

**VERNAL POOLS OF THE
MARSH-BILLINGS-ROCKEFELLER
NATIONAL HISTORICAL PARK AND ADJACENT LANDS**

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Twelve potential vernal pools were located and mapped (Fig. 1) on the Marsh-Billings-Rockefeller National Historical Park (MBRNHP) and adjacent lands. All pools were monitored for amphibian use during 1998, 1999, and April 2000 (Table 1), and notes were kept on the hydrological cycle of each pool during 1999. Of these 12 pools, 10 were used by at least one vernal pool indicator species (Wood Frog, Jefferson or Spotted salamanders).

During 1999, the 11 monitored pools were dry by 11 July, although drying dates varied widely between pools (range = 28 April to 11 July). Jefferson and Spotted salamander larvae may have suffered high mortality rates at some pools during the 1999 breeding season as no metamorphs were observed or captured in drift fences. Wood Frog larvae may have had a higher survival rate as 10 juveniles (avg. size = 19.4mm) were captured in drift fences on 27 August, and metamorphs were observed on several occasions around the Field-Wetland.

Field-Wetland – North and South Pools

Located to the east of the Pogue and just west of a large hayfield/cattle pasture, the Field-Wetland (FW) consists of 2 distinct breeding pools in a shallow, shrub-dominated, mossy wetland within a hemlock/hardwood canopy. The 2 FW breeding pools are not contiguous, but are separated by a narrow, 20m long, seasonal seep that was mostly dry during 1999. During periods of high water, the north pool (FWN) drains imperceptibly northward through a seep as well as overflowing southward into the south pool. The south pool drains slowly to the south through a seep, eventually draining into the stream that drains the Pogue. Both pools are well-shaded by a nearly closed canopy.

Both pools have substantial breeding populations of amphibians, including Jefferson and Spotted salamanders, Wood Frogs, Spring Peepers, and possibly Red-spotted Newts. Large numbers of egg masses of both salamander species and Wood Frogs were observed in the pools during April and early May, 1999. On 15 April a minimum of 54 Jefferson Salamander egg masses were counted in the north pool alone. Among the several other breeding pools in this area of the park, the 2 Field-Wetland pools appear to be the most important to breeding populations of amphibians, particularly *Ambystomid* salamanders and Wood Frogs. Moss mats and hummocks were actively searched on 22 April, 1999 for presence of Four-toed Salamanders. Although none were encountered, conditions look suitable for this species.

Of all the breeding pools monitored, the FW pools had standing water for the longest period of time. Both pools were dry on 11 July, although the water levels were quite low during most of June. While this hydro-period may have provided enough time for some amphibian larvae to metamorphose successfully, no young salamanders and only 6 Wood Frog metamorphs were captured in the FW drift fences during late August and September, a period when most salamander metamorphs disperse away from their natal pools. It is possible that salamander metamorphs survived and were missed during pitfall trapping, either due to low trapping effort in mid-summer, or because dispersal routes took metamorphs away from drift fence locations.



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Hardwood-Wetland

The Hardwood-Wetland (HW) is a shallow, shrub-dominated wetland in a hardwood-dominated forest, located approximately 200m northwest of the Field-Wetland. This site has many grassy hummocks, less moss than the FW, and little open water available for breeding amphibians. One small breeding pool (ca. 2x3.5m) was located on the south-central side of the wetland.

Use of the HW for egg laying by pool-breeding amphibians appears to be limited to a small population of Wood Frogs. On 21 April, actively calling Wood Frogs and about 15 egg masses were present in the small pool mentioned above. During late August and September, 1999 several Wood Frog metamorphs were captured in drift fences at the HW, suggesting successful metamorphosis may have occurred, despite the pool being nearly dry on 8 June and completely dry 2 weeks later. Although both Jefferson and Spotted salamanders were captured in drift fences, no evidence (e.g. spermatophores, egg masses, etc.) was found to indicate that either species used the HW for breeding. Recaptures of 2 Spotted Salamander individuals suggest that salamanders may pass through the HW enroute to the FW for breeding. However, the moist microclimate of this wetland may provide important summer habitat for many amphibian species, particularly in drought years.

In addition, it appears that a Snapping Turtle used the HW as a hibernaculum during the winter of 1998-99. On 21 April, while searching the HW for presence of amphibians, an adult Snapping Turtle was observed basking in shallow water next to a large (ca. 60x90cm) hummock. The turtle immediately submerged beneath a log. When the area under the log and hummock was probed with a stick the turtle's carapace could be felt about 50cm deep. Because of the proximity of this wetland to the Pogue (ca. 75m) it may be an important over-wintering site for Snapping Turtles as well some amphibian species.

Pogue Roadside Pool

The Pogue Roadside Pool appears to have been artificially created when the carriage road around the Pogue was constructed. Located near the northeast corner of the Pogue, the pool is surrounded to the north by hardwood forest and to the south by the carriage road and the Pogue. This lack of forest cover to the south exposes the small, shallow pool to a high level of solar radiation, increasing water temperature and evaporation. The pool was monitored with minnow traps, and visually by egg mass counts and observations.

At least 3 species of amphibians laid eggs in the Roadside Pool; Jefferson and Spotted salamanders, and Wood Frogs. However, it doesn't appear that any larvae transformed before the pool dried up completely on 22 June, 1999.

Pogue Pool

The Pogue Pool is a small, shallow vernal pool approximately 100m northwest of the Pogue Roadside Pool. Located in a hardwood forest with a partially closed canopy, the pool is in close proximity to the Pogue (ca. 25m) and 2 carriage roads. This pool is 1 of 2 in the study area that is included in a state-wide investigation of vernal pools being conducted by the Vermont DEC. Amphibian use of the pool was monitored by minnow trapping, egg mass counts, and observations.

At least 2 species of amphibians laid eggs in the Pogue Pool; Spotted Salamanders and Wood Frogs. Like the Pogue Roadside Pool however, the pool was dry by 22 June, 1999 and it seems unlikely that amphibian larvae survived to metamorphosis. In addition to amphibians, fingernail clams were found in the dry pool bottom on 6 October, 1998.

Saddle Pool

The Saddle Pool is a small, ridge-top vernal pool of medium depth, located in a saddle just south of the summit of Mt. Tom, on land adjacent to the M-B-R NHP and owned by the Town of Woodstock. The well-shaded pool is surrounded by hemlock/conifer forest to the south, and hardwood forest to the north. The

area just east of the pool is steep and rocky with exposed cliffs and many large boulders. Immediately west of the pool is a carriage road leading to a scenic vista. Of all the pools monitored, the Saddle Pool was the last to lose ice cover (it was still 90% ice-covered on 9 April, 1999 when 1 female Jefferson Salamander was captured in a minnow trap), and routinely had water temperatures 3-9 degrees F lower than other pools. Accordingly, the Saddle Pool held water until 6 July, longer than all other pools except the Field-Wetland. The Saddle Pool, in addition to the Pogue Pool North, is included in a state-wide vernal pool study being conducted by the Vermont DEC.

The Saddle Pool has a significant population of breeding amphibians, including Jefferson and Spotted salamanders, and Wood Frogs. On 20 April, a total of 40 Jefferson Salamander egg masses were counted, and a female Jefferson Salamander was observed depositing an egg mass near the center of the pool. Based on the number of egg masses observed, this site appears to be especially important to Jefferson Salamanders, and represents the only likely breeding site for this subpopulation.

Successful productivity at the Saddle Pool was unlikely in 1999 due to dry weather conditions. We know that most of the Jefferson egg masses were laid on 19 April and that the pool was dry 79 days later on 6 July. Although larval growth rates vary with water temperature, food availability and other variables, this hydro-period may not have been sufficient for Jefferson Salamanders to develop, hatch, and metamorphose. Petranks (1998) reports that Jefferson Salamanders require at least 88 days (28-day embryonic period & 60-day larval period) for successful metamorphosis.

Scout Camp Pool

Located approximately 450m east of the Saddle Pool, the Scout Camp Pool is a small vernal pool in a mixed, white pine/hardwood forest. The pool is adjacent to a boy scout camp building on Town of Woodstock property, and is in close proximity to the M-B-R NHP boundary. The Scout Camp Pool had wide fluctuations in water level during 1999 that may or may not be related to the pool's proximity to the scout building. The pool was found to be nearly dry on 29 April, then full on 6 May; then completely dry on 17 May, and full 2 days later on 19 May. It was completely dry again on 11 and 18 June.

Both Wood Frogs and Spotted Salamanders were found breeding in the Scout Camp Pool, although the size of these breeding populations is not known. It is unknown what effect the widely fluctuating water level had on the egg masses and/or larvae in the Scout Camp Pool, but it seems unlikely that any larvae survived to metamorphosis.

King Farm - East, West, and South Pools

Adjacent to the Park's southwestern border is the King Farm Property of the Vermont Land Trust. Two small pools are located near the northeastern boundary of this property within a northern hardwood/hemlock stand and were monitored during the 1999 season. A third vernal pool is located on the King Farm southwest of the 2 pools described above. Also in a mixed hemlock/hardwood stand, this small pool will be monitored during the 2000 breeding season. All 3 pools have small breeding populations of amphibians.

During 1999, the West Pool - despite being smaller and shallower than the East Pool - held water about a week longer, when on 25 June it was noted as being nearly dry. The East Pool was very low on 11 June, and nearly dry on 18 June.

All 3 King Farm pools showed indications of amphibian breeding activity. On 21 April, 1999 two Wood Frog egg masses along with 2 adult Wood Frogs were found in the East Pool. A week later a total of 26 Spotted Salamander eggs were observed in the East Pool and 4 in the West Pool. On 21 April, 2000, 6 Spotted Salamanders were captured in a minnow trap in the East Pool, and several Jefferson Salamander egg masses were observed. Also on 21 April 2000, a single Jefferson Salamander was captured in a minnow trap

in the South Pool. In addition, a total of 24 Jefferson Salamander egg masses were counted here, along with 1 Wood frog egg mass and Spotted Salamander spermatophores.

Hardwood Pool/Seep

The Hardwood Pool/Seep is a shallow seep that was originally thought to be a vernal pool. It is located about 400m NNE of the Pogue in a hardwood stand. It was monitored on several occasions for signs of breeding activity but none was noted. This site does not appear to provide water deep enough for pool-breeding amphibian species to lay eggs.

Pine Stand Pool

The Pine Stand Pool is a small vernal pool in a Scots Pine plantation near the northwestern boundary of the Park. The pool was visited several times during 1998 and 1999 with no signs of amphibian breeding activity. The pool was found to be completely dry on 28 April and does not appear to provide the necessary conditions for breeding amphibians.

Table 1. Presence/absence data for 12 pools monitored with minnow traps and egg mass counts.

Pool Name	Total Minnow Trapping-hours	Species Captured in Minnow Traps	Species Egg Masses Observed
Field-Wetland North	72.0	JESA, SPSA, WOFR	JESA, SPSA, WOFR
Field-Wetland South	92.0	JESA, SPSA, WOFR, RSNE	JESA, SPSA, WOFR
Hardwood-Wetland	39.0		WOFR
Pogue Roadside Pool	91.5	WOFR	JESA, SPSA, WOFR
Pogue Pool North	175.0	SPSA	SPSA, WOFR
Saddle Pool	216.0	JESA, SPSA, WOFR	JESA, SPSA, WOFR
King Farm East	216.0	SPSA	SPSA, WOFR, JESA
King Farm West	24.0		SPSA
King Farm South	48.0	JESA	JESA, WOFR
Scout Camp Pool	33.5	SPSA	SPSA
Hardwood Pool/Seep	54.0		None
Pine Stand Pool	54.0		None

JESA – Jefferson Salamander
 SPSA – Spotted Salamander
 RSNE – Red-spotted Newt
 WOFR – Wood Frog

The second part of the document provides a detailed overview of the company's revenue streams. It includes a breakdown of sales by product line and region, as well as an analysis of the factors contributing to growth or decline in certain areas. This information is crucial for strategic planning and resource allocation.

The third part of the document focuses on the company's expenses and cost management. It details the various categories of expenditures, from raw materials to marketing and administrative costs. The goal is to identify areas where costs can be reduced without compromising the quality of the products or services.

The final part of the document presents a summary of the overall financial performance. It includes key metrics such as net income, profit margins, and return on investment. This section also provides a comparison of the company's performance against industry benchmarks and a forecast for the upcoming period.

Fig. 1. Vernal Pools of the Marsh-Billings-Rockefeller National Historical Park and Adjacent Lands



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