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Nutrient regeneration by rotifers in New England (USA) bogs

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Introduction

Limnologists have paid little attention to bogs, compared to other aquatic ecosystems, and during the last 2 decades only 2% of all limnological papers were focused on bogs (KORNIJOW & BLEDZKI 1999). Likewise, most studies of rotifer diversity and dynamics have been restricted to ponds. Those few papers on rotifers within bogs present only a list of rotifer species along with other descriptive ecological data recorded from interstitial water (FRANCEZ 1981, 1984, 1987, 1988, FRANCEZ & POURRIOT 1984, FRANCEZ & DEVAUX 1985, PEJLER & BERZINS 1993). The latter authors also concluded that the ecology of mire (bog) rotifers is still in the descriptive stage, awaiting more in-depth analysis.

Here, N and P regeneration is estimated as a function of rotifer density in *Sphagnum* bogs. In an earlier study, it was found that rotifers can supply a valuable amount of nutrients in forms available for uptake by the purple pitcher-plant, *Sarracenia purpurea*, a common host for the rotifer *Habrotrocha rosa* in New England (USA) bogs (BLEDZKI & ELLISON 1998). During a recent survey, 38 rotifer species occurred in these bogs, which range geographically from northern Vermont to south-eastern Massachusetts (BLEDZKI & ELLISON in review).

Materials and methods

Sampling was carried during the summers of 1999 and 2000 in 30 north-eastern American bogs across Massachusetts and Vermont, USA (Table 1), all relatively undisturbed bogs located following consultation with local nature conservation organizations (The Nature Conservancy, Audobon Society, and state Natural Heritage Programs). Detailed physical characteristics of the study sites have been provided by GOTELLI & ELLISON (2002).

At each bog, two 50-mL samples of interstitial water were collected from the peat surface. Samples were stored in a cooler and transported to the laboratory, where they were concentrated to 5- or 10-mL volumes for live rotifer identification and counting. The concentrated sample was placed on a counting

Table 1. Abundance of rotifers reported from interstitial water.

Bog name	Abbreviation	Rotifers/dm^3
Massachusetts mainland		
Arcadia Bog	ARC	14,575
Bourne-Hadley Ponds	BH	150
Black Pond Bog	BPB	1125
Clayton Bog	CB	51,250
Chockalog Bog	CK	3100
Hawley Bog	HAW	669
Halls Brook Cedar Swamp	HBC	2950
Lilly Pond Bog	LPB	900
Otis Bog	OB	925
Ponkapoag Bog	PK	1000
Quabbin Bog	QB	1475
Quag Pond Bog	QP	725
Round Pond Bog	RP	16,800
Shankpainter Ponds	SKP	250
Swift River Bog	SR	1875
Lake Jones Bog	WIN	4500
Massachusetts Islands		
Arethusa Bog	AB	6000
Cedar Tree Neck	CTN	3560
Cranberry Bog	CRA	1500
Donut Bog	DON	1250
Schmitt Bog	SB	9500
Taupshwa Bog	TAB	250
Vermont		
Carmi Bog	CAB	12,000
Chickering Bog	CHB	4150
Colchester Bog	COB	2000
Molly Bog	MOL	6500
Moose Bog	MOO	5600
Peacham Bog	PEA	2225
Snake Mountain Bog	SNA	5500
Springfield Bog	SPR	15,625

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wheel and counted under a Wild M8 zoom stereomicroscope. Species identification was carried out using a compound microscope (see BLEDZKI & ELLISON (in review) for a detailed analysis of the species identification and the diversity). N and P regeneration/m^2 was calculated as a function of rotifer biomass using formulae given by EJSMONT-KARABIN (1984) and BLEDZKI & ELLISON (1998). N and P regeneration was estimated assuming an average volume of 2.5 L/m^2 of pore water (BLEDZKI unpublished data).

Results

The abundance of rotifers across the 30 bogs ranged from 150 to 51,250 individuals/dm^3 (mean = 5931 ± 9784 (SD)/dm^3; Table 1). The most frequent and abundant species were *Habrotrocha rosa* Donner 1949, *Lecane pyriformis* (Daday 1905), *Cephalodella gibba* (Ehrenberg 1832), *Lecane lunaris* Ehrenberg 1832 and *Polyarthra vulgaris* Carlin 1944 (BLEDZKI & ELLISON in review).

Estimated rates of nitrogen and phosphorus regeneration (Table 2) ranged from 0.9 to 138 mg N/m^2/year, and from 0.5 to 225 mg P/m^2/year during the growing season (average of 160 days in western Massachusetts). Because *Habrotrocha rosa* alone accounted for 31% of the rotifer abundance (BLEDZKI & ELLISON in review), it probably contributes >50% of N and >75% of P regenerated by rotifers in these bogs. Across this relatively small geographical region, N and P regeneration increased significantly with latitude (Fig. 1).

Discussion

The estimated range of 150–51,250 specimens of rotifers per L of surficial interstitial bog water is, as far as can be ascertained, the first known such estimate. Similarly, the estimates of nitrogen and phosphorus regeneration by rotifers in these bogs are also the first such estimates. Previous studies of rotifers in bogs (FRANCEZ 1981, 1984, 1987, 1988) presented lists of rotifers recorded in bog ponds, along with characterization of their habitat, or simply a list of species recorded from interstitial water (PEJLER & BERZINS 1993).

Experimental estimations of N and P regeneration by *Habrotrocha rosa* (BLEDZKI & ELLISON 1998) differed significantly from values calculated using published formulae (EJSMONT-KARABIN 1984). For the whole dataset, the estimated value of regeneration by *H. rosa* would be 18.49 ± 21.15 (based on BLEDZKI & ELLISON 1998) versus 0.52 ± 0.60 (based on EJSMONT-KARABIN 1984) mg N/m^2/year and 89.58 ± 102.45 (based on BLEDZKI & ELLISON 1998) versus 4.87 ± 5.57 (based on EJSMONT-KARABIN 1984) mg P/m^2/year. The estimates based on direct experimentation were higher by 1–2 orders of magnitude than estimates based on formulae derived for other species. *Habrotrocha rosa* is a bdelloid rotifer that can rapidly contract its body and probably has a faster and more efficient metabolism than non-bdelloid rotifers. Thus, it is not surprising that empirically derived estimates for its nutrient regeneration differ from those predicted by formulae based on non-bdelloids (EJSMONT-KARABIN 1984).

These data support the assertion that the role of fauna in wetland nutrient cycling is not well understood (HOWARD-WILLIAMS 1985). Nutrient dynamics in bogs will be underestimated if nutrients regenerated by rotifers are not included in nutrient budgets for these ecosystems.

Table 2. Estimated lower and upper means, standard deviations, and range of N and P regeneration in 30 New England (USA) bogs.

	mg N/m^2/year	mg P/m^2/year
Mean ± SD	31.8 ± 35.52	48.1 ± 54.75
Range	0.9–138.0	0.5–225.1

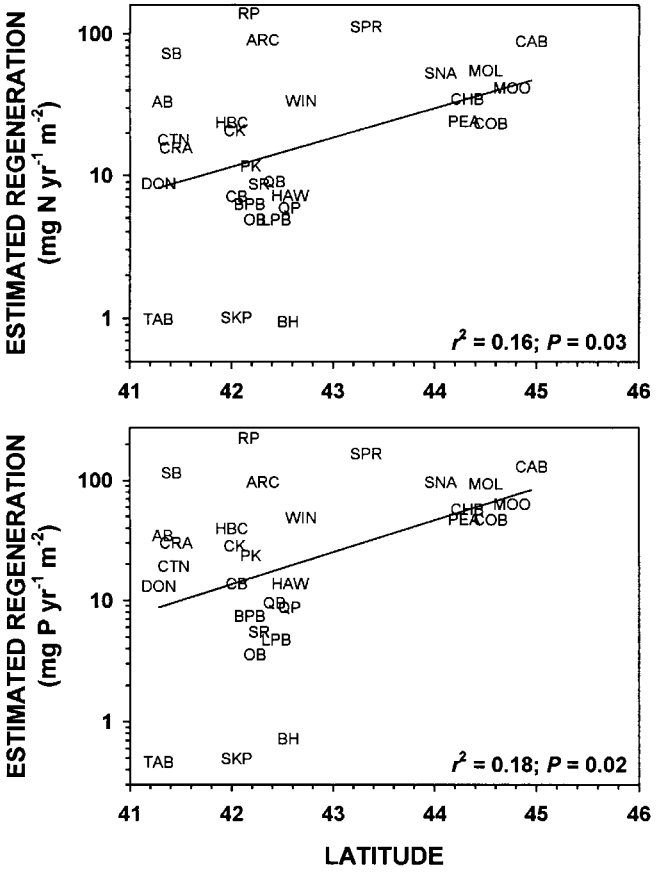

Fig. 1. Estimated N and P regeneration as a function of latitude for 30 New England (USA) bogs. Site abbreviations as in Table 1. Note logarithmic scale on both plots.

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