

RELATIVE DENSITY OF *Bufo americanus* AND *Rana clamitans melanota* IN THE PLYMOUTH BEACH CANAL AND BURT LAKE

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Abstract

Due to its interesting anthropogenic history, students from the University of Michigan Biological Station surveyed the Plymouth Beach Canal, a man-made waterway on Burt Lake, Michigan. The purpose of this survey was to analyze the human impact on the canal. Due to their importance as bioindicators, amphibians were collected in the canal and at different locations around Burt Lake. Species' distributions give an indication of varying ecosystems because of specific vegetation and moisture level requirements for breeding. The relative density of amphibians between the canal, Maple Bay, Maple River, and Carp Creek – all sites in or near Burt Lake – was recorded. *Bufo americanus* was found only within the canal, and *Rana clamitans melanota* was absent from the canal, found only at sites on the lake. The canal is a specialized habitat, allowing for *Bufo americanus* to exist in the Burt Lake area.

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Introduction

The Plymouth Beach Canal on Burt Lake in Cheboygan County, Michigan was built in the 1960s to increase the number of waterfront properties and raise the house values. This canal connects to Burt Lake, so it is of great importance to the Burt Lake Association. Members of this association invited students from the University of Michigan Biological Station to survey the canal. The focus of this study is amphibians because they are important bioindicators – they can provide a solid picture of the health of the canal.

Bufo americanus, the American Toad, is a well-adapted species to the Eastern half of North America and Canada. This species can spread its range easily due to its ability to breed in temporary water, and tolerate a broad range of habitats. As long as there is sufficient moisture, *B. americanus* will survive (Hammerson, 2011). Female toads prefer to breed in shallow, slow or standing bodies of water with sparse to moderate amounts of emergent and submerging vegetation. The eggs are deposited in strings among submerged branches and vegetation, or left in loops at the bottom of the habitat. The habitat can be either temporary or permanent (Harding, 1997). Temporary habitats are usually preferred by *B. americanus* because females prefer to lay their eggs in water without fish (Grossman, S.). In temporary pools within terrestrial ecosystems however, raccoons, birds, and snakes become a threat in addition to the threat of desiccation (Holomuzki, 1997). *B. americanus* must find a balance between predation threats and water availability. Open woodlands, woods' edges, marshes, meadows, and yards are the ideal habitats for *B. americanus* (Harding, 1997).

Rana clamitans melanota, the Green Frog, is also native to the Eastern half of North America. However, the habitat requirements differ significantly between *B. americanus* and *R. clamitans*. *R. clamitans* can tolerate sparsely vegetated areas, but temporary waters are avoided. *R. clamitans* takes several months to develop from larvae to tadpoles, requiring a permanent habitat to survive through the winter. The tadpoles burrow in the mud during cold months (Chesapeake Bay Program, 2003). Breeding habitat also depends on the type of vegetation. Eggs of *R. clamitans* cannot be deposited on the sediment; they are attached to emergent and surface vegetation in shallow water. Ponds, lakes, swamps, or slow streams are the ideal habitat for *R. clamitans* (Harding, 1997).

This study looks at the relative density of *Bufo americanus* and *Rana clamitans melanota* in the Plymouth Beach Canal compared to several areas on Burt Lake and in the Maple River. The purpose is to determine whether the canal holds the same ecosystem as the lake. Ecological variances between sites should manifest as differences in biological parameters, thus resulting in distinct amphibian distribution based upon individual species' requirements.

Methods & Materials

Nine GPS coordinates were taken within Plymouth Beach Canal in Burt Lake, in Cheboygan County, Michigan, and four just outside of the channel. One site on Burt Lake, right outside of the mouth of Carp Creek, and one site 20 meters into Carp Creek were examined. Three sites on Burt Lake, in Maple Bay, and two sites in Maple River were sampled. The sites in Plymouth Beach Canal were chosen based off of the vegetation on the bank of the canal (Table 2). The toads and frogs are more likely to be found in areas with a lot of ground cover near the water, so those areas were sampled most. For sites outside of the canal, areas with ample vegetation near the water's edge were sampled (Table 2). At every GPS location, two meter by

two meter squares were marked off either on land next to the water, in the water, or on the edge of the water. The searching time was one-sixth of a person hour. At every location, all of the frogs and toads were collected with long-handled dip-nets that had small mesh and were deep enough so that the frogs could not jump from the net (Ruthven et al., 1912). The toads were small and slow enough that they were all caught by hand. Every frog and toad was identified and counted. The density of frogs and toads in each plot were compared to determine if the channel's existence changed the dynamics of the amphibian population in the Burt Lake area. Knowledge of frog and toad species in Cheboygan County was acquired from the survey, *Environmental Status of the Lake Michigan Region*, (Pentecost & Vogt, 1976), and the descriptions were provided in *The Herpetology of Michigan* - a Michigan geological and biological survey (Ruthven et. al., 1912).

Table 1: General Descriptions and Aquatic Vegetation for Sites 1–9 in the canal.

Site	General Description	Aquatic Vegetation
1	Huge Drainage pipe from road, Gravel on one side of canal, lawn on other	<i>Myriophyllum heterophyllum</i> , <i>Nuphar variegata</i> , <i>Nymphaea odorata</i> , <i>Najas flexilis</i> , <i>Potamogeton crispus</i> (introduced), <i>Utricularia vulgaris</i> , <i>Spirodela polyrhiza</i>
2	Small drainage pipe into water	<i>Myriophyllum heterophyllum</i> , <i>Najas flexilis</i> , <i>Nuphar variegata</i> , <i>Nymphaea odorata</i> , <i>Utricularia vulgaris</i> , <i>Vallisneria americana</i>
3	Vegetation leading into water on one side of canal, woodchips on other side	<i>Najas flexilis</i> , <i>Nymphaea odorata</i>
4	Forest on one side of canal, lawn on other	<i>Najas flexilis</i> , <i>Potamogeton amplifolius</i>
5	Small drainage pipe, lawn on one side of canal, Gravel on other	<i>Najas flexilis</i> , <i>Potamogeton amplifolius</i>
6	Large drainage pipe, forest on one side of canal, lawn on other	Note: <i>Lythrum salicaria</i> (purple loosestrife; introduced; along shore). <i>Najas flexilis</i> , <i>Nuphar variegata</i>
7	Lawns on both sides of canal, pipe just before site 7	<i>Najas flexilis</i> , <i>Nymphaea odorata</i> , <i>Potamogeton amplifolius</i>
8	Largest pipe in canal,	Note: Densest aquatic macrophyte

	Lawn on both sides, gravel leading to edge of water on one side	sampling site; <i>Lythrum salicaria</i> (purple loosestrife; introduced; along shore). <i>Myriophyllum heterophyllum</i> , <i>Najas flexilis</i> , <i>Nuphar variegata</i> , <i>Nymphaea odorata</i> , <i>Potamogeton crispus</i> (introduced), <i>Vallisneria americana</i>
9	Ample amount of trees on both side of canal, boat launch on one side	Note: <i>Lythrum</i> along bank <i>Myriophyllum heterophyllum</i> , <i>Najas flexilis</i> , <i>Sparganium americanum</i> , <i>Vallisneria americana</i>

Results

Table 2: Frog/Toad species at every site, including terrestrial vegetation descriptions and number of frogs/toads.

Location	GPS N	GPS W	Terrestrial Vegetation Description	Chlorine Levels (mg/L)	# of Frogs	Species
Burt Lake, 10 m south of canal	45.46168	084.62655	Large rocks with few brambles	8.2	0	N/A
Burt Lake, 20 m south of canal	45.46199	084.62653	Beach with few weeds	8.2	0	N/A
Burt Lake, 10 m north of canal	45.46199	084.62665	Medium sized rocks with weeds	8.2	0	N/A
Burt Lake, 20 m north of canal	45.46209	084.62667	Beach with lots of weeds	8.2	0	N/A
Site 1	45.45583	084.62617	Ample vegetation – mint, small tree, grasses	68.0	1	<i>Bufo americanus</i>
Site 2	45.45680	084.62553	Ample vegetation – salix (willow), grasses, ruse	63.8	3	<i>B. americanus</i>
Site 3	45.45707	084.62530	Trees (cedar), little ground cover, leaves and branches on ground.	69.6	1	<i>B. americanus</i>
Site 4	45.45785	084.62513	Thick grasses, Cedar tree, wolf spiders and many other spiders	68.2	0	N/A
Site 5	45.45851	084.62495	Medium amount of grass, trees	69.0	2	<i>B. americanus</i>
Site 6	45.45970	084.62486	Cedar, leaf liter	67.7	0	N/A
Site 7	45.46088	084.62475	Big Cedar, grasses	62.8	2	<i>B. americanus</i>
Site 8	45.46187	084.62508	Very thick grasses	42.9	0	N/A
Site 9	45.46188	084.62574	Hill side into the water, large roots	27.0	0	N/A
Carp Creek site on the Lake			Ferns, sheltered by trees on the bank, 50% vegetation cover, hard soil	5.9	0	N/A
20 m into Carp Creek			Ferns, trees, moist soil, less water flow against bank	9.9	1	<i>Rana clamitans melanota</i>
Maple Bay area, ten feet from shore of Burt Lake in water			30% vegetation – emergent grasses	10.6	0	N/A
Along Burt Lake bank in Maple Bay area			Very thick vegetation in water, 85%	10.6	0	N/A
Bank of Burt Lake in Maple Bay region			Half land, half water. 90% vegetation cover on land	10.6	1	<i>R. clamitans melanota</i>
Shoreline of			Mud, many thin branches, 90%	6.8	1	<i>R. clamitans</i>

Maple River			vegetation cover, shore is slightly inclined into the water			<i>melanota</i>
Shoreline of Maple River			50% vegetation, many ferns, completely on land	6.8	0	N/A

Location	<i>Bufo americanus</i>	<i>Rana clamitans melanota</i>
Site 1	+	0
Site 2	+	0
Site 3	+	0
Site 4	0	0
Site 5	+	0
Site 6	0	0
Site 7	+	0
Site 8	0	0
Site 9	0	0
Burt Lake, 10 m N of canal	0	0
Burt Lake, 20 m N of canal	0	0
Burt Lake, 10 m S of canal	0	0
Burt Lake, 20 m S of canal	0	0
Source of Carp Creek on Burt Lake	0	0
20 m into Carp Creek	0	+
Maple Bay in Burt Lake	0	0
Maple Bay in Burt Lake	0	+
Maple River	0	+
Maple River	0	0

Table 3: Presence and Absence of *B. americanus* and *R. clamitans*

Key
+ indicates the presence of such species
0 indicates the absence of such species

Tables 2 and 3 indicate where *Bufo americanus* and *Rana clamitans melanota* can be found. *Bufo americanus* was only populated in the area of the Plymouth Beach Canal, and was found nowhere else on the lake. *Rana clamitans melanota* was not found within the canal, and was only found on the lake and in the Maple River. The terrestrial vegetation cover and type did not influence the species found. Chlorine levels in the canal were considerably higher than in Burt Lake, Maple River, Maple Bay, and Carp Creek.

Discussion

The two populations of *Bufo americanus* and *Rana clamitans melanota* did not overlap in habitats. *Bufo americanus* was found in areas with rooted vegetation. *Rana clamitans melanota* was found in areas with floating unattached, floating attached, and emergent vegetation. The aquatic vegetation composition makes a large difference in toad and frog species present. *B. americanus* is found in the canal because the sides of the canal are shallow enough to lay eggs in the sediment. Also, when herbicides are not being sprayed, there is sufficient rooted vegetation that *B. americanus* can attach its eggs to. *Najas flexilis* is found at every site in the canal [figure 1].

Just outside of the canal, at the four sites on Burt Lake, there is no aquatic vegetation, and no frogs or toads were found. At Maple Bay, Carp Creek, and Maple River, *Rana clamitans melanota* was found in areas with vegetation. The vegetation outside of the canal, in Burt Lake, was primarily *Nupher variegata* (Bullhead Lily), *Nymphaea odorata* (Fragrant Water Lily), and *Schoenoplectus pungens* (Common Three-Square). *R. clamitans* attaches its eggs to emergent and surface vegetation, so these areas are very ideal for *R. clamitans melanota* to breed.

In the canal, a shallow, low flow habitat has been created. It is not a temporary habitat like *B. americanus* prefers, but it is absent of large fish, and turtles are concentrated at certain sites. Temporary waters are subjected to fewer predators usually, but there is the threat of desiccation before metamorphosis can be completed. The canal is an ideal habitat for *B. americanus* because there is no threat of desiccation, and there are minimal predators. Turtles were only seen in abundance at site 8, and few minnows were observed at sites 5 and 7.

At the end of the canal, in Burt Lake, the four surveyed plots contained no frogs or toads because the flow against the shore was high, and there was no aquatic vegetation in the area.

After observing aquatic vegetation and water characteristics such as depth and flow, it can be concluded that the Plymouth Beach Canal is actually a specialized habitat for *Bufo americanus*. The rest of the lake regularly harbors *Rana clamitans melanota*, but with the addition of the canal, *Bufo americanus* is able to survive in the area.

Unfortunately, the human activity around the canal is not favorable for aquatic life, and may have a negative affect on the growth rate and survival of *B. americanus*. High levels of chlorine in the canal come from runoff from nearby roads. Although members of the Bufonidae family are least susceptible to chlorine at time of exposure compared to other species, they are one of the species with the highest lag affects (Jones, Hammond, Relyea, 2009). Even if *B. americanus* tadpoles are only in the canal for a short period of overlap at times of high chlorine levels, the metamorphs may have damaged gill tissues, a slower neuromuscular system, disruption of the endocrine, or eye abnormalities (Jones, Hammond, Relyea, 2009). *Rana clamitans melanota* tadpoles react in the opposite way to higher levels of chlorine. Fifty percent of the *R. clamitans* population suffers immediate deformities or death upon exposure to four days of 6ppb concentrations of endosulfan. Endosulfan is an herbicide with high amounts of chlorine. However, *R. clamitans* suffers no lag effects from high levels of chlorine (Jones, Hammond, Relyea, 2009). It is possible that the differential reaction to chlorine levels is also a reason why *R. clamitans* is not found within the canal. *B. americanus* does not spend as much time in the water, its habitat after metamorphosis is more terrestrial than that of *R. clamitans*. If *R. clamitans* lived in the canal, it would suffer immediate affects from high levels of chlorine. Whereas *Bufo americanus* can travel to surrounding areas for moisture more easily than *R. clamitans* can migrate.

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