Wood Frog and Boreal Chorus Frog Distribution and Habitat Associations in Wapusk National Park, Cape Churchill, Manitoba: 2004 Summary Report

December 2004

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Distribution, abundance, population dynamics, and habitat relationships of anurans that inhabit sub-arctic regions are poorly understood. In addition, concern about amphibian populations at a global scale has resulted in recent efforts to establish monitoring programs for amphibians in North America (e.g., North American Amphibian Monitoring Program) and elsewhere. In an attempt to assess anuran abundance, distribution, and habitat associations in Wapusk National Park in the Cape Churchill region of Manitoba, we conducted 4 3-km transect surveys in 2002 (Boal and Andersen 2003) on the Nestor One Study Area. We detected both boreal chorus frogs (*Pseudacris maculata*) and wood frogs (*Rana sylvatica*), but also assessed survey methodology for application to the study area (Boal and Andersen 2003). In 2004, we conducted more extensive surveys to (1) further develop anuran survey protocols suitable for describing distribution and estimating abundance for anurans in sub-arctic areas (Wapusk National

Park specifically), (2) assess distribution of anurans at a wider scale than was done in 2002, and (3) assess anuran distribution and abundance near Cape Churchill.

Methods

We used ArcView 3.3® (ESRI), the vegetation classification layer developed by Brook (2001), and habitat categorizations by Didiuk and Rusch (1979) to delineate the that portion of Wapusk National Park north of the Broad River into 3 zones based on physiography and vegetation types. These were (1) Coastal beach ridge/sedge meadow (BRSM), (2) Interior sedge meadows (ISM), and (3) Transition – boreal forest/ tundra interface (TRAN; Fig. 1). The BRSM region extends from the high tide line to approximately 3 – 5 km inland. This stratum is characterized by low relief, continuous permafrost, poor drainage, beach ridges, coastal marshes, and coastal tundra vegetation (Wellein and Lumsden 1964, Didiuk and Rusch 1979). The ISM zone begins at the western edge of the BRSM zone and extends westward toward the northern boreal forest edge. This stratum is characterized by reduced numbers of beach ridges, extensive sedge and grass meadow complexes, and shallow water bodies. The TRAN zone begins where spruce trees become increasingly present and consists primarily of lichen spruce bog, sphagnum spruce bog, lichen melt pond bog, and sedge meadow vegetation types (Brook 2001). Combined, these strata extend from Cape Churchill (58˚ 50’ N) south to the mouth of the Broad River (58˚ 10’ N) and from the Hudson Bay coastline (93˚ 05’ W) west to La Perouse Bay (95˚ 30’ W).

We used ArcView 3.3 to randomly establish Universal Transverse Mercator (UTM) coordinates for 5 points in each stratum. These points served as the starting location for 1-km transects. Survey crews were transported by helicopter to each starting location. Once the approximate starting location was located from the air, we generated a random compass bearing along which to run the transect. In locations where a random bearing would send a survey crew through impassable terrain (e.g., lakes, rivers, etc.) we selected an alternative randomly generated bearing. The helicopter dropped off the team of 2 surveyors near the starting point, then flew >1 km in the direction of the compass bearing of the survey transect, landed, and shut down. Observers waited for 5 minutes after the helicopter shut down to begin a survey.

Based upon information gained in 2002 surveys (Boal and Andersen 2003), sampling methods consisted of an unbounded transect width within which we recorded all aural and visual detections of anurans. The primary observer walked each transect and recorded a track of the survey route using handheld Global Positioning System (GPS) unit. At each anuran detection, the observer recorded species detected, Call Index Value (CIV: 1-individuals counted, space between calls, 2-individuals counted but calls overlap, 3-full chorus, calls are constant and overlapping) by species, estimated distance and bearing from transect line to calling anurans (estimated with a laser rangefinder and a compass), general landscape and vegetation characteristics, weather conditions, and time of observation. Every 2 to 3 detections, a second observer conducted microhabitat measurements consisting of pH, total dissolved solids (TDS) recorded as parts per million (ppm), and temperature (˚C) in the water body at or near where anurans were detected calling and, if possible, in an adjacent water body where anurans were not detected. Microhabitat measurements were collected with a pH/TDS/EC combination meter that was calibrated each morning and checked and recalibrated, if necessary, at least once during the survey day. Anurans located >100 m from survey transects were not included in microhabitat analysis because of the difficulty in correctly identifying their location. Similarly, in areas of high anuran abundance, identifying a body of water where anurans were not present was not possible, and thus microhabitat measurements at a paired point were not made. In addition, at times when frogs were calling from large areas of continuous sheet water, paired random locations were not easy to identify and were not visited. If no anurans were detected along a survey transect, we attempted to survey the closest water body to the traversed route every 250 m. We report detections as means (± SE). We used 1-way analysis of variance to compare means among strata.

Results

We completed 15 transects; 5 in each stratum. We conducted surveys on 29 and 30 June and 2 July 2004 between 0930 and 1900 CDT. Twelve transects covered 1,000 m and we truncated 3 transects at 800, 860, and 900 m due to helicopter disturbance (at the end of transects) or, in 1 instance, when the presence of a lake prevented us from completing a transect. Transect surveys averaged 55 minutes to complete.

<u>Anuran Detections:</u>

We detected boreal chorus frogs and/or wood frogs on 11 (73%) of 15 transects and in all 3 zones. We made a total of 77 detections and all detections were aural. Total anuran detections across all transects averaged 2.57 (± 0.61) per transect. Average wood frog detections per transect were 3.43 (± 1.13) and boreal chorus frog detections averaged 1.67 (± 0.35) per transect (Table 1). Wood and chorus frog detections per survey were similar ($F_{1,28} = 2.31$, $P = 0.14$).

BRSM zone: We detected anurans on 40% (2 of 5) of transects in the BRSM zone and detections averaged 1.2 (± 0.8) per transect. Wood frog and boreal chorus frog detections averaged 0.4 (± 0.4) and 0.6 (± 0.49) per transect, respectively (Table 1). Both CIVs for wood frogs (n = 2) were 3 and CVIs for all boreal chorus frog detections (n = 4) were 1.

INT zone: We detected anurans on 80% (4 of 5) of transects in the interior zone with a mean of 4.5 (± 2.42) detections per transect. Wood frog and boreal chorus frog detections per transect averaged 3.2 (± 1.83) and 1.4 (± 0.68), respectively (Table 1). CIVs for wood frog detections (n = 16) were classified as 1 (n = 8 detections), 2 (n = 7 detections), and 3 (n = 1 detection). CVIs for boreal chorus frogs were 1 (n = 6) and 2 (n = 1).

TRAN zone: We detected anurans on 100% (5 of 5) of transects surveyed in the TRAN zone, with a mean of 9.6 (± 2.25) detections per transect. Wood frog and boreal chorus frog detections per transect averaged 6.8 (± 2.20) and 2.8 (± 0.20), respectively (Table 1). On all or part of 3 of 5 transects in this zone, there was a steady chorus of wood frogs—we recorded these choruses as single detections. Thus, mean detections per transect for wood frogs in this zone may be negatively biased. Wood frog detections (n = 34) consisted of CVIs of 1 (n = 17), 2 (n = 7), and 3 (n = 10). We detected boreal chorus frogs 14 times in this zone, with CVIs of 1 (n = 10), 2 (n = 3), and 3 (n = 1). The TRAN zone was the only zone in which we detected a full chorus of boreal chorus frogs.

We made significantly more anuran detections in the TRAN zone than the BRSM zone ($F_{1,8} = 12.38$, $P = 0.008$). However, anuran detections were not different between the BRSM and INT zones ($F_{1,8} = 1.78$, $P = 0.22$) nor the INT and TRAN zones ($F_{1,8} = 2.29$, $P = 0.16$).

<u>Microhabitat Sampling:</u>

We sampled 29 bodies of water where anurans were detected (2 BRSM, 9 INT, 18 TRAN) and 22 where anurans were not detected (8 BRSM, 6 INT, 8 TRAN). Twenty-six of the total 51 samples consisted of a location where we detected anurans (n = 13) and a paired adjacent pool where anurans were not detected (n = 13). Of the remaining 25 samples, 16 consisted of locations where we detected anurans but a paired site to sample was not available, and 9 samples were taken at random locations were anurans were not detected (Table 2).

Mean pH of water bodies where anurans were detected (7.86; n = 29) and where no anurans were detected (8.09; n = 22) were not statistically different ($F_{1,49}$ = 4.04, P = 0.078), but the slightly lower pH readings at detection points may warrant further investigation and could be of biological relevance. Median TDS where anurans were present (n = 29) and were not present (n = 22) were 156 ppm and 195 ppm, respectively. (We report median for TDS because initial assessments reveal highly skewed data for this parameter.) Average water temperatures at points where anurans were detected (15.8˚C; n = 29) and where no anurans were detected (16.0˚C; n = 22) were not different ($F_{1,49}$ = 0.043, P = 0.84; Table 2).

Discussion

We detected wood frogs and boreal chorus frogs in all 3 landscape zones that we sampled—coastal beach ridge-sedge meadow, interior sedge meadow, and boreal forest-tundra interface. Our detections, however, indicated anurans were not equally distributed across the study area. Detections of anurans were lowest close to the Hudson Bay coastline and highest at the tundra/boreal forest interface. Detections of wood frogs were more than twice that for chorus frogs in the INT and TRAN zones, but similar to chorus frogs in the BRSM zone.

We obtained the highest mean detections per transect for both species in the TRAN zone. However, on 3 transects in the TRAN zone, large numbers of wood frogs were in full chorus. These choruses made individual detections difficult to discern and may have lead to a negative bias in detection rates in the TRAN for both species. Thus, the actual difference in total anuran abundance may be greater than our preliminary analyses indicate.

Our preliminary assessments of microhabitats suggest no statistically significant differences in TDS or water temperature between bodies of water where anurans were and were not detected. However, we suspect that observed difference in pH levels, while not statistically significant, may be biologically meaningful and may influence anuran presence. Closer examination of the pH levels in water bodies across the study area and the potential influence of pH on anurans in the study area may be warranted.

Virtually no information is available for anurans in tundra ecosystems. Our pilot study near Cape Churchill in Wapusk National Park of Canada provides basic information pertaining to anuran distribution and relative abundance. However, our data should be interpreted cautiously for 2 reasons. First, our sample size was limited to ≤5 km of survey transect in each of 3 vegetation/physiographic zones. Second, our data are limited because we do not know the relationship between environmental factors and probability of anuran detection (e.g., timing of surveys and conditions at the time of surveys could influence calling and detection probability). For example, our qualitative observations suggest that species-specific differences occur in timing of peak calling, with boreal chorus frogs becoming active earlier than wood frogs, commencing calling soon after lake ice melts and, in some cases, calling before lakes were completely free of ice. In contrast, wood frogs were more vocal and, hence, more detectable later in the summer when boreal chorus frog activity had dropped off.

To develop a better understanding of anuran distribution, habitat associations, and relative densities in Wapusk National Park, we propose a more comprehensive study encompassing multiple field seasons. Such a study would have several advantages. First, it would allow for an increased number of transects in each vegetation community and a higher sampling intensity. Higher sampling intensity would allow for more sophisticated and powerful statistical analyses. Second, it would allow for repeat surveys of established transect or listening locations. By conducting repeat surveys, it is possible to estimate detection probability (MacKenzie et al. 2002) and assess the relationship between detectability and environmental factors such as time of season, weather, habitat characteristics, etc. Repeat surveys would also allow assessment of temporal patterns in anuran calling behavior and development of a statistically based population monitoring protocol (MacKenzie et al. *In press*).

Acknowledgments

We thank Parks Canada, Wapusk National Park for providing funding for helicopter support to conduct anuran calling surveys in 2004. Manitoba Conservation, the Mississippi Flyway Council, and Parks Canada provided logistical support in the form of maintenance and operation of the Nestor One research camp at Cape Churchill, from which surveys were conducted. Hudson Bay Helicopters, Ltd. provided flight support. We especially wish to acknowledge Murray Gillespie (Manitoba Conservation), Bob Reside (Parks Canada), Joan Brauner (Hudson Bay Helicopters), and Scott Dewindt (Hudson Bay Helicopters) for their efforts in support of field work in 2004.

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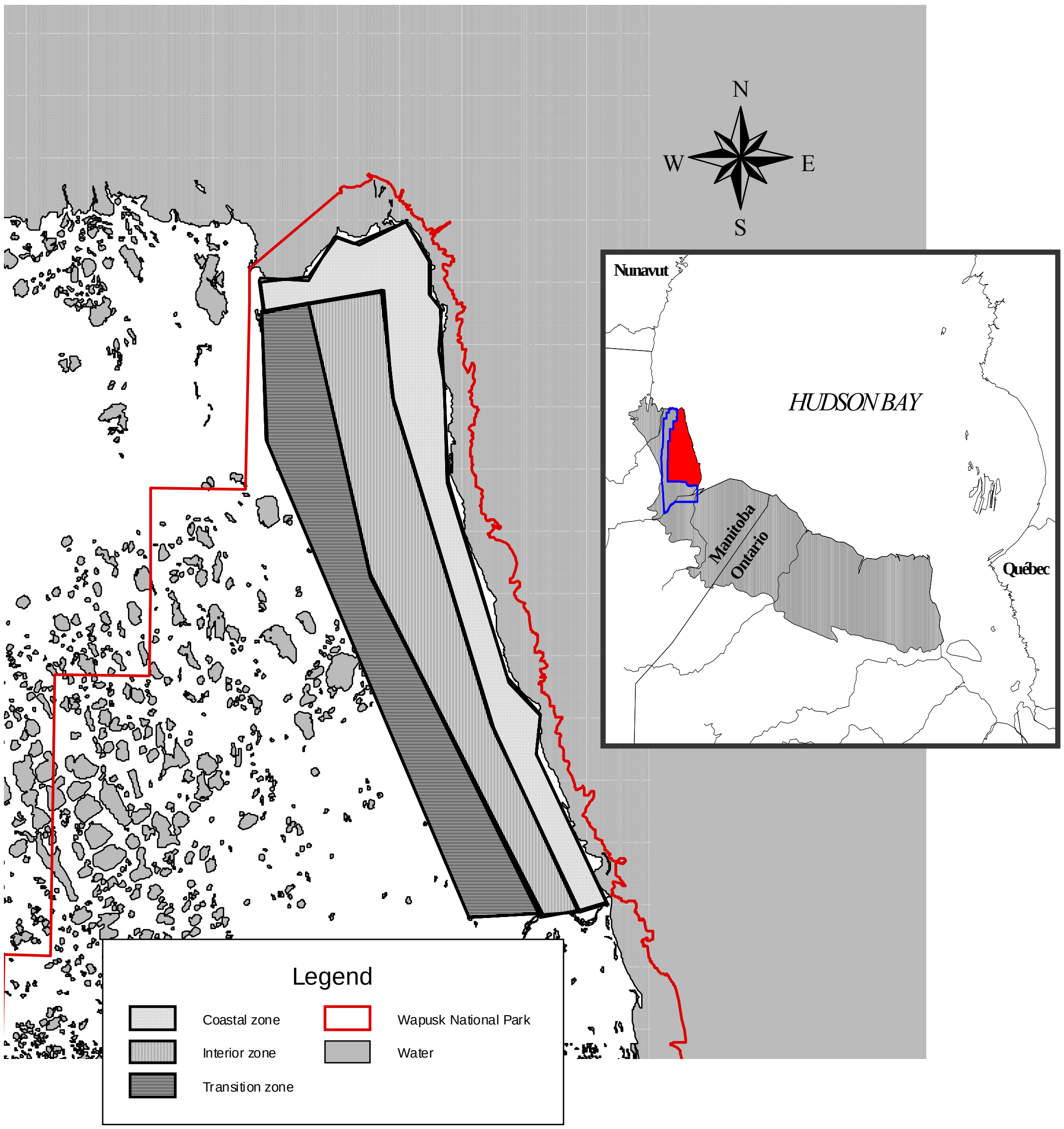

Figure 1. Study area and vegetation/physiographic zones, Wapusk National Park, Cape Churchill, Manitoba, Canada.

Table 1. Mean detections (± SE) of anurans in 3 vegetation/physiographic zones in Wapusk National Park, Cape Churchill, Manitoba, Canada, 2004.

	Coastal Zone	Interior Zone	Transition Zone	Total
Wood frog	0.4 ± 0.4	3.2 ± 1.83	6.8 ± 2.20	3.43 ± 1.13
Boreal chorus frog	0.6 ± 0.49	1.4 ± 0.68	2.8 ± 0.2	1.67 ± 0.35
Total	1.2 ± 0.8	4.6 ± 2.42	9.6 ± 2.25	2.57 ± 0.61

Table 2. Mean pH, total dissolved solids (TDS) in parts per million, and temperature at locations of anuran detection and no detection in 3 vegetation/physiographic zones in Wapusk National Park, Cape Churchill, Manitoba, Canada, 2004.

	n	pH	TDS (ppm)	Temperature (˚C)
Coastal zone				
Anurans detected	2	8.5	178	19.2
No detection	8	8.4	212	15.8
Interior zone				
Anurans detected	9	7.9	105	14.2
No detection	6	8.1	171	14.7
Transition zone				
Anurans detected	18	7.8	200	16.3
No detection	8	7.7	138	17.3
Total				
Anurans detected	29	7.9	156	15.8
No detection	22	8.1	195	16.0

Appendix 1. Examples of vegetation/physiographic zones in which transect surveys for calling wood frogs and boreal chorus frogs were conducted in Wapusk National Park in 2004.


Coastal beach ridge/sedge meadow


Interior sedge meadow


Boreal forest/tundra interface