A Biophysical Inventory of the Reptiles and Amphibians of Elk Island National Park

by

Gordon R. Burns

Edmonton

September 1986

ABSTRACT

One reptilian and four amphibian species were recorded in Elk Island National Park in 1986.

Wood frogs and boreal chorus frogs were abundant and found throughout the park during the present study. Calls from these species were heard in all areas visited in late April and early May. Frogs were found in all wetland habitats during the breeding season except for large, open lakes. In the post-breeding period, boreal chorus frogs tended to stay close to breeding areas in grassy, damp habitats while wood frogs wandered to a variety of habitats where some dampness, shade and cover could be found. Hibernation habitats for these frogs appeared to be similar to post-breeding habitats but tended to be higher and drier.

Canadian toads were rare residents of the park. Toads were observed only twice in 1986 while CANSIS records suggest that toads were more common in the past. Toads stayed near breeding ponds through the summer and probably hibernated in the same areas.

Tiger salamanders were uncommon residents of the park. Six salamanders recorded in September 1986 and CANSIS records from an earlier wildlife inventory suggest that salamanders are more common than scarce observations from spring and summer would suggest. Salamanders moved from breeding ponds into aspen forest for the summer and tended to appear in disturbed habitats before hibernation.

Plains garter snakes were rare and were observed at three locations in 1985 - 1986. Habitat associated with these observations included disturbed areas and wetlands. No hibernation sites are known in the park.

TABLE OF CONTENTS

TABLE OF CONTENTS continued

LIST OF TABLES

1.0 INTRODUCTION

Elk Island National Park is currently updating the information available on the resources of the park to improve the planning, interpretation and management of park resources. Prior to the present study, soils (Crown 1977), vegetation (Polster and Watson 1979, Hardy Associates (1978) Ltd. 1986), water birds (Kemper 1974), non-ungulate mammals (Burns and Cool 1984) and birds (Burns et al. 1986) were examined in a biophysical context.

The present biophysical inventory of reptiles and amphibians is the first wildlife inventory to use the revised biophysical land classification prepared by Hardy Associates (1978) Ltd. This inventory was designed mainly to determine the status, distribution, relative abundance and habitat preferences of reptiles and amphibians found in the park. An annotated bibliography and recommendations for resource management were also included in this report. The terms of reference for this study are reprinted in Appendix 1.

2.0 METHODS

2.1 Sampling Strategy

The short duration of the present inventory (13 weeks) meant that sampling had to be limited to key habitat types. Sampling for two species of frogs, one or two species of toads, one salamander species and one or two species of garter snakes in all landform/vegetation/soil/slope combinations would require a massive effort far out of proportion to the number of species concerned. The main objective of this inventory was to describe the relative abundance of reptiles and amphibians in all combinations of soils (10 types) and dominant vegetation types (15 types). Forty-six soil-vegetation combinations (habitats) were identified on the biophysical maps prepared by Hardy Associates (1978) Ltd. Twenty-seven sites, each in a different habitat type, were marked for sampling in April 1986. One additional site, also in a different habitat type, was marked in July 1986 as casual observations in June from this habitat type (D) pointed to the need for sampling.

Habitats were selected for sampling such that each soil type and each dominant vegetation type were sampled by at least one plot. When habitat types were selected to represent the range of soil types, the range of associated vegetation types was kept to a minimum. For example, soil types 1, 2, 4, 5, 6 and 7 were sampled under vegetation type TA and soil types 3, 6 and 9 were sampled under vegetation type W. Similarly, when habitat types were selected to represent vegetation types, the range of soil types was kept to a minimum. One sample plot was located in each of the following habitat types: TA/1, TA/2, TA/4, TA/5, TA/6, TA/7, AP/6,

BP/1, WB/6, WB/9, WS/6, BS/8, B/1, B/6, W/3, W/6, W/9, LT/8, AG/10, G1/6, G1/10, G2/6, S/3, S/9, SW/9, F/3, MF/3 and D. Two plots were located in polygons which were mapped as MF/3 but the plot which was marked first was treated as S/3 because the area supported a dense growth of sedges. The plot located in a polygon mapped as W/6 was treated as a sample of W/9 habitat because standing water was found throughout the polygon and the soil is more likely to be type 9 rather than type 6. The plot sampling BP/1 was located in a small balsam poplar stand in a polygon described as TA/1. Polygons which were visited by a field crew from Hardy Associates (1978) Ltd. were used as much as possible for sample sites in an effort to reduce problems with identification of vegetation and soils and mapping problems.

Two sampling periods (May to early August and late August to early September) and two sampling methods (multiple coverage terrestrial plots and single-coverage wetland plots) were used in an attempt to define breeding, post-breeding and hibernation habitats for amphibians. Wetland plots were used in May to determine breeding habitats. Terrestrial plots were used from May until early September with the expectation that late August and early September distribution would represent hibernation habitat and that the May - early August distribution would describe post-breeding habitats. Casual observations of egg masses, vocalization in spring and young of the year were also used to define breeding habitat. It was hoped that an Electroshocker would facilitate the gathering of information on amphibians in wetland habitats in spring. The Electroshocker did not have the desired effect on amphibians and was not used in sampling. (The experimental use of an Electro-

shocker is described in Appendix 2.)

2.2 Wetland Plots

Plot areas ranging from 250 to 10000 m^2 were estimated by an observer standing at the edge of a wetland and counts of amphibians seen or heard within plot boundaries were recorded. The size of a plot was determined by wetland size or by the number of calling amphibians. When calls were numerous, plot size had to be sufficiently small to permit a reasonable estimate of the number of calling amphibians. Plots were generally located at roadsides and were selected as being typical of a particular wetland habitat type. Data were coded under CANSIS Survey Type HRP1. Plot size (m^2) was entered in columns 25 to 32 on Card 5.

2.3 Terrestrial Plots

Twenty-seven plots were marked with flagging tape in April 1986. (Locations are described in Appendix 3). A 50 m centre line was flagged and a metal stake (rebar) was placed at one end of the centre line as a permanent marker. During each search of the plot, the observer searched to a maximum of 5 m on either side of the flagged line. (Plot area was 10 m by 50 m or 500 m^2.) Observers generally made two passes on each side of the plot's centre line and searched a path 2.5 m wide on each pass. This search pattern could not always be maintained; a weaving or zigzag pattern was necessary in willow wetlands and areas where several frogs were found were completely searched before the remainder of the plot was searched. Logs were lifted to search for salamanders during the first month of sampling. This search technique failed to find any salamanders and this aspect of the search was discontinued.

An additional plot was added to the original 27 plots in July 1986. As many casual observations of amphibians were being recorded in disturbed habitats (roadsides, trails) and as none of the existing plots sampled disturbed habitat, the addition of a plot in disturbed habitat (Moss Lake trail) was considered necessary. This plot was 150 m long and 3 m wide (trail width approximately) (area 450 m^2) and was searched in two passes.

Data from terrestrial plots were coded under CANSIS Survey Type HERP and plot size (m^2) was coded on Card 5 in columns 25 to 32.

3.0 RESULTS

3.1 Wetland Plots

Call counts on wetland plots were conducted from 7 to 12 May 1986. Four wetland habitats and 18 sites were sampled by this method (Table 1).

Two species of frogs, the wood frog and boreal chorus frog, were recorded on wetland plots. Both species were recorded in greatest numbers in flooded habitats (F) but were also regularly heard calling from sedge wetlands (S/3, S/9). The two species of frogs were recorded in cattail marshes (C/9) but in the lowest numbers of the four sampled habitats. Flooded habitats and sedge wetlands were clearly the preferred breeding habitats.

Two observations about the preferred breeding habitats of these frogs cannot be seen in the tabulated data. First, most of the flooded habitats which were sampled during the present study were recently flooded. Recently flooded habitat appeared to be preferred for breeding over habitats which had been flooded for a longer time. Recent flooding tended to create areas of shallow water with islands of grass and shrubs while older flooding was associated with either deeper water and forest margins or dense sedge growths. Second, a preference for certain types of sedge wetlands was not apparent in the tabulated data. Extensive, dense growths of sedges were not used as breeding habitat as much as pools which were surrounded by sedges or pools with clumps of sedges. The frogs appeared to avoid extensive stretches of water and dense emergent vegetation in preference for shallow water and clumps of emergent vegetation (sedges) or low density growths of emergents.

Table 1. Densities of calling frogs on wetland plots sampled in May 1986.

HABITAT	AREA SAMPLED (M^2)	NO. OF SAMPLES	DENSITY (FROGS/HA)	
			WOOD FROG	BOREAL CHORUS FROG
S/3	1900	2	5.3	31.6
S/9	14900	11	5.4	21.5
C/9	13700	3	2.2	3.7
F	850	2	23.5	117.7

Breeding habitats of wood frogs and boreal chorus frogs overlapped extensively. However boreal chorus frogs tended to be restricted to more open situations such as in sedge wetlands which surround lakes while wood frogs inhabited small ponds under the forest canopy. The breeding habitat of the wood frog was more likely to include temporary ponds than that of the boreal chorus frog. Neither species was found in black spruce bogs (BS), open Labrador tea bogs (LT) or white spruce forests (WS) at the time of breeding.

Canadian toads and tiger salamanders were not recorded on wetland plots.

3.2 Terrestrial Plots

Searches on terrestrial plots were conducted from 5 May to 4 September 1986. Twenty-seven plots were searched 13 times and one plot, set up in July, was searched seven times. Plot searches were carried out on 5 - 9 May (search #1), 12 - 16 May (#2), 20 - 22 May (#3), 23 - 27 May (#4), 28 - 29 May (#5), 2 - 4 June (#6), 23 - 29 June (#7), 8 - 24 July (#8), 28 July - 12 August (#9), 24 - 27 August (#10), 27 - 28 August (#11), 29 August - 2 September (12) and 3 - 4 September (#13). Plot 28 sampling habitat D was added to the sampling program on 14 July 1986 and was searched twice during search period #8.

Three species of amphibians were observed on terrestrial plots - the wood frog, boreal chorus frog and Canadian toad. The Canadian toad was recorded only once; one toad was recorded on 25 June 1986 on the plot sampling habitat B/6. Wood frogs were first observed during the third search of the plots (21 May) and were still pre-

sent on the plots on the last day of field work for this study (4 September 1986). Boreal chorus frogs were first observed during the third plot search (20 May 1986) and were also found on the last day of field work.

Wood frogs were observed on 19 of the 28 plots used in this study (Table 2). On ten of these plots, wood frogs were recorded in only one or two plot searches. Habitats where counts averaged more than one wood frog per search included TA/2, W/9 and D. Frogs were found in habitat D during all seven plot searches from mid-July to early September.

Boreal chorus frogs were found less frequently than wood frogs on terrestrial plots (Table 3). This frog was observed on nine of the 28 study plots. It was recorded a single time on four plots, on two searches of four plots and on three searches of one plot (W/9).

Some frogs could not be identified to species because of their rapid escape and effective hiding techniques. While these were generally thought to be wood frogs, there was some doubt in the identification and these observations were recorded as unidentified frogs (Table 4).

Both wood frogs and boreal chorus frogs were observed most frequently in vegetation type D (Tables 2, 3 and 5). Among the undisturbed vegetation types, willow wetlands (W) showed the highest counts for both species of frogs. The lowest counts of the two species were recorded in vegetation types WB, WS, BS, AG and S. Both frogs apparently preferred to spend the post-breeding period among the sedges growing in willow wetlands rather than in sedge wetlands.

Table 2. Numbers of wood frogs observed on terrestrial plots searched between 5 May and 4 September 1986.

HABITAT	PLOT SEARCH NUMBER												
	1	2	3	4	5	6	7	8	9	10	11	12	13
TA/1													
TA/2				2	6	2	2	5					
TA/4													
TA/5													
TA/6													
TA/7					1		4						
AP/6			1				3		5			1	
BP/1*			1	2								1	
WB/6													
WB/9								2					
WS/6													
BS/8								1					
B/1							1		2				
B/6				1			3	1					
W/3										1	2	2	1
W/9*				3	1	3				4	4	3	
W/9			3	7	8	2	5	5	3		1		
LT/8								3	1				
AG/10													
G1/6								1					
G1/10													
G2/6							3	1					
S/9							1						1
S/3*													
SW/9					1							1	
F/3					2	1		1					
MF/9									5		3		
D								**44,75	23	2	7	8	1

*Vegetation or soil type not as mapped.

*Two searches: 14 and 24 July 1986.

Table 3. Numbers of boreal chorus frogs observed on terrestrial plots searched between 5 May and 4 September 1986.

HABITAT	PLOT SEARCH NUMBER												
	1	2	3	4	5	6	7	8	9	10	11	12	13
TA/1													
TA/2													
TA/4													
TA/5													
TA/6													
TA/7													
AP/6													
BP/1*												1	
WB/6													
WB/9													
WS/6													
BS/8													
B/1													
B/6													
W/3											2		
W/9*										1	1		
W/9				3	3		2						
LT/8													
AG/10													
G1/6													
G1/10													
G2/6							2						
S/9													
S/3*													
SW/9										1	1		
F/3			1										
MF/9									1				1
D								**0,2		1			

*Vegetation or soil type not as mapped.

**Two searches: 14 and 24 July 1986.

Table 4. Numbers of unidentified frogs observed on terrestrial plots searched between 5 May and 4 September 1986.

HABITAT	PLOT SEARCH NUMBER												
	1	2	3	4	5	6	7	8	9	10	11	12	13
TA/1													
TA/2													
TA/4													
TA/5													
TA/6													
TA/7								1					
AP/6									2				
BP/1*													
WB/6													
WB/9													
WS/6													
BS/8													
B/1								2					
B/6							4						
W/3													
W/9*								2					
W/9							1	3					
LT/8													
AG/10													
G1/6								2					
G1/10													
G2/6													
S/9													
S/3*													
SW/9							1						
F/3													
MF/9													
D								**					

*Vegetation or soil type not as mapped.

**Two searches: 14 and 24 July 1986.

Table 5. Densities (per hectare) and numbers of amphibians observed on terrestrial plots summarized by vegetation type.

VEGETATION	WOOD FROG		BOREAL CHORUS FROG		CANADIAN TOAD		FROG SP.	
TYPE	N	N/ha	N	N/ha	N	N/ha	N	N/ha
TA	22	5.6	0	0	0	0	1	0.3
AP	10	15.4	0	0	0	0	2	3.1
BP	4	6.2	1	1.5	0	0	0	0
WB	2	1.5	0	0	0	0	0	0
WS	0	0	0	0	0	0	0	0
BS	1	1.5	0	0	0	0	0	0
B	8	6.2	0	0	1	0.8	6	4.6
W	58	29.7	12	6.2	0	0	6	3.1
LT	4	6.2	0	0	0	0	0	0
AG	0	0	0	0	0	0	0	0
G1	1	0.8	0	0	0	0	2	1.5
G2	4	6.2	2	3.1	0	0	0	0
S	2	1.5	0	0	0	0	0	0
SW	2	3.1	2	3.1	0	0	1	1.5
F	4	6.2	1	1.5	0	0	0	0
MF	8	12.3	2	3.1	0	0	0	0
D	160	507.9	3	9.5	0	0	0	0

Wood frogs were most abundant on the plot which sampled soil type 2 (Table 6). However, the abundance of frogs on soil type 2 when compared with their abundance on a wetland soil such as type 9 makes the significance of soil type 2 suspect. Combining of samples from similar soil types provides a larger sample size and a realistic density of frogs; the observed density of frogs on dry upland soils (types 1, 4 and 6) was 3.8 frogs per hectare and was 11.3 frogs/ha on wet upland soils (types 2, 5 and 7). The highest observed density of wood frogs (16.9 frogs/ha) was then found on soil type 9. The lowest observed density of wood frogs was recorded on soil type 10 (solonetz).

Boreal chorus frogs were most abundant on soil type 9. Strangely, boreal chorus frogs were not found on the three plots sampling wet upland soils (types 2, 5 and 7) while three frogs were recorded on dry upland soils (types 1, 4 and 6). Low numbers of this species in upland habitats and the larger sample size on dry upland soils may explain this anomaly. This frog was recorded at an observed density of 1.5 frogs/ha on soil type 3 (gleysol) and was not recorded on soil types 8 (deep organic) and 10 (solonetz).

While the objective of the terrestrial plots was primarily to measure habitat preferences of amphibians during the terrestrial phase of their lives, one could also examine the recruitment of the young of the year into the terrestrial population or the growth of the population. This was not possible during the present study. Although search effort should have been consistent between plots during each search period, one cannot assume that search effort was constant throughout the sampling program. One observer conducted search numbers 1 to 6 and 10 to 13 while a second obser-

Table 6. Densities (per hectare) and numbers of amphibians observed on terrestrial plots summarized by soil type. (Sample from vegetation type D not included.)

SOIL TYPE	WOOD FROG		BOREAL CHORUS FROG		CANADIAN TOAD		FROG SP.	
	N	N/ha	N	N/ha	N	N/ha	N	N/ha
1	7	3.6	1	0.5	0	0	2	1.0
2	17	26.2	0	0	0	0	0	0
3	10	5.1	3	1.5	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	20	4.4	2	0.4	1	0.2	8	1.8
7	5	7.7	0	0	0	0	1	1.5
8	5	3.9	0	0	0	0	0	0
9	66	16.9	14	3.6	0	0	7	1.8
10	0	0	0	0	0	0	0	0

ver conducted searches 7 to 9. Detectability of frogs varied over the sampling period. Vocalizations aided the search in May but later were an insignificant part of the search. Visibility of the ground was good prior to spring green-up, was still fairly good in early June due to a caterpillar outbreak and was poor from then until early September when leaf fall began. One plot which was flooded in early April was drained and produced a dense growth of sedges by August. Four plots around Goose Lake were flooded in August when water was released from a number of beaver ponds. Many upland plots had temporary pools of water in May and these pools disappeared over the summer. Weather conditions such as wind affected the observer's ability to hear calling frogs and flickering light on the forest floor obscured movements of frogs. Warm, dry weather had distractions in the form of grasshoppers.

4.0 SPECIES ACCOUNTS

4.1 Tiger Salamander (*Ambystoma tigrinum*) TISA

Status and Distribution

Tiger salamanders occur in North America from the east coast to the west coast and from southern Canada to Puebla, Mexico (Stebbins 1966). They occur north to central Alberta and Saskatchewan. This species does not occur in New England, the Appalachians and the far west of the continent (Behler and King 1979).

Sampling of the present study failed to detect salamanders in Elk Island National Park. All plot searches were conducted in the daytime but salamanders are mainly nocturnal. It had also been anticipated that salamanders would be found under logs during the daytime. During pitfall trapping (Burns and Cool 1984), a number of tiger salamanders were captured in traps located beside logs. Assuming that salamanders were spending the daytime under logs, the search of terrestrial plots included a check under deadfall for salamanders. This search technique was unsuccessful in May and was discontinued.

Tiger salamanders are uncommon and widespread residents of Elk Island National Park. The absence of this species from sampling of the present study describes more the nocturnal nature of this species than its abundance in the park. Following the field season for the present study, several salamanders were recorded in the park - one was found in a window well at the residence near the south gate on 13 September 1986 (C. Blyth pers. comm.), two were observed on the Parkway near the bison paddock on 23 September 1986 (T. Winkler pers. comm.), two were observed on the Park-

way near the Shirley Lake trailhead on 29 September 1986 (M. Dillon pers. comm.) and one was observed on the Parkway near the cattle guard at the south gate on 29 September 1986 (C. Blyth pers. comm.). While these recent records came only from the south zone of the park, past records came from all three park zones. Three captures of salamanders were recorded in 1983 (CANSIS) during the inventory of non-ungulate mammals (Burns and Cool 1984) - two were captured in the Isolation Area and one was captured in the park's south zone. Two additional observations were recorded in the north zone and one was recorded in the south zone (CANSIS).

Griffiths (1971) described the tiger salamander as "appearing to be rare" in the park.

Habitat

Breeding occurs in temporary ponds, quiet permanent ponds, reservoirs, lakes and backwaters of streams soon after the ice has melted in spring. Single eggs or clusters of three to five eggs are attached to submerged vegetation and debris in shallow water. Larvae are found in deeper water by day and shallower water by night (Stebbins 1966). After breeding, adults may be found in habitats ranging from sagebrush plains to grasslands and from mountain meadows to forests. While adults occur in a variety of habitats, they are most abundant in damp meadows where burrowing in soil is easy or in areas where burrowing mammals are found.

CANSIS records describe two habitat types occupied by salamanders - disturbed habitats (D) and aspen forest (TA). The three observations which resulted from pitfall trapping were all recorded in vegetation type TA but on different soil types - 1, 5 and 6. Three other CANSIS records came from disturbed habitats in

the Administration Area, Recreation Area and the area of the information building at the south gate. Breeding habitats can be described by vegetation types S, SW and W and soil types 3 and 9. Habitats occupied by adults in summer can be described by vegetation types TA, AP, BP, B and G and soil types 2, 3, 5, 7 and 9. Highest numbers of salamanders are probably found in habitats favoured by pocket gophers (Thomomys talpoides) and other burrowing mammals. Mammal burrows are frequently used by hibernating salamanders.

4.2 Canadian Toad (Bufo hemiophrys) DATO

Status and Distribution

The Canadian toad, known by several names including the Dakota toad, Manitoba toad and Winnipeg toad, occurs north in the boreal forest to the southern District of Mackenzie and south to South Dakota and Montana (Stebbins 1966). It ranges from eastern Manitoba west to the foothills of the Rocky Mountains (Cook 1984).

Canadian toads are rare residents of Elk Island National Park. During the present study, one toad was observed on 25 June 1986 on a terrestrial plot and a casual observation of this species was recorded on 24 August 1986 near the residences in the Administration Area. CANSIS records include only one observation under the species code DATO; one toad was observed in the Recreation Area on 2 August 1985. Four CANSIS records under the species code NOTO probably also refer to the Canadian toad. These four observations were all recorded around the park residences at the Administration Area and near the northwest arm of Astotin Lake. The "brilling" call of three toads was heard on 20 June 1971, single

toads were recorded on 8 May 1969 and 12 May 1975 and 200 ("probably more") were reported on 31 May 1972. Griffiths (1971) described the Canadian toad as being "fairly widespread in the park, but not nearly as abundant as Rana and Pseudacris" and as "heard calling around the marshy margins of many of the lakes and larger ponds in early spring". This toad appears to have been more numerous in the park from 1969 to 1971, the period described in Griffiths' comments, than in the mid-1980's. This population trend is consistent with that in central Alberta (W. Roberts pers. comm.).

Habitat

The Canadian toad breeds in shallow water in ponds, lakes, streams, marshes and ditches (Stebbins 1966). Adults are mainly diurnal during the breeding season; they bury themselves in soil and leaf litter around the breeding ponds at night but may be active at night during warm weather. As post-breeding adults, these toads seldom venture far from water and their breeding habitat.

Four CANSIS observations from May-June in 1969 to 1975 and one observation from the present study are the only breeding season records for this toad in the park. The CANSIS records came from sedge-cattail wetlands (vegetation type S-C, soil type 9) while the single June observation from this study was recorded in habitat B/6 adjacent to probable breeding habitat in a beaver pond (F/9). In August observations, single toads were found in disturbed habitat (D) and aspen forest (TA/1). Generally, breeding habitats can be described by vegetation types S, SW and C and soil type 9 and non-breeding habitats can be described by vegetation types TA, BP, AP, B and W and soil types 1 to 7.

4.3 Boreal Chorus Frog (*Pseudacris triseriata*) BOFR

Status and Distribution

The boreal chorus frog occurs from Great Bear Lake south to the Gulf of Mexico and from Ontario and New Jersey west to British Columbia and central Arizona (Stebbins 1966). It is found in suitable habitat throughout Alberta but is limited in occurrence in the mountains.

Calls of the boreal chorus frog were heard around almost every wetland visited during the present study from late April until late May. This species is abundant and widespread in the park and is probably the most common amphibian species. The highest density of calling frogs on wetland plots was estimated at 118 per hectare in flooded habitats (F). This represents a minimum estimate because the call counts were limited by the observer's ability to separate calling individuals; several calling frogs in a small area would probably be heard as one individual. Boreal chorus frogs appeared to be less abundant on terrestrial plots than on wetland plots; the highest observed density on any terrestrial plot was 0.6 frogs per hectare (W/9). This species was probably poorly represented in tallies from terrestrial plots because (1) they tended to stay near breeding wetlands in areas which received little sampling by terrestrial plots, (2) they tended to stay in grassy habitats where they were hard to find and (3) they are small and difficult to see.

Habitat

Chorus frogs inhabit grassy areas in dry to swampy situations in agricultural lands, forests, mountains and near lakes and riv-

ers (Behler and King 1979). They breed in shallow, temporary pools in the open and in deep, permanent waterbodies in dense forest (Stebbins 1966). This species hibernates under objects and under leaf litter close to breeding areas.

Flooded habitats (F) were preferred breeding habitats for chorus frogs in the present study. Second in preference as breeding habitat were the sedge wetlands (S/3, S/9). Coverage of the terrestrial plots from May to early September showed little movement of frogs away from breeding areas to more terrestrial habitats. The life of the boreal chorus frog appears to be carried out in a very small area. Observations during April are consistent with this impression. Frogs were heard calling from terrestrial habitat (B/1) in the first few days (16 - 18 April) following emergence from hibernation. Searches for the calling individuals lead to clumps of grass and clumps of buckbrush and grass located 2 to 20 m away from potential breeding habitat but no frogs were found. These frogs had begun calling before leaving their hibernation site. In the last days of August and first days of September, chorus frogs were heard calling from relatively dry sites such as among clover growing on roadsides (D) and from aspen forest (TA/1). Post-breeding habitats appear to be slightly drier zones around breeding ponds and hibernation habitats are drier than the post-breeding habitats. Breeding occurs in vegetation types F, S and SW and soil types 3 and 9. Following breeding, adults occupy additional vegetation types including B, W and G and soil types 1 and 6. For hibernation, the wetter summer vegetation types (F, S, SW, W) are abandoned and drier habitats found nearby are occupied (vegetation types TA, AP, BP; soil types 1, 2,

4, 5, 6, 7).

Griffiths (1971) reported that boreal chorus frogs were first seen annually between 15 and 22 April, called from 15 April until 30 June and were last seen annually on 7 September.

4.4 Wood Frog (Rana sylvatica) WOFR

Status and Distribution

Wood frogs occur throughout most of Canada except for the far north. They range from western Alaska east to Labrador and south to the southern Appalachian Mountains roughly following the distribution of spruce forests in North America (Stebbins 1966).

This frog is abundant and widespread in Elk Island National Park. During the present study, it was heard from most wetlands visited in late April and early May. Wood frogs were heard less frequently than boreal chorus frogs on wetland plots but wood frogs were observed more frequently than boreal chorus frogs on terrestrial plots. Wood frogs were observed 289 times on terrestrial plots while boreal chorus frogs were observed 23 times.

Habitat

The wood frog may be found in open, grassy areas bordered by willow thickets, aspen forests or tundra ponds in the northwest of its range. Elsewhere, it typically occurs in forests with small ponds. Breeding occurs in small ponds over a period of one or two weeks and then the adults disperse to more terrestrial habitats near the breeding ponds. Wood frogs hibernate under leaf litter, logs and stones (Stebbins 1966).

Flooded habitats (F) and sedge wetlands (S/3, S/9) were the preferred breeding habitats in Elk Island National Park. Temporary

ponds in aspen forest were used as breeding habitat by wood frogs but tended not to be used by boreal chorus frogs. Wood frogs began to appear in the terrestrial plots during the third search period (20 - 22 May); adults had apparently remained in wetland breeding habitats until mid-May. Two terrestrial plots in aspen forest (TA/2, AP/6), three willow plots (W/3, W/9, W/9) and the plot in disturbed habitat (D) had wood frogs during four to eight searches. Both aspen forest plots had sparsely vegetated, temporary ponds which dried to damp depressions by August. While all three willow plots were flooded in April, water levels had dropped by August and one plot had no standing water through most of the summer. The disturbed habitat (Moss Lake trail) included damp depressions with little vegetation and vegetation which was suppressed by trampling and/or mowing. The highest densities of frogs were observed in vegetation types D and W and soil types 2 and 9 on terrestrial plots. The implied high significance of soil type 2 is questionable because only one plot was used to sample this soil type and a wet depression on this plot, not entirely typical of soil type 2, was the source of all frog observations for the plot. There is also some doubt about the very high significance of vegetation type D; the high counts of frogs in this habitat may be purely indicative of its attractiveness or significance to wood frogs but high counts may also be due in part to the high visibility of frogs.

During the last search of the terrestrial plots in early September, frogs were recorded on the plots where they had been found most frequently through the summer. There was no evidence of a shift to new habitats in preparation for hibernation. A single frog was heard calling on 28 August 1986 from habitat mapped as

of S-F/9-1 (UTM: UQ778476); while this area was flooded some time ago, the area was found as a grassy meadow cut by stream channels which are wet only in spring and during rain storms. This calling frog may have spent the summer in this area but it may also have found that the dense growth of grass provided suitable cover for hibernation. A clearer indication of hibernation habitat was found in spring on 17 April 1986; wood frogs were heard calling from aspen forest (G11 TAo-B/6-1) and a search for these calling frogs found one already at a small temporary pond while the others, still presumably at their hibernation sites, could not be found in the forest leaf litter.

Griffiths (1971) reported the first annual sighting of wood frogs between 16 and 23 April, the calling period lasting from 16 April until 10 June and the last annual observation on 13 September.

4.5 Plains Garter Snake (*Thamnophis radix*) PLSN

Status and Distribution

The plains garter snake occurs in the prairie region of North America. In Canada, it occurs in the prairie and aspen parkland of Alberta, Saskatchewan and Manitoba (Cook 1984).

This snake is rare in Elk Island National Park and apparently restricted to the east and west boundary areas of the Isolation Area. A single observation was recorded in 1986; one snake was observed on 25 July where the creek leaving Goose Lake passes under Highway 16. During the summer of 1985, one snake was observed on two occasions on the boundary road along the east side of Goose Lake and one snake was observed on the county road along the west

side of the Isolation Area. No earlier observations of this species were recorded in CANSIS. The north and south zones of the park are well travelled by visitors and park staff relative to the Isolation Area but no observations of snakes have been recorded north of Highway 16.

Habitat

This garter snake frequents ponds, marshes, ditches, streams, meadows and woods near water during the summer. In winter, adult garter snakes usually find hibernacula near their summer habitat but occasionally travel considerable distances to their hibernacula. Hibernacula are often associated with karst topography but may also be found in other frost-free sites such as in piles of rock or debris or in burrows of ground squirrels.

Most observations in Elk Island National Park are from the area of Goose Lake. No hibernacula are known from this area, however, the burrows of ground squirrels found in this part of the park offer an opportunity as hibernation sites. This area also offers bare ground for basking and an abundance of frogs and grasshoppers for food.

4.6 Hypothetical Species

The boreal toad (*Bufo boreas*), also known as the western toad or northwestern toad, is a possible resident of Elk Island National Park. No observations of this species were recorded during the present study and no historical records were found in the park. (Records in CANSIS under species code NOTO are assumed to be Canadian toads.) The boreal toad has been found in bogs in the Edmonton region (W. Roberts pers. comm.). Although the range of this species

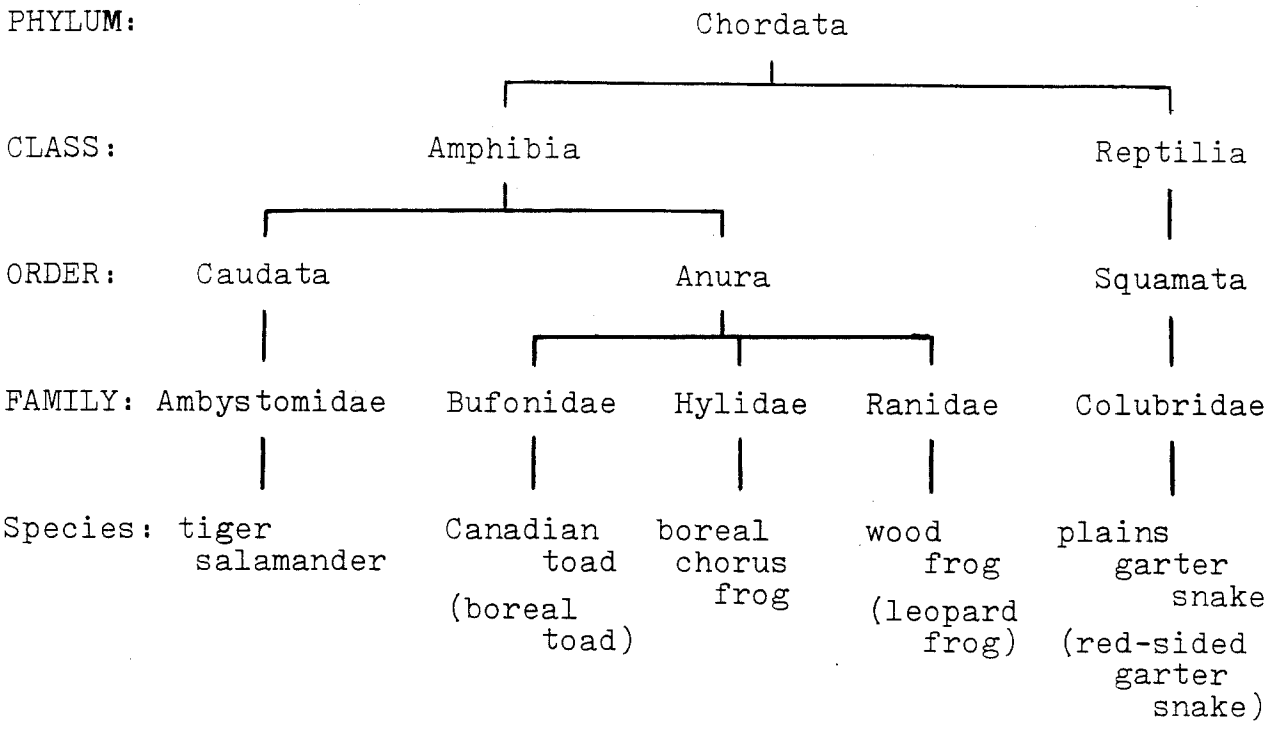
in Alberta generally does not reach east of the foothills of the Rockies, the range does extend east of Edmonton in the boreal forest to the north of the city (Cook 1984).

The leopard frog (Rana pipiens) was probably found in the park in the past and could still be a very rare resident or could return to the park in the future. No records of this species were found in the park and Griffiths (1971) noted that she had not seen this frog. The range of the leopard frog includes Canada and the United States. In Canada, it has been recorded from the Maritimes, much of Quebec and Ontario, across the prairies to the foothills of the Rockies and in the southern Northwest Territories and southeastern British Columbia (Cook 1984). Leopard frogs seem to have disappeared from much of their former range in northern and central Alberta and to survive in reduced numbers in the south of the province (W. Roberts pers. comm.). Cook (1984) attributed sudden population crashes to the rigours of the Canadian environment.

The common garter snake (Thamnophis sirtalis) is a possible resident or summer visitor in Elk Island National Park. The form which occurs in Alberta is also referred to as the red-sided garter snake. No observations were recorded during the present study, no observations were recorded in CANSIS and Griffiths (1971) provides the only recorded evidence for this species in the park - a colour slide of a snake identified as a common garter snake and presumably taken in the park. This garter snake occurs over a large range from the Maritimes west to Vancouver Island and from the southern Northwest Territories south to the southern United States. In Alberta, it occurs widely in the boreal forest. Elsewhere in the province its distribution is closely tied to wetlands.

5.0 TAXONOMY

The taxonomic relationship of the reptiles and amphibians of Elk Island National Park is shown below. Taxonomy follows Cook (1984). Hypothetical species in the park are enclosed by parentheses.



6.0 RECOMMENDATIONS

6.1 Critical Habitats

No habitat or site was considered critical in the present study. Wood frogs, boreal chorus frogs, Canadian toads and tiger salamanders are not concentrated in occurrence in the park and breeding, post-breeding and hibernation habitats are widely available. The significance of the Goose Lake area to garter snakes could not be determined due to the scarcity of observations. A hibernaculum of some size (more than 10 or 20 snakes) would be considered a critical habitat if no other hibernacula are known.

With an abundance of habitat in the park, weather is probably the most important factor for amphibian and reptile populations. Annual variations in population size are most often related to winter mortality. Long winters with deep frost penetration are associated with low survival from hibernation. Also periods of drought, particularly in spring, could reduce the survival of the young of the year.

Predation does not pose a significant threat to reptile and amphibian populations. Predators such as hawks and water-related mammals and birds (e.g. mink, muskrat, herons, gulls) are highly mobile and while they may dampen population growth, they would switch to alternate prey before seriously depleting one prey species. (Similarly, amphibians prey on a number of species of insects but extinction of insect species should not occur as a result of predation by amphibians.)

6.2 Monitoring

A monitoring program is not a necessity. Wood frogs and boreal

chorus frogs are abundant, secure and therefore not in need of monitoring. Canadian toads and garter snakes are rare and tiger salamanders are uncommon; habitat suitable for these species is generally found throughout the park and a monitoring program for such species would be very labour intensive.

While a monitoring program for reptiles and amphibians is not a priority, a program may be desired to monitor long term population trends. (The widespread disappearance of leopard frogs in Alberta or the apparent decline in numbers of Canadian toads in central Alberta could be sufficient justification for a monitoring program.) If a monitoring program is desired and labour is available, a simple survey should be sufficient to monitor amphibian populations. One possible survey method would be similar to that of the wetland survey of the present study. A series of 20 or more wetlands, or portions of wetlands, would be checked for the calls of amphibian species in late April. Presence or absence of species would be determined at each sample site rather than numbers of each species (Estimations of numbers are too variable). Annual repetition of such a survey would require the use of the same wetlands, sampling at the same time of day, sampling on similar dates, sampling under similar weather conditions and using the same time period for listening and searching at each site. Surveys would be compared on the basis of the percentage of wetlands occupied by each species. Time involved would include one day to define the wetlands to be surveyed and one day annually to conduct the survey. An alternative monitoring method would be a road-based survey. The observer would travel a section of the park roads in June on a wet evening. Amphibians observed on the

road would be counted. Survey methods would be established during the first survey - method and speed of travel, time of day, date and road section. Surveys would be compared on the basis of the tallies for each species. One day would be needed to find a suitable section of road and to work out the details of the sampling method. The survey would require about one half day but would vary with the sample size (road length), observer proficiency at identification and the details of the sampling method.

6.3 Further Study

No specific studies demand immediate attention. However, additional information on the reptiles and amphibians of the park would be valuable. The recording of useful observations should be encouraged. Specifically, useful observations would include observations of amphibians as they emerge from hibernation in mid-April toward a better understanding of habitats used for hibernation, observations of breeding activity and tadpoles of tiger salamanders and Canadian toads toward a better understanding of the breeding habitats of these species, observations of adult salamanders toward an improved understanding of their post-breeding or summer habitat (Excavations left open at night present an opportunity to check for salamanders.) and observations of snakes both in and around the park toward locating hibernacula and defining their range in the park. While radio telemetry can be used to follow snakes, this method is more appropriate for home range studies than to follow snakes to their hibernacula. (Snakes which are equipped with radio transmitters are force-fed the transmitters and the transmitter remains in the snake for a limited period of time.) Owners of land around the park may be aware of hibernacula

or locations where snakes are frequently seen. Opportunities to tap the knowledge of residents living near the park should be exploited.

Management of breeding habitats could be perfected through a study of the microhabitats where egg masses are laid. Frogs seem to call from many wetland habitats in spring but egg masses are not found everywhere. The perception that frogs preferred recently flooded habitat over wetlands which have been flooded for longer periods of time could be investigated.

6.4 Legend of Habitat Use

The legend of habitat use is intended to provide a quick reference to the habitats used by the reptiles and amphibians of the park. Only the five species known to occur in the park at the present time are treated. The significance of habitat types was interpreted primarily from collected data (wetland and terrestrial plots, casual observations) but also from published descriptions of habitat preference. Habitat use was rated high (H) in preferred breeding habitats, moderate (M) in other breeding habitats also used during the post-breeding season and low (L) in habitats where low numbers may be found at any time of the year. Blanks indicate habitats which are avoided or for which no evidence of use has been recorded.

HABITAT	TIGER SALAMANDER	CANADIAN TOAD	BOREAL CHORUS FROG	WOOD FROG	PLAINS GARTER SNAKE
TA/1	L	L		L	
TA/2	L	L		L	
TA/4	L	L		L	
TA/5	L	L		L	
TA/6	L	L		L	

Legend of Habitat Use continued.

HABITAT	TIGER SALAMANDER	CANADIAN TOAD	BOREAL CHORUS FROG	WOOD FROG	PLAINS GARTER SNAKE
TA/7	L	L		L	
AP/1	L	L		L	
AP/4	L	L		L	
AP/6	L	L		L	
AP/7	L	L		L	
BP/1	L	L	L	L	
BP/4	L	L	L	L	
BP/6	L	L	L	L	
WB/1	L	L			
WB/2	L	L			
WB/6	L	L			
WB/8					
WB/9	L	L		L	L
WS/1					
WS/2					
WS/4					
WS/6					
BS/8				L	
B/1	L	L	L	L	L
B/4	L	L	L	L	L
B/6	L	L	L	L	L
W/2	L	L	L	L	L
W/3	M	M	M	M	L
W/9	M	M	M	M	L
LT/8			L	L	
LT/9		L	L	L	
AG/10					
G1/1	L	L	L	L	L
G1/4	L	L	L	L	L
G1/6	L	L	L	L	L
G1/10					
G2/1	L	L	L	L	L
G2/4	L	L	L	L	L
G2/6	L	L	L	L	L
S/3	H	H	H	H	L
S/9	H	H	H	H	L
SW/3	M	M	M	M	L
SW/8	M	L	L	L	L
SW/9	M	M	M	M	L
C/3	L	L	L	L	
C/9	L	L	L	L	
D/1	L	L	L	L	M
D/6	L	L	L	L	M
D	L	L	L	L	M
F/3	H	H	H	H	L
F/8	L	L	L	L	
F/9	H	H	H	H	L
MF/3	L	M	M	L	L
Wa	L	L	L	L	

7.0 LITERATURE CITED

Behler, J.L. and F.W. King. 1979. The Audubon Society field guide to North American reptiles and amphibians. Alfred A. Knopf Inc., New York. 743pp.

Burns, G.R. and N.L. Cool. 1984. A biophysical inventory of the non-ungulate mammals of Elk Island National Park. Prep. for Parks Canada, Calgary by Can. Wildl. Serv., Edmonton. 195pp.

Burns, G.R., R.M. Wershler, N.L. Cool and J.A. Williams. 1986. A biophysical inventory of the birds of Elk Island National Park. Prep. for Parks Canada, Calgary by Gordon R. Burns, Edmonton. 490pp.

Cook, F.R. 1984. Introduction to Canadian amphibians and reptiles. Nat. Mus. Canada, Ottawa. 200pp.

Crown, P.H. 1977. Soil survey of Elk Island National Park. Prep. for Parks Canada, Calgary by Soil Research Institute, Agriculture Canada, Edmonton. 128pp.

Griffiths, D.E. 1971. letter of 21 July 1971 to Dr. F.R. Cook, Curator of Herpetology, National Museum of Natural Sciences, Ottawa describing the status of reptiles and amphibians in Elk Island National Park. Park files.

Hardy Associates (1978) Ltd. 1986. Ecological land classification of Elk Island National Park. Prep. for Parks Canada, Elk Island National Park by Hardy Associates (1978) Ltd., Calgary. 44pp+Appendices+Maps.

Kemper, L. 1974. Water-oriented birds of Elk Island National Park. Prep. for Parks Canada, Calgary by Can. Wildl. Serv., Edmonton. 101pp.

Polster, D.F. and L.E. Watson. 1979. Vegetation classification and evaluation - Elk Island National Park. Prep. for Parks Canada, Calgary by Techman Ltd. 137pp+maps.

Stebbins, R.C. 1966. A field guide to western reptiles and amphibians. Houghton Mifflin Company, Boston. 270pp.

Appendix 1. TERMS OF REFERENCE

INVENTORY OF AMPHIBIANS AND REPTILES

1. INTRODUCTION

This contract covers the provision of all professional, technical, and other services necessary to complete an inventory of the reptiles and amphibians of Elk Island National Park.

The inventory will include all reptilian and amphibious species presently and/or historically occurring within the park.

Results of this study will be utilized in planning, interpretation and management of the park resource.

2. OBJECTIVES

2.1 To determine the status, distribution, relative abundance, and habitat requirements of each species.

2.2 To identify monitoring methodologies suitable for predicting population trends and future status of each species.

2.3 To present the results of field study and literature review in a concise, comprehensive final report. Tables, figures, photos, graphs and maps will be used to enhance the report. (An annotated bibliography will be included to summarize all literature sources reviewed).

2.4 To identify any further work or study requirements beyond the scope of this project that are deemed necessary for the successful maintenance of the resource within the park.

3. PROJECT AREA

The project area comprises all lands within the gazetted boundaries of Elk Island National Park (refer to N.T.S. topo. map sheet 83 H/10 Elk Island Park) and including the Shirley Lake addition.

Field study and mapping may extend beyond park boundaries only where necessary, if permission is granted by the agencies responsible -- and providing scope and quality of the project do not suffere because of it.

4. PROJECT REQUIREMENTS

4.1 Literature Review

The contractor will review all pertinent literature related to amphibians and reptiles for the park and surrounding area. The review will be

4.1 cont.

limited to the Province of Alberta. Literature that relates to areas outside of Alberta and is significant to Elk Island, will be included.

Information will be assembled into an annotated bibliography and will be submitted with the final report.

4.2 Field Work

The contractor will conduct field surveys and investigations as required to meet the objectives of this project. Methods and techniques used, will follow accepted practices, and will be selected for their particular suitability to this project.

Data collected will include, but not be restricted to:

- a systematic survey to determine diversity and relative abundance of reptiles and amphibians in each of the park's biophysical units (as per Hardy, 1985).

- identification of rare and/or unique species, and of associated critical habitats.

The sampling program will be determined by the contractor and approved by Resource Conservation, E.I.N.P.

4.3 Monitoring Methodologies

The contractor will review current census techniques for reptiles and amphibians in terms of their limitations and usefulness, and will propose a monitoring program specific to the resource within Elk Island National Park. This program will be based on field activities and will include:

- optimum frequency of survey(s),

- timing of survey(s), i.e. spring, fall,

- checklist of species to be treated in the survey(s) and identifying key or indicator species,

- recommendation of suggested locations or specific sites to be monitored, which will be permanently marked and identified at the site and on a map included in the report,

- list of sampling methodology and observational techniques,

- all survey data should be codeable on Parks Canada Wildlife Survey Cards for computer storage of information,

4.3 cont.

- total manpower and equipment requirements to carry on this monitoring, and

- level of expertise required to carry out the monitoring.

6. SUBMISSION REQUIREMENTS

6.1 Progress Report

The field season will be broken up into two seperate units:

6.1.1 Spring Survey (April 7th to June 6, 1986)

A detailed project outline, including a proposed time action schedule will be submitted to the contract supervisor with a copy to the field supervisor on or before April 31, 1986.

6.1.2 A progress report will be submitted to the contract supervisor with a copy to the field supervisor on or before June 6, 1986.

6.1.3 Fall Survey (August 18th - 29th, September 15th - 30th

No progress report required.

6.2 Final Report

The final report will analyze data collected and methods used, will make recommendations for management, conservation and further study and present all data in the specified format.

The contractor will submit a final, unbound report on or before September 30, 1986.

The text of the final report should fulfill the objectives and include, but not be limited to:

- title page
- an abstract
- table of contents
- introduction
- copy of Terms of Reference
- description of sampling and monitoring methodologies
- literature review and annotated bibliography
- its status and distribution, relative abundance in the park both regionally and historically
- recommendations for management for National Parks

6.2 cont.

- recommendations for further study, if required
- any illustrative materials, such as figures, graphs or photos, air photos or even specimens
- species checklist
- map outlining transects and/or sample plots surveyed
- species legend portraying seasonal use of habitat with respect to breeding, brooding, migrating, hibernating.

6.3 Scale Map(s)

All maps are to be prepared as overlays registered to the base "Ecological Land Classification Map", Elk Island National Park. All maps must be drafted to cartographic standards and be suitable for black/white reproduction.

In addition to resource information, all maps will contain:

- an informative and appropriate title
- an adequate scale, North arrow and legend
- appropriate registration marks to the base map
- reference to title and date of submitted report.

Parks Canada will provide copies of the Biophysical Base Map, at a scale of 1:7,500, delineating park boundaries, to the contractor at the commencement of the project.

7. SCHEDULE OF PAYMENTS/CONTRACT COST

7.1 On submission of satisfactory project outline, required by section 6.1.1. . . . . 27%

7.2 On submission of satisfactory progress report, required by section 6.1.2. . . . . 40%

7.3 On submission of final report, required by section 6.2 and upon satisfactory completion of all contract requirements on or before September 30, 1986 . . . . . 33%

7.4 Contract Cost

Contractor's Wages - $139.23 per day

67 working days = $139.23 x 67 =

Total Contract Cost = $9,328.41.

8. SPECIAL CONDITIONS

8.1 The contractor shall agree not to transfer the responsibility to a third party without the consent of Parks Canada.

8.2 The principal contractor shall be: Gordon R. Burns.

8.3 The project manager shall be:

Jack Willman, C.P.W.
c/o Superintendent
Elk Island National Park
Site 4, R. R. 1
Fort Saskatchewan, Alberta
T8L 2N7

All inquiries and submission of materials will be made to her at the above address.

8.4 The Field Supervisor shall be:

Normand Cool
c/o Jack Willman, C.P.W.
Elk Island National Park
Site 4, R. R. 1
Fort Saskatchewan, Alberta
T8L 2N7

8.4.1 The contractor shall inform the field supervisor in advance, of the date of arrival at the park and shall make arrangements so that the field supervisor is kept informed of progress while personnel are in the field.

8.4.2 At the commencement of field work, the contractor shall meet with the field supervisor and such park staff as he designates to review his plans for the season.

8.4.3 Prior to leaving the park after the field season, the contractor shall meet with the field supervisor to review progress and inform him or any important results to date.

8.4.4 The contractor will incorporate into the field team at least one (1) Park Warden and shall instruct the Warden in any techniques or methodologies which might be required to supplement or update the data.

8.4.5 Upon completion of the final report, the contractor will give an in-house seminar on the project to provide all interested park personnel with a better understanding of the results, purposes or methodologies of the study.

8.5 The contractor shall supply all equipment and materials required for the study unless otherwise agreed to by the project supervisor, except where specifically noted in this contract.

8.6 The final report will be professionally adequate in content, presentation, and terminology and of a quality that it could, at the discretion of the Director General, Parks Canada, be published. The reports and other illustrative materials are the property of the Government of Canada.

8.6.1 On this section:

"Copyright Work" means any work in which a copyright may submit, produce in or as a result of performing the contract.

"Publication" or "publish" do not include disclosure to an academic supervisor or appraiser for the sole purpose ofacademic evaluation.

8.6.2 Copyright in any work rests in Her Majesty, but in any publication of such work by or on behalf of Her Majesty, the contribution of the contractor and of the author shall be acknowledged.

8.6.3 The contractor, and the author, each shall have a royalty free, non-exclusive licence to publish or have published any copyright work in the course of the normal dissemination of knowledge in the subject field, but they shall not publish or have published any copyright work during the performance of the contract or for a period of three months, thereafter, without the prior written consent of the Minister.

8.6.4 Any copyright work published by or on behalf of the researcher or the author shall acknowledge that the work was performed under the contract with Her Majesty, represented by Parks Canada, unless the Minister gives notice to the contrary.

8.6.5 The copyright and all proprietory rights or ownership or use of any and all slides, photographs - positives and/or negatives, sketches or other illustrations made, or taken by the contractor in any way related to the work to be performed under this contract shall belong to Her Majesty the Queen in right of Canada.

8.7 Collection of specimens under the contract agreement will be strictly limited to those specified on the Collecting Permit.

8.8 The contractor shall be allowed access to reports in the Research and Resource Inventory collection which pertain to the project and where necessary, may be provided pertinent information from Branch files.

8.8 cont.

Such material is located at Branch Headquarters, Regional Office and Park Offices and shall be utilized at these places.

8.9 The contractor shall be granted vehicle access to all roads within the park for the purpose of field work as necessary to complete this contract.

8.10 Work space or housing will not be made available within the park for the principal researcher.

Appendix 2. Experimental use of an Electroshocker to sample amphibian populations.

The use of an Electroshocker was proposed to sample amphibian populations in deep water and dense vegetation situations. (A method of visually searching for amphibians in marshes, sedge wetlands and beaver ponds was rejected because amphibians hide as an observer approaches and vegetation density does not permit observation from a distance.) It was hoped that amphibians hiding on pond bottoms or among dense aquatic vegetation would swim to the surface of the water and toward the Electroshocker.

The effectiveness of an Electroshocker was tested on 7 May 1986. Two small ponds were located where many frogs were calling. As the observers approached the ponds, the frogs became silent and could not be seen. No frogs became visible when the Electroshocker was activated in spite of an extensive sweep of areas where the frogs had been calling. A boreal chorus frog and a wood frog were found by the observers and their behaviour was observed as the Electroshocker was activated. Instead of swimming when current was applied, the legs of the frogs stretched out and remained rigid until after the current was turned off. The frogs recovered in a few seconds and continued their escape attempts. The range of the Electroshocker appeared to be limited to a distance of less than one metre from the electrodes. The Electroshocker also appeared to be less effective on the large body of the wood frog as compared to the small body of the boreal chorus frog.

Appendix 3. Locations of terrestrial plots with habitat notes.

1. TA/1, Isolation Area at UTM UQ736354. Found 1.4 km south of the gate on the Isolation Area road (50 m north of a wooden culvert marked by yellow posts) and 54 m at 97° from the centre of the road. Centre line of the plot on 90° bearing. Temporary water source near plot, permanent water source over 50 m away.

2. TA/2, Isolation Area at UTM UQ708352. Found 1.9 km south of the northwest corner of the Isolation Area, 50 m east from the boundary fence along an old cutline and 5 m south from the south edge of the cutline. Centre line of the plot on 180° bearing. Temporary water source on plot, permanent water over 100 m away.

3. TA/4, Isolation Area at UTM UQ708346. Found 2.6 km south of the northwest corner of the Isolation Area (A fence running east-west is found outside of the park.) and 30 m east from the boundary fence. Centre line of plot on 90° bearing. Temporary water source adjacent to plot, permanent water over 50 m away.

4. TA/5, Isolation Area at UTM UQ753322. Found 200 m north of the Isolation Area Warden Station, east along an old cutline 400 m past the drainage which intersects the cutline and 10 m south. Centre line of plot on 180° bearing. Nearest water source (permanent) is over 50 m away.

5. TA/6, South zone at UTM UQ783385. Found 10 m at 270° bearing from the speed limit sign (60 kmph) located by the turnaround south of the park's south gate. Centre line of plot on 270° bearing. No water on plot but roadside ditch is a temporary water source.

6. TA/7, North zone at UTM UQ763530. Found 400 m south of the northwest corner of the park and 31 m east of the boundary fence. Centre line of plot on 90° bearing. Damp depression on plot but no permanent water source within 100 m of plot.

7. AP/6, South zone at UTM UQ804413. Found 75 m on 330° bearing from the drill pipe located on the northeast side of a clump of about 90 aspen trees in the Soapholes grassland. (A blind is located in this clump of aspens.) Centre line of plot on 330° bearing. Temporary water sources are located in and around the

plot but permanent water sources are over 100 m away.

8. BP/1 (small stand of balsam poplar located in a TA/1 polygon), South zone at UTM UQ711397. Found 400 m south of the culvert under the county road beside Oxbow Lake and 56 m from the boundary fence on a 94° bearing. Centre line of plot on 74° bearing. Temporary water source located on plot, permanent water found less than 50 m away.

9. WB/6, South zone at UTM UQ729427. Found 50 m west of the intersection of trail #9 and the road which passes just north of Adamson Lake and 10 m south of the south road edge. Centre line of plot on 200° bearing. Temporary water source less than 30 m away, permanent water source (Adamson Lake) about 50 m away.

10. WB/9, South zone at UTM UQ773426. Found 750 m north along the Parkway from the intersection with the Tawayik Road and 43 m at a 60° bearing from the east edge of the paved surface. Centre line of plot on 64° bearing. Temporary water source located less than 20 m from plot, permanent water located about 50 m from plot.

11. WS/6, North zone at UTM UQ776481. Found 50 m north of a concrete pad located roughly in the middle of Elk Island. Centre line of plot on 200° bearing. Closest water source (Astotin Lake) less than 50 m from plot.

12. BS/8, North zone at UTM UQ771455. Found along the Parkway 1.7 km south of the intersection with the Administration Road and 50 m at 50° bearing from the east edge of the paved surface. Permanent water source less than 50 m from plot.

13. B/1, North zone at UTM UQ766458. Found along the Parkway 1.1 km south of the intersection with the Administration Road (north edge of clearing on west side of Parkway) and 230 m at 250° bearing. (Start of plot was 20 m downslope from the forest edge.) Plot centre line on 245° bearing. A seepage area is located about 25 m downslope from the plot, permanent water is about 50 m from the plot.

14. B/6, North zone at UTM UQ762478. Found 178 m at 273° bearing

from the southwest end of the culvert under the Administration Road at the southwest corner of Astotin Lake. Centre line of plot on 300° bearing. A beaver pond located less than 50 m downslope from the plot was drained in May 1986 just before the first search of the plot.

15. W/3, Isolation Area at UTM UQ806368. Found 40 m (or 11 fence posts) north of the angle in the paige wire boundary fence at UTM UQ805367 and 18 m at 50° bearing. Centre line of plot on 90° bearing. A small permanent pool of water is found on the plot and the willow habitat is surrounded by a sedge wetland with some standing water. This area was flooded in August - September 1986 when beaver dams were removed elsewhere in the park.

16. W/9 (mapped as W/6), Isolation Area at UTM UQ804372. Found 50 fence posts west of the northeast corner of the Isolation Area and 47 m at 202° bearing from the boundary fence. Centre line of plot on 232° bearing. Water is found on the plot and surrounds the willow habitat. This area was flooded in August - September 1986 when beaver dams were removed elsewhere in the park.

17. W/9, Isolation Area at UTM UQ737358. Found 0.9 km south of the gate on the Isolation Area road and 25 m at 113° bearing from the east edge of the road at the southern of two culverts. Centre line of plot on 150° bearing. Areal extent of standing water on the plot varied over the sampling season from 40% in May to no standing water in August - September.

18. LT/8, North zone at UTM UQ768453. Found along the Parkway 1.75 km south of the intersection with the Administration Road and 34 m at 230° bearing from the centre of the road. No water is found on the plot but a temporary pool is located between the road and the plot.

19. AG/10, South zone at UTM UQ803410. Found at the Soapholes 88 m at 221° bearing from the drill pipe located on the northeast side of a clump of about 90 aspen trees. (A blind is located in this clump of trees.) The centre line of the plot travels

northwestward curving and following the boundary between the AG and G1 vegetation types. Upwelling water is found on a portion of the plot and a permanent water source is found less than 50 m from the plot.

20. G1/6, South zone at UTM UQ781381. Found on a bearing of 280° from the northwest corner of the Information Centre and 295 m measured from the west edge of the Parkway. Centre line of plot on 270° bearing. No water on plot and nearest temporary water source is over 50 m away.

21. G1/10, South zone at UTM UQ805411. Found at the Soapholes. The plot starts at the drill site located on the northeast side of a clump of about 90 aspen trees. (A blind is located in this clump of trees.) Centre line of plot on 64° bearing. Temporary water source is located about 50 m from the plot and a permanent water source is found about 100 m from the plot.

22. G2/6, South zone at UTM UQ789399. Found 100 m east of the northwest corner of the north hay meadow and 25 m south of the fence. Centre line of plot on 180° bearing. Temporary water source in sedge-covered depression is less than 50 m west of the plot.

23. S/9, Isolation Area at UTM UQ802372. Found 86 fence posts west of the northeast corner of the Isolation Area and 36 m south of the fence. Centre line of plot on 285° bearing. Standing water covers 5 to 25% of the plot. About 90% of the plot was flooded in August - September when beaver dams were removed elsewhere in the park.

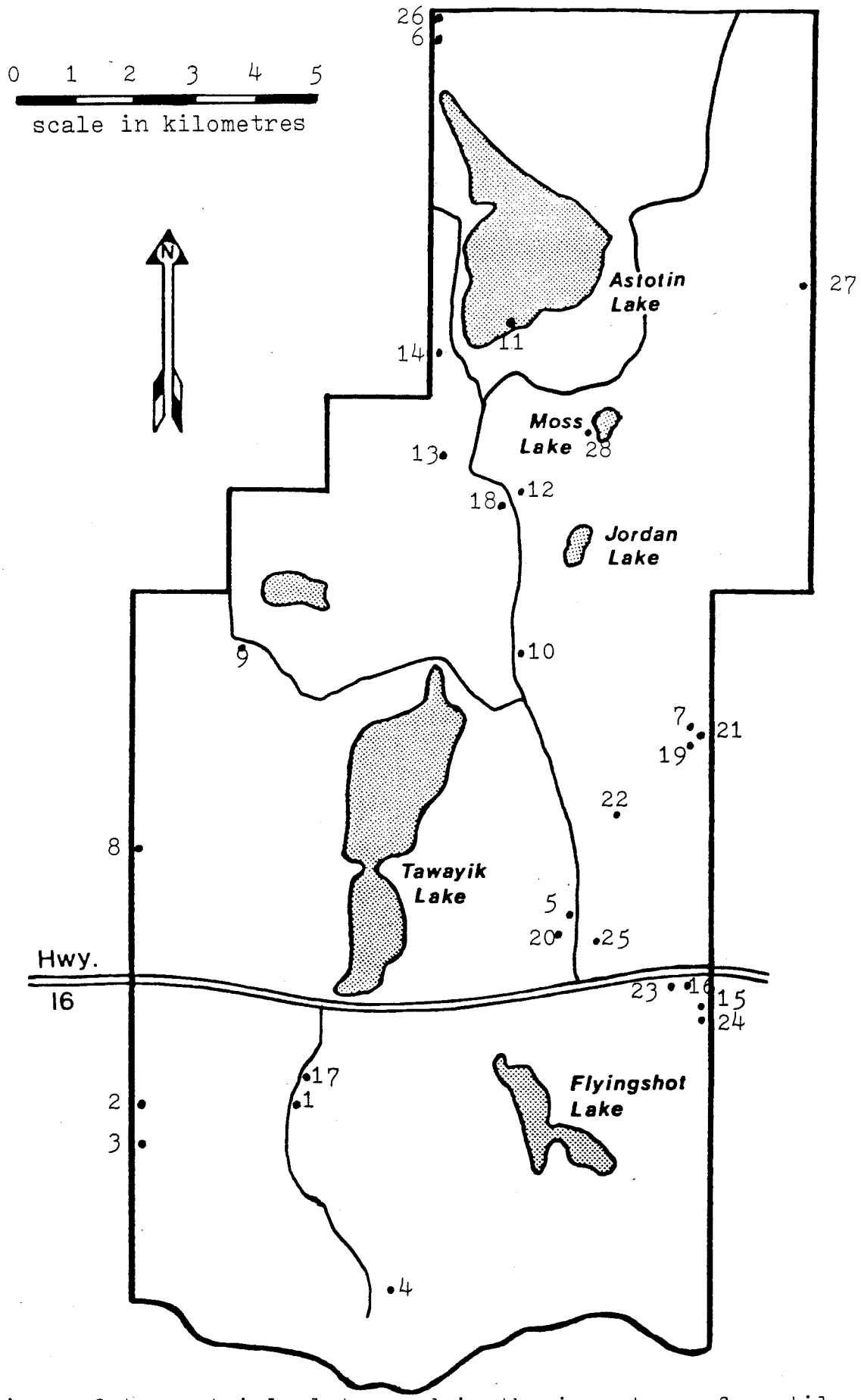
24. S/3 (mapped as MF/3), Isolation Area at UTM UQ806367. Found 25 m at 38° bearing from the angle in the paige wire boundary fence at UTM UQ805367. Centre line of plot on 173° bearing. Open water (Goose Lake) is about 50 m from the plot. Standing water covers 10 to 40% of the plot in spring or early summer. In August - September 1986, the plot was flooded when beaver dams were removed elsewhere in the park.

25. SW/9, South zone at UTM UQ786379. Found 52 m at 160° bearing from the southwest corner of the horse barn. Centre line of plot on 175° bearing. Temporary pools of water in and around plot.

26. F/3, North zone at UTM UQ763533. Found 49 m at 166° bearing from utility pole located at the northwest corner of the park. First 23 m of centre line of plot on 90° bearing and final 27 m on 96° bearing. The plot is intersected by water-filled beaver channels and is located on the edge of an active beaver pond. Water levels rose slowly over the sampling season; 20% of plot was under water in May while almost 50% was under water in August.

27. MF, North zone at UTM UQ824487. This area was a sedge-willow wetland, was flooded by beaver, was drained by park wardens prior to the present study and was revegetated by sedges by the end of the summer of 1986. Found 1.2 km south of the AGT tower on the park's east boundary, 9 m south of the culvert under the county and park boundary roads and 19 m west of the boundary fence. Centre line of plot is due north. Water from the culvert drains across the plot. Ponds of permanent water are located less than 50 m from the plot.

28. D, North zone at UTM UQ792466. The plot is located on the east-bound path of the Moss Lake trail starting 50 m at 104° bearing from the point where the trail branches to the east and south. The trail branches in a meadow located about 300 m from the trailhead. The start of the plot is located beside the first tree (aspen) on the right side as the trail leaves the meadow. The plot follows the trail for 150 m and is 3 m wide. Permanent water source (Moss Lake) less than 50 m from plot.



Locations of terrestrial plots used in the inventory of reptiles and amphibians of Elk Island National Park, April - September 1986.

Appendix 4. An annotated bibliography of literature on reptiles and amphibians relevant to Elk Island National Park.

Publications reviewed for this bibliography were found in the Cameron Library of the University of Alberta or the library of the Canadian Wildlife Service, both in Edmonton. Literature cited in this bibliography is certainly not complete but focuses on species found or studies conducted in western Canada. References are listed in alphabetical order by author.

Alberta Educational Communications Corporation. 1983. Frogs and toads. Access, Edmonton. 15 minute cassette tape.

The eight species of frogs and toads occurring in Alberta are described and identified by call.

Behler, J.L. and F.W. King. 1979. The Audubon Society field guide to North American reptiles and amphibians. Alfred A. Knopf Inc., New York. 743pp.

Identification, breeding biology, habitat, range, subspecies and diet of reptiles and amphibians occurring in the United States and Canada are described. Range maps are included and species are illustrated in colour plates.

Bellis, E.D. 1959. A study of movement of American toads in a Minnesota bog. Copeia 1959:173-174.

Toads (Bufo terrestris) were studied by mark-and-recapture methods in a Minnesota bog. Most toads remained in a restricted area during the summer. Mean daily movement between capture sites for 27 toads was 4.08 yards.

Bellis, E.D. 1962. The influence of humidity on frog activity. Am. Midl. Nat. 68:139-148.

Wood frog activity was studied in summer in a spruce-tamarack bog in Minnesota. They were mainly diurnal with activity peaks in mid-morning and late afternoon. Frog activity in the morning varied inversely with vapour pressure deficit. Activity increased with increasing light intensity in the morning, during rainfalls and after rainfalls.

Bellis, E.D. 1965. Home range and movements of the wood frog in a northern bog. Ecology 46:90-98.

Wood frogs were studied in a Minnesota bog by mark-and-recapture methods. Mean home range was 77.2 sq. yd. and was highly variable. Seventy-eight percent of recaptures over winter had moved 32 yd. or less. Young-of-the-year frogs moved into the study area from upland ponds in July - August.

Bishop, S.C. 1947. Handbook of salamanders. Comstock Publishing Co. Inc., Ithaca, N.Y. 555pp.

This is a detailed text describing the salamanders of North America. Subspecies are described in terms of range, habitat, size, identification, breeding and development. Taxonomic keys to the Families and Genera are included.

Blanchard, F.N. 1933. Late autumn collections and hibernating situations of the salamander Hemidactylium scutatum (Schlegel) in southern Michigan. Copeia 1933:216.

Concentrations of several amphibian species and a snake were found while a search for hibernacula of the four-toed salamander was being conducted. The species found included chorus frogs, wood frogs and a garter snake (T. sirtalis).

Breckenridge, W.J. and J.R. Tester. 1961. Growth, local movements and hibernation of the Manitoba toad, Bufo hemiophrys. Ecology 42:637-646.

This Minnesota study investigated the ecology of the Manitoba toad on prairie habitat. Most animals lived near ponds where they tended to stay in one small area before moving to a new area. Eighty-four percent of daily movements were of 100 feet or less. Toads hibernated in upland sites 75 to 115 feet from pond edges. Most toads used earth mounds, such as those created by pocket gophers, for hibernacula.

Carpenter, C.C. 1953. A study of hibernacula and hibernating associations of snakes and amphibians in Michigan. Ecology 34: 74-80.

Hibernacula were found during studies of garter snakes in Michigan. Hibernacula included an ant mound, crayfish burrows and a vole tunnel. Species found in these hibernacula included Thamnophis sirtalis, T. butleri, Ambystoma jeffersonianum, Pseudacris nigrita and Bufo americanus.

Cook, F.R. 1984. Introduction to Canadian amphibians and reptiles. Nat. Mus. Canada, Ottawa. 200pp.

Identification and range of reptiles and amphibians in Canada are described for both species and subspecies. Range maps and drawings of species are included. Maintenance of reptiles and amphibians as pets is described.

Cook, F.R. 1970. Rare or endangered Canadian amphibians and reptiles. Can. Field-Nat. 84:9-16.

One hundred and ten forms and 84 species of amphibians and reptiles occur in Canada and 29 forms are considered rare or endangered, usually because of loss of habitat. An annotated list of the endangered species is presented. No forms which occur in Elk Island National Park are listed.

Fitch, H.S. and H.W. Shirer. 1971. A radiotelemetric study of spatial relationships in some common snakes. Copeia 1971: 118-128.

Radio transmitters were force-fed to eight species of snakes and the movements of the snakes were followed on a daily basis. Thamnophis sirtalis travelled an average of 8 m between daily determinations of location.

Gosner, K.L. and I.H. Black. 1957. The effects of acidity on the development and hatching of New Jersey frogs. Ecology 38:256-262.

This study examines pH as a factor restricting the breeding of frog species. Embryos of different species varied in their response to acid water; some showed abnormal embryonic development. It was concluded that acid water of some bogs and swamps is a factor excluding breeding by some frog species.

Gregory, P.T. 1974. Patterns of spring emergence of the red-sided garter snake (Thamnophis sirtalis parietalis) in the Interlake region of Manitoba. Can. J. Zool. 52:1063-1069.

Activity at hibernaculum sites of red-sided garter snakes was studied in spring in Manitoba. A one and one half month period was characterized by intense mating activity and a majority of males over females.

Gregory, P.T. 1977. Life history observations of three species of snakes in Manitoba. Can. Field-Nat. 91:19-27.

Data on seasonal activity, diets, body size and age classes and aspects of reproduction in T. radix, Storeria and Opheodrys were collected during studies of T. sirtalis in Manitoba. Characteristics studied varied little with those found in other parts of the species' range.

Gregory, P.T. and K.W. Stewart. 1975. Long-distance dispersal and feeding strategy of the red-sided garter snake (Thamnophis sirtalis parietalis) in the Interlake of Manitoba. Can. J. Zool. 53:238-245.

Summer movements and feeding habits of the red-sided garter snake were studied in Manitoba. Distances of up to 17.7 km between hibernation sites and summer range were recorded. The wood frog was the main item in the diet.

Groombridge, B. 1981. World checklist of endangered amphibians and reptiles. Wildlife Advisory Branch, Nature Conservancy Council, London. 63pp.

Endangered species of reptiles and amphibians of the world are listed. No species occurring in Elk Island National Park are listed.

Harper, F. 1931. Amphibians and reptiles of the Athabaska and Great Slave Lake region. Can. Field-Nat. 45:68-70.

Observations of amphibians and reptiles are described from trips in 1914 and 1920 from Edmonton north to Great Slave Lake. Canadian toads were noted at Edmonton, Rochester, Athabaska Landing, Firebag River and Athabaska Delta. Chorus frogs were noted at Edmonton, along the Athabaska River and Lake Athabaska. The common garter snake was noted at Edmonton, near the Birch Mountains and Fort Smith.

Heatwole, H. 1961. Habitat selection and activity of the wood frog, Rana sylvatica Le Conte. Am. Midl. Nat. 66:301-313.

Habitat selection of wood frogs was studied in Michigan. Habitat used in the non-breeding season was described as combining a forest canopy with small ponds. They occur along pond edges. When the ponds dry up, they move under the leaf litter of the forest floor.

Hodge, R.P. 1976. Amphibians and reptiles in Alaska, the Yukon and Northwest Territories. Alaska Northwest Publishing Co., Anchorage. 89pp.

This is a popular account of the reptiles and amphibians of northern North America. Notes on life history, distribution, adaptations to northern regions, legends about herpetiles in the north and checklists of species occurring in Alaska and in the Yukon and Northwest Territories are included. Species are described in terms of identification, distribution in the north, habitat and voice.

Kelleher, K.E. and J.R. Tester. 1969. Homing and survival in the Manitoba toad, Bufo hemiophrys, in Minnesota. Ecology 50:1040-1048.

Emergence from hibernation, homing to hibernation sites and populations of Manitoba toads were studied in Minnesota. Annual survival of toads ranged from 24 to 44%. Juveniles had the highest mortality rates and years with deepest frost penetration had the highest mortalities among toads. Toads returned to hibernate at the same site 88 to 95% of the time.

Kramer, D.C. 1973. Movements of western chorus frogs Pseudacris triseriata triseriata tagged with Co^{60}. J. Herpetology 7:231-235.

Movements of chorus frogs between March and August were studied in Indiana. Most animals remained within 100 m of breeding pools. Two out of 324 moved over 200 m. Mean daily rate of movement was 3.5 m.

Frogs remained hidden in leaf litter during the day and were active between dusk and dawn.

Kramer, D.C. 1974. Home range of the western chorus frog Pseudacris triseriata triseriata. J. Herpetology 8:245-246.

Home ranges of chorus frogs captured 10 or more times (N=9, all males) had minimum area home ranges ranging from 641 to 6024 m^2 (mean 2117 m^2). Home range included a breeding pool. Home ranges of individuals overlapped in time and space.

Marshall, W.H. and M.F. Buell. 1955. A study of the occurrence of amphibians in relation to a bog succession, Itasca State Park, Minnesota. Ecology 36:381-387.

Food habits of amphibians, amphibian populations and microclimate were studied along a successional gradient at a bog in Minnesota in August of 1949 to 1953. The most abundant foods in diets were similar for three out of four frogs. Microclimate was considered to be the major factor influencing distribution of frogs among the habitat types.

Moore, J.A. 1939. Temperature tolerance and rates of development in the eggs of amphibia. Ecology 20:459-478.

The effects of temperature on embryonic development of amphibians were studied under laboratory conditions. Species studied included Rana sylvatica, Bufo americanus and Ambystoma tigrinum. A correlation between breeding habits, range of the species, temperature tolerance and rates of embryonic development was found.

Moore, J.E. and E.H. Strickland. 1954. Notes on the food of three species of Alberta amphibians. Am. Midl. Nat. 52:221-224.

Stomach contents of Rana pipiens, Pseudacris nigrita and Bufo hemiophrys from southern Alberta were examined. Insects, mainly ground dwelling, made up the bulk of the diet of the adult Canadian toad. Juvenile toads ate mainly small beetles and flies.

Mushinsky, H.R. 1975. Selection of substrate pH by salamanders. Am. Midl. Nat. 93:440-443.

This laboratory study tested the preference of eight salamander species for a pH of 5.5 versus 7.7. Six species preferred a basic pH while two species showed no preference.

Pough, F.H. 1976. Acid precipitation and embryonic mortality of spotted salamanders, Ambystoma maculatum. Science 192:68-70.

Spotted salamanders in the northeastern United States were found to suffer high embryonic mortality in temporary pools formed by acid rain.

Preston, W.B. 1982. The amphibians and reptiles of Manitoba. Manitoba Museum of Man and Nature, Winnipeg. 128pp.

This is a popular guide to the amphibians and reptiles of Manitoba. Species accounts include notes on identification, range, habitat, food habits and breeding. Species are illustrated in colour photographs. Keys to identification (including tadpoles) and Manitoba range maps are included.

Roberts, W., V. Lewin and L. Brusnyk. 1978. Amphibians and reptiles in the AOSERP study area. Prep. for the Alberta Oil Sands Environmental Research Program by University of Alberta Museum of Zoology. AOSERP Report 62. 51pp.

Three amphibian species, the wood frog, boreal chorus frog and Canadian toad, were found in the AOSERP study area in northern Alberta in June, July and August of 1976. Spawning, development, habitat use and population sizes in each habitat were studied. Wood frogs were found over 100 m from water but most were within 50 m of water. Chorus frogs were usually within 20 m of water and never beyond 100 m. Abundance of toads declined at distances over 40 m from water.

Smith, H.M. 1978. Guide des batraciens de l'Amerique du Nord. Marcel Broquet Inc., La Prairie, Quebec. 165pp.

A guide to the identification of amphibians of North America. French text. Species are described for identification. Subspecies are listed and range maps are presented. A short discussion of amphibian physiology, reproduction, territoriality, hibernation, movements, predators, ecology and maintenance as pets is included.

Stebbins, R.C. 1966. A field guide to western reptiles and amphibians. Houghton Mifflin Company, Boston. 270pp.

A total of 207 species of salamanders, frogs, toads, turtles, lizards and snakes occurring in the western United States and Canada are described. Descriptions include notes on identification, range, habitat, diet, activity patterns and subspecies. Capture techniques and maintenance of captive animals are described. A key to the identification of reptiles and amphibians is provided.

Strijbosch, H. 1979. Habitat selection of amphibians during their aquatic phase. Oikos 33:363-372.

Habitats in fens in the Netherlands were examined for breeding by frogs and toads. Nearly all frogs and toads avoided oligotrophic and acid waters.

Tamsitt, J.R. 1962. Notes on a population of the Manitoba toad (Bufo hemiophrys) in the Delta Marsh region of Lake Manitoba, Canada. Ecology 43:147-150.

Growth rates, activity cycles, distribution patterns and predation were studied. Breeding activity peaked in May. Newly metamorphosed

toads appeared in late June and July. In September, only young of the year were active, older toads having gone into hibernation.

Werner, J.K. and M.B. McCune. 1979. Seasonal changes in anuran populations in a northern Michigan pond. J. Herpetology 13: 101-104.

Eight species of amphibians were found in the Michigan study area. Five species composed the bulk of the biomass and these included the American toad (Bufo americanus) and wood frog (Rana sylvatica).

Wright, A.H. and A.A. Wright. 1949. Handbook of frogs and toads of the United States and Canada. Comstock Publishing Co., Inc. Ithaca, N.Y. 640pp.

Subspecies of North American frogs and toads are described in terms of range, habitat, size, identification, voice and breeding. Keys for the identification of eggs, tadpoles and adults are included.