 1991; Berven 1995), the probability of local extinction increases with reduced habitat quality (deMaynadier and Hunter 1995), and reduced immigration (Blaustein *et al*. 1994).

Threats

The most significant threat to *P. triseriata* in Canada is the destruction or modification of habitat (Bonin and Galois 1996; Seburn and Seburn 2001; Picard and Desroches 2004) due to urbanization or the intensification of agricultural activities (Schueler 2001b). The range of *P. triseriata* is within an area designated by the WWF as having a critical level of human impact (WWF Canada 2003). The most recent Canadian census data indicate that from 2001 to 2006 population growth in the Greater Golden Horseshoe area and in the Montérégie is among Canada's highest rates (Statistics Canada 2007). Urbanization and intensified agriculture are detrimental to *P. triseriata* populations by eliminating habitat, by decreasing connectivity among remaining habitat, and by decreasing the quality of the habitat that remains.

Urbanization and the intensification of agricultural practices directly eliminate crucial Western Chorus Frog breeding habitat by draining and filling of temporary ponds. In the 1900s, the St. Lawrence lowlands were almost entirely deforested and drained for agricultural purposes (Brisson and Bouchard 2003) and Bleakney (1959) made a link between the absence of *P. triseriata* in some St. Lawrence valley areas and the clearing and drainage of land.

The direct destruction of habitats leaves the remaining habitat less connected, increasing the probability of local extinction (Sjögren 1991). Immigration and

colonization rates of amphibians usually decrease with an increase in habitat isolation (Blaustein *et al.* 1994). Roads of any size inhibit dispersal of *P. triseriata* (Picard and Desroches 2004; Whiting 2004) and road kills have been observed (Desroches *et al*. 2002). Road mortality can be significant enough in some amphibian populations to affect local density (Fahrig *et al.* 1995; Hels and Buchwald 2001).

Chemical contaminants can be potential direct threats to amphibian health. Of concern for frog populations is the effect of nutrient loading in industrial agriculture. Nitrates are directly toxic to amphibians and are associated with reduced hatching success and developmental abnormalities at concentrations commonly found in some parts of southern Ontario (Rouse *et al*., 1999). Many breeding sites are also vulnerable to contamination by pesticides, herbicides and other pollutants (Harding 1997; 2000). Laboratory experiments have shown that some pesticides and insecticides, including some used in Canada, are toxic to Western Chorus Frog tadpoles (Sanders 1970, Berrill *et al.* 1997). Pesticides have been implicated to have mutagenic effects on frogs in agricultural lands of southern Quebec (Bonin *et al.* 1997). One biopesticide is, so far as is known, benign to frogs. *Bacillus thuringiensis* (Bt) is widely used in temporary ponds as a mosquito biopesticide, especially since the arrival of the West Nile Virus. Although known chorus frog breeding sites have been treated with Bt for mosquito control, no negative effects of Bt on frogs and salamanders have been detected in laboratory tests (Agriculture Canada 1982).

Another threat to the future continuance of *P. triseriata* in Canada may be the re-forestation of abandoned agricultural lands by secondary succession (Schueler 2001b; Bonin and Galois 1996). There are cases of local extinctions of Western Chorus Frog populations in ponds that have been overgrown by trees, rendering the pond inappropriate breeding habitat (Skelly *et al*. 1999). This phenomenon may seem counter-intuitive; however, after years of agricultural use it is not likely that the land would resemble its pre-settlement state. However, secondary growth does not always result in the loss of resident populations, as persistent populations have been observed in Essex County, Ontario in re-grown, open forest woodlots (S. Hecnar personal communication).

SPECIAL SIGNIFICANCE OF THE SPECIES

Because *P. triseriata*, like many other amphibian species, uses both aquatic and terrestrial habitats at different life stages, the presence of the species is a good indicator of the overall maintenance of both aquatic and terrestrial ecosystems (Barinaga 1990; Blaustein and Wake 1990; Harding 1997; Schueler 2001d). Promoting this idea can have a positive impact on the public concern for both *P. triseriata* and its habitat (Ireland 2004). In Quebec, *P. triseriata* is now an emblem of endangered species and habitats. Many newspapers have published articles about the fate of the species and its habitat in suburban areas south of Montreal. *Pseudacris triseriata* is now well-known to the public and many are concerned about its persistence in Canada, particularly in Quebec.

Pseudacris triseriata may be ecologically significant at a local scale given the typically large number of individuals in a population. The species is an important food source for many types of predators, and also helps to control invertebrate populations where it lives (Harding 1997).

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

In 2001, COSEWIC considered *P. triseriata* as a single unit and designated the species as “Not at Risk”. In Ontario, outside of inclusive wildlife protection areas, *P. triseriata* is not protected by any legislation. In Quebec, the drastic decline of the species in the province (Daigle 1992; 1994; 1997) led to a provincial status report (Bonin and Galois 1996) and a recovery plan (Équipe de Rétablissement de la Rainette Faux-grillon de l’Ouest 2000). In spite of the legal designation of ‘vulnerable’ in 2000, no Western Chorus Frog habitat is under protection under species at risk legislation (Gazette Officielle du Québec 2000). Conservation plans that identify all breeding sites, and classify them by priority have been published in Quebec (Picard and Desroches 2005; St. Hilaire and Belleau 2005; St. Hilaire *et al*. 2005). It is prohibited in Quebec to kill Western Chorus Frogs, their eggs or their larvae.

TECHNICAL SUMMARY (1)

Pseudacris triseriata
Western Chorus Frog — Rainette faux-grillon de l'Ouest
Carolinian population — Population carolinienne
Range of Occurrence in Canada: Ontario

Extent and Area Information

• *Extent of occurrence (EO)(km²)* Based on minimum convex polygon encompassing Canadian range as in Fig. 4.	25,585 km²
• *Specify trend in EO*	Stable
• *Are there extreme fluctuations in EO?*	No
• *Area of occupancy (AO) (km²)* Based on 2 x 2 km grid occupancy of known sites ca. 1997 as in Fig. 4.	644 km²
• *Specify trend in AO*	Stable
• *Are there extreme fluctuations in AO?*	No
• *Number of known or inferred current locations*	100's
• *Specify trend in #*	no detectable trend
• *Are there extreme fluctuations in number of locations?*	No
• *Specify trend in area, extent or quality of habitat*	no detectable trend

Population Information

• *Generation time (average age of parents in the population)*	1 year
• *Number of mature individuals*	Unknown
• *Total population trend:*	no significant trend
• *% decline over the last/next 10 years or 3 generations.*	no significant trend
• *Are there extreme fluctuations in number of mature individuals?* Pond-breeding anurans, especially short-lived ones, are known to have severely fluctuating population sizes.	Yes
• *Is the total population severely fragmented?*	Probably
• *Specify trend in number of populations*	no significant trend
• *Are there extreme fluctuations in number of populations?*	No
• *List populations with number of mature individuals in each:*	no data

Threats (actual or imminent threats to populations or habitats)

Habitat loss resulting from urban and residential development, intensive agriculture and drainage of seasonal wetlands which results in the destruction of breeding sites.
Landscape conversion that results in fragmentation of the landscape and isolation of habitat patches.

Rescue Effect (immigration from an outside source)

• *Status of outside population(s)?* USA: Michigan (S5), New York (S4), Ohio (SNR), Pennsylvania (S2)	
• *Is immigration known or possible?*	No
• *Would immigrants be adapted to survive in Canada?*	yes
• *Is there sufficient habitat for immigrants in Canada?*	yes
• *Is rescue from outside populations likely?*	no

Quantitative Analysis

n/a

Current Status

COSEWIC: Not at Risk (2008) COSEWIC: Not at Risk (2001) Ontario: S4

Status and Reasons for Designation

Status:	**Alpha-numeric code:**
Not at Risk	n/a
Reasons for Designation: Although there are ongoing losses of habitat and breeding sites due to urban and suburban expansion and changes in agricultural practices, declines in abundance are not appreciable in southwestern Ontario, no significant trends have been detected and the species remains abundant in many areas.	

Applicability of Criteria

Criterion A: (Declining Total Population): Not applicable.
Criterion B: (Small Distribution, and Decline or Fluctuation): Not applicable.
Criterion C: (Small Total Population Size and Decline): Not applicable. Abundance cannot be estimated with certainty but is evidently too high for the criterion to apply.
Criterion D: (Very Small Population or Restricted Distribution): Not applicable.
Criterion E: (Quantitative Analysis): Not applicable.

TECHNICAL SUMMARY (2)

Pseudacris triseriata
Western Chorus Frog
Great Lakes/St. Lawrence – Canadian Shield population

Rainette faux-grillon de l'Ouest
Population des Grands Lacs / Saint-Laurent et du Bouclier canadien

Range of Occurrence in Canada: Ontario and Quebec

Extent and Area Information

• *Extent of occurrence (EO)(km²)* Based on minimum convex polygon comprising Canadian range as in Fig. 4.	170,990 km²
• *Specify trend in EO*	decline
• *Are there extreme fluctuations in EO?*	No
• *Area of occupancy (AO) (km²)* Based on 2 x 2 km grid occupancy of known sites ca. 1997 as in Fig. 4.	2,820 km²
• *Specify trend in AO*	decline
• *Are there extreme fluctuations in AO?*	No
• *Number of known or inferred current locations*	< 100
• *Specify trend in #*	decline
• *Are there extreme fluctuations in number of locations?*	No
• *Specify trend in area, extent or quality of habitat*	decline

Population Information

• *Generation time (average age of parents in the population)*	1 year
• *Number of mature individuals*	unknown
• *Total population trend:*	decline
• *% decline over the last/next 10 years or 3 generations.* Based on data from the Marsh Monitoring Program data for Ontario indicating 30% decline in the past 10 years and population surveys for Quebec indicating 37% decline in the past 10 years.	Over 30% decline
• *Are there extreme fluctuations in number of mature individuals?* Pond-breeding anurans, especially short-lived ones, are known to have severely fluctuating population sizes.	Yes
• *Is the total population severely fragmented?* Habitat conversion and roads have severely fragmented the landscape at the scale of movement of a small frog.	Yes, in most parts of the range
• *Specify trend in number of populations* In Montérégie, Quebec, 90% of the species' former range is now unsuitable. A significant decline is estimated in Ontario.	decline
• *Are there extreme fluctuations in number of populations?*	No
• *List populations with number of mature individuals in each:*	Data are unavailable

Threats (actual or imminent threats to populations or habitats)

Habitat loss resulting from urban and residential development, intensive agriculture and drainage of seasonal wetlands that results in the destruction of both breeding sites and summer foraging habitats. Landscape conversion that results in fragmentation of the landscape and isolation of habitat patches.

Rescue Effect (immigration from an outside source)

• *Status of outside population(s)?* USA: New York (S4), Vermont (S1)	
• *Is immigration known or possible?*	No

• *Would immigrants be adapted to survive in Canada?*	Yes
• *Is there sufficient habitat for immigrants in Canada?*	Yes
• *Is rescue from outside populations likely?*	No

Quantitative Analysis

n/a

Current Status

COSEWIC: Threatened (2008) COSEWIC: Not at Risk (2001) Ontario: S4 Quebec: Vulnerable (2000), S2

Status and Reasons for Designation

Status:	**Alpha-numeric code:**
Threatened	A2bc
Reasons for Designation: Ongoing losses of habitat and breeding sites for this small frog due to suburban expansion and alteration in farming practices have resulted in losses of populations and isolation of remaining habitat patches. Populations in Quebec are documented to have declined at a rate of 37% over 10 years and are expected to continue to decline. Despite there being some areas where chorus frogs remain evident, surveys of populations in Ontario indicate a significant decline in abundance of 30% over the past decade.	

Applicability of Criteria

Criterion A: (Declining Total Population): Based on documented rates of decline in habitat in southern Quebec, estimated at 90% since the 1950s, and evidence of decline over the whole range for the past 10 years, decline is estimated to have been 30% over the past decade, and is likely to continue.
Criterion B: (Small Distribution, and Decline or Fluctuation): Not applicable. AO and EO > 20,000 km^2 and 2,000 km^2, respectively, despite evidence of decline and high expectation of population fluctuations.
Criterion C: (Small Total Population Size and Decline): Not applicable. Abundance cannot be estimated with certainty but is evidently too high for the criterion to apply.
Criterion D: (Very Small Population or Restricted Distribution): Not applicable.
Criterion E: (Quantitative Analysis): Not applicable.

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COLLECTIONS EXAMINED

The Canadian Museum of Nature amphibian and reptile collection for the verification of tadpole identifications.

BIOGRAPHICAL SUMMARIES OF REPORT WRITERS

Isabelle Picard and Jean-François Desroches are biologists specialiZed in herpetology and malacology. They have conducted many studies and surveys of amphibians in Québec and Ontario, some concerning the Western Chorus Frog. In 2001 and 2002, with colleagues, they conducted year-round studies on a Western Chorus Frog population from southwestern Québec. In 2004, they initiated a major survey of all populations from the Montérégie, Québec in order to properly locate and characterize each of the breeding ponds, and to evaluate the size of Western Chorus Frog populations. This survey allowed the writing of two important reports, the first on the status of the Western Chorus Frog in the Montérégie, Québec (Picard and Desroches 2004) and the second on the classification of all sites by conservation priorities (Picard and Desroches 2005).

Frederick W. Schueler is a general naturalist whose herpetological work has focused on the geographic variation and distribution of ‘common’ species, such as chorus frogs. He has been mapping the distribution of Western Chorus Frogs by roadside auditory monitoring since 1971, in New York State (1972-1980), Vermont (first State record, 1975), Newfoundland (1976), James Bay (1971-1972, 2002), northwestern Ontario (1973, 1983), the Bruce peninsula (1984-present), the Lake Ontario waterfront (1994), and in eastern Ontario (1979-present). He initiated the 2001 First Annual International Conference on North-eastern *Pseudacris triseriata,* which first brought together researchers to discuss the possibility that Western Chorus Frog decline was more than a local phenomenon.

APPENDIX 1

Marsh Monitoring Program Amphibian Survey Protocol

(*Communicated by Steven T.A. Timmermans, Aquatic Surveys Scientist and Program Manager, Bird Studies Canada, P.O. Box 160, Port Rowan, Ontario, N0E 1M0*)

Amphibians surveyed by Marsh Monitoring Program (MMP) volunteer participants are calling frogs and toads that typically depend on marsh habitat during spring and summer breeding periods. MMP routes are surveyed for calling amphibians on three nights each year, between the beginning of April and the end of July, with at least 15 days occurring between visits. Because peak amphibian calling periods are more strongly associated with temperature and precipitation than with date, visits are scheduled to occur on three separate evenings according to minimum night air temperatures of 5 °C (41 °F), 10 °C, (50 °F), and 17 °C (63 °F), respectively.

Amphibian surveys begin one-half hour after sunset and end before or at midnight. Visits are conducted during evenings with little wind, preferably in moist conditions with one of the above corresponding temperatures. During three-minute survey visits, observers assign a Call Level Code to each species detected; for two of these levels, estimated numbers of individuals are also recorded. Call Level Code 1 is assigned if calls do not overlap and calling individuals can be discretely counted. Call Level Code 2 is assigned if calls of individuals sometimes overlap, but numbers of individuals can still reasonably be estimated. Call Level Code 3 is assigned if so many individuals of a species are calling that overlap among calls seems continuous (i.e., full chorus); a count estimate is impossible for Call Level Code 3 and is not required by the protocol.

Population Trend Analyses – For Chorus Frog (CHFR), a trend was assessed first on a route-by-route basis in terms of annual proportion of stations with this species present (Fig. A). These route level trends were then combined for an overall assessment of trend for this species, and were defined relative to 2006 values. Indices were scaled to correct for over dispersion before transformation for regression analyses using the DSCALE statement in SAS models (SAS Institute Inc. 2001). The overall effect of year as a class variable or as a continuous variable was tested using likelihood ratio tests (PROC GENMOD; SAS Institute Inc. 2001) to compare deviance of these models to models with no year variable. For each year, 95% confidence limits around each annual index were calculated. Annual percent change (trends) in occurrence of Chorus Frog was also estimated, and the associated upper and lower extremes of the 95% confidence limits of this species' trend are presented herein. Because Chorus Frog annual indices were derived based on presence or absence of this species at a station, logistic (or binary) regression was used to evaluate year-to-year variance of annual indices and overall direction of trends in Chorus Frog occurrence across years.

Statistically testing for year-to-year variance of occurrence indices provides knowledge about whether such indices for a given species were similar or different among years, whereas statistically testing for overall magnitude and direction of trends

across years evaluates whether temporal trends differ from a slope of zero (i.e., no change). It is important to emphasize that the most meaningful interpretation of results is done by assessing both year-to-year variance in annual indices as well as overall magnitude and direction of trends. For example, a species may exhibit high year-to-year variance in its annual indices, yet the overall trend through time may not differ from a slope of zero. Similarly, a significant positive or negative trend over time for a given species may be driven by a single outlying year-specific index value that differs considerably from those of all other years combined. In the latter example, significant year-to-year variance in indices may not occur, and such a scenario is less meaningful than if both year-to-year variance and overall direction of a trend has occurred (i.e., each or most years having contributed to the overall increase or decline in trends).

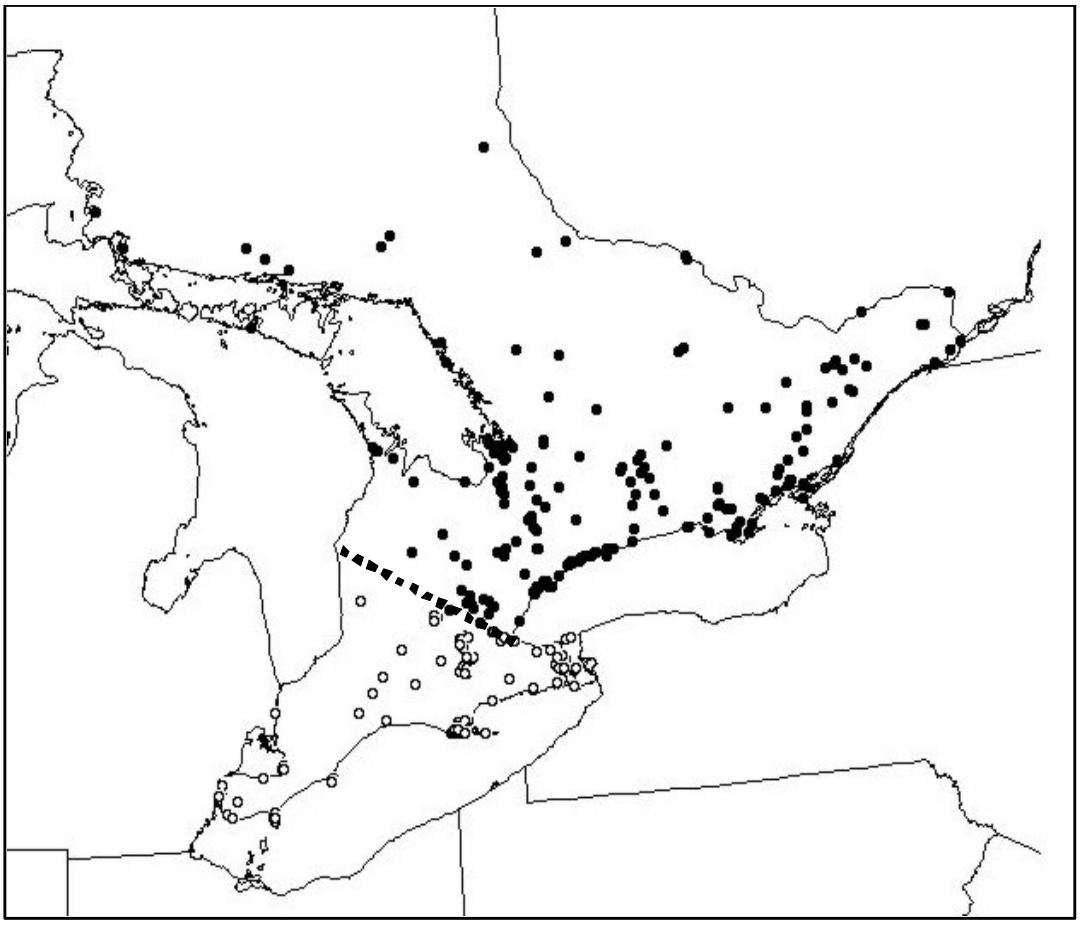

Figure A. Locations of MMP survey routes with CHFR observation data used to analyze trends in annual occurrence indices. The black dotted line represents the approximate boundary separating putative designatable units of CHFR in Ontario (open vs. closed symbols).