AMPHIBIAN AND REPTILE SURVEY REPORT AND MANAGEMENT PLAN FOR BUCKLEY AFB, COLORADO

May 20, 2011

Prepared for: **U. S. Department of Defense, Buckley Air Force Base, CO 80011-9564**

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Amphibian and Reptile Survey Report
And
Management Plan for Buckley AFB, Colorado

Conducted May – September, 2010

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Cover photograph: After being released from a pitfall trap, a northern many-lined skink, *Plestiodon multivirgatus multivirgatus*, leaves the area of a drift fence transect, photo by John Sovell

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INTRODUCTION

The U. S. Department of Defense and the Department of Interior – Fish and Wildlife Service contracted with Colorado State University - Colorado Natural Heritage Program (CSU-CNHP) to provide a survey for amphibians and reptiles at Buckley Air Force Base. There were two objectives defined in the agreement that outlined the purpose of the study:

1) Document the amphibian and reptile species that occur at Buckley AFB.
2) Identify the potential management issues arising from results of the survey and development of a management plan addressing those issues.

Buckley AFB is located within the Central Shortgrass Prairie Ecoregion in east-central Colorado within the greater Denver metropolitan area. The Central Shortgrass Prairie ecoregion lies in the western portion of the Great Plains of North America. It encompasses approximately 56 million acres, and includes parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, Texas, and Wyoming. Grasslands are one of the least protected yet most converted habitat types on Earth and are one of the most imperiled ecosystems in North America (Neely et al. 2006). Biodiversity of the shortgrass prairie is moderately to highly threatened due to fragmentation and habitat conversion resulting in small patch sizes of what native prairie remains (Neely et al. 2006). Climate, grazing (herbivory), and fire are the primary ecological processes driving natural upland systems in the shortgrass prairie (Ostlie et al. 1997). Primary ecological processes supporting the aquatic systems include precipitation, timing and intensity of snowmelt (some streams), hydrological dynamics, groundwater availability, nutrient inputs, pH, and aquatic community composition. Human alterations of aquatic ecosystems have greatly affected natural ranges of variability, particularly surface water flows, groundwater availability, and nutrient inputs. As a result, the biodiversity of amphibian communities within the shortgrass prairie may have declined (Samson and Knopf 1996).

Buckley AFB covers an area of approximately 3,300 acres within the Shortgrass Prairie near Denver, Colorado. The Base is characterized by low relief. Surficial geology varies throughout the Base, ranging from Quaternary eolian dune sand and loess to tertiary sandstones and basalt flows to Cretaceous shales and limestones (Tweto 1979). In undeveloped areas of the Base the landcover consists of shortgrass prairie; riparian woodland and shrubland including cottonwood and willow along East Toll Gate Creek; and cottonwood, sedges, and rushes at Williams Lake.

Little is known about the herpetofauna community at Buckley AFB. To effectively conserve amphibians and reptiles at Buckley AFB, one of the few remaining shortgrass prairie landscapes in the greater metropolitan Denver Area, will require understanding their biodiversity. This report provides baseline data on the herpetofauna community at Buckley AFB and management recommendations for their conservation.

NATURAL ENVIRONMENT

CLIMATE

Buckley AFB has a semiarid climate typical of eastern Colorado with low humidity and a high evaporation rate. Winter temperatures can be below 0 degrees Fahrenheit (°F), with January and February being the coldest months. Summer maximum temperatures can exceed 100°F, July is the hottest month. The average annual rainfall for Buckley AFB is 15 inches, of which 62% falls from April through August.

TOPOGRAPHY

The topography of Buckley AFB is marked by flat plains with riparian areas along East Toll Gate Creek and at Williams Lake. Elevations on Base range from 5,480 feet above mean sea level (MSL) at the boundary of the Base near Williams Lake to 5,700 feet above MSL at the end of the airstrip in the south east corner of the base.

The Base can be characterized as having two distinct physiographic areas. The first is the upland area that extends south and also east of the developed areas, which occupy the northwest portion of the Base. This area is characterized by flat plains with elevations ranging between 5,500 and 5,700 feet above MSL.

The second physiographic area includes the East Toll Gate Creek drainage flowing northwest along the west boundary of the Base. This riparian area is lower in elevation than the plains adjacent to the east and it extends from the southwestern corner of the Base to near the northwestern boundary of the Base.

GEOLOGY AND SOILS

Geology

Buckley AFB is located within the Denver Basin, a huge syncline that underlies Denver plus most of northeastern Colorado (Foutz 1994). The Denver Basin consists of sedimentary rocks ranging from Late Cretaceous to Early Tertiary in age. At Buckley AFB, the Denver Formation either crops out, or is overlain by Quaternary-age unconsolidated alluvial and eolian deposits. These deposits consist of variable consolidated, fractured and unfractured interbedded claystone, siltstone, and fine- to coarse-grained sandstone, with occasional coal seams that occur in discontinuous lenticular beds.

Soils

There are three different soil series represented at Buckley AFB, the Colby, Westplain, and Renohill Series. Soil series are groups of soils that because of their analogous characteristics perform similarly for land use purposes. The Colby series consists of very deep soils that are well drained to somewhat excessively drained. Soils of the Colby series are moderately permeable and are formed in calcareous loess. Soils of this series are silt loam in structure and associated vegetation consists mostly of native short grasses.

The Westplain soils consist of deep soils that are poorly to somewhat poorly permeable. They are formed on polylithologic alluvial sediments consisting of relatively fine textured materials deposited over sand and gravel. Westplain soils occur on concave portions of alluvial fans and stream terraces and form level to gently inclined terraces with slopes ranging from 0 to about 5 percent. Westplain soils consist of heavy clay loam sediments and are associated with native prairie grasslands.

The Renohill series consists of well drained soils that are moderately deep to soft bedrock and are found on bedrock, alluvial fans, hills, and ridges. They form in alluvium, colluvium and residuum derived from calcareous shale and have slopes from 0 to 30 percent. The sediments of Renohill soil consist of clay loam that support native short prairie grasses including western wheatgrass (*Pascopyrum smithii*), green needegrass (*Nassella viridula*), and blue grama (*Bouteloua gracilis*).

WATER RESOURCES

Ephemeral Streams and Associated Wetlands

East Toll Gate Creek is a well-defined drainage flowing along the Base's west boundary for approximately 3.5 miles. The creek enters the Base north of Jewell Avenue and exits the Base north of Mississippi Avenue where Alameda Parkway turns to the west as the parkway moves away from the Base. Residential areas of the City of Aurora parallel the creek on its west side. In the project area East Toll Gate Creek has a moderate stream sinuosity, moderate meandering, and supports Western Great Plains Riparian Woodland and Shrubland dominated by cottonwood (*Populus deltoids*) and willow (*Salix* spp.).

Flows along East Toll Gate Creek are a seasonal occurrence. Usually the creek is without active flows, but the channel sustains intermittent ponds throughout the summer. However, the creek will periodically flood following high-intensity spring and summer rainstorms. These rains maintain the seasonal ponds located in the creek's main channel. A base-wide jurisdictional wetlands determination by the USACE has not been completed for Buckley AFB (BAFB 2010). However, data from the 2010 ground survey and the National Wetland Inventory maps for Buckley AFB identify s23 wetland areas on the Base. Most of these wetlands consist of seasonal ponds on East Toll Gate Creek. There is also an unnamed drainage that flows north from Williams Lake, exiting the Base at East 6th Avenue. This drainage was dry during the entire 2010 survey period and appears to receive very sporadic overflow from the outflow channel of Williams Lake and seepage from behind the dam at Williams Lake. These flows appear much less than the flows in East Toll Gate Creek. There is also a small area of Western Great Plains Riparian Woodland and Shrubland along this drainage.

Jurisdictional wetlands are those protected as a subset of waters of the U.S. under Section 404 of the Clean Water Act and protected by Executive Order 11990, Protection of Wetlands. Wetlands are defined by the U.S. Army Corps of Engineers (USACE) and the USEPA as, "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (33 CFR § 328.3[b]). The USACE requires a permit for any activities crossing wetlands or other waters of the U.S.

Artificial Waters

Williams Lake, in the northeastern corner of the Base, is the largest body of water on the Base. Ground water sustains the lake and this water is pumped from one of the Base's existing wells (USAF 2010). The lake's water level is also augmented by surface runoff. The lake attracts migratory waterfowl during migration, transient and foraging waterfowl throughout summer, and a small number of nesting waterfowl during spring and summer. The lake also is potential habitat for breeding amphibians. Cottonwood, sedges, and rushes are the predominant riparian plants at the lake.

BIOTIC ENVIRONMENT

Buckley AFB contains multiple surface features including natural vegetation types or ecological systems that are comprised of native plant and animal communities; hydrologic areas; and developed areas containing military infrastructure, housing, and office complexes (Figure 1). The natural distribution of habitats on Base is dependent on topography, moisture, and abiotic factors associated with surface disturbance. Typically, the Base is described in terms of two major ecological systems: Western Great Plains Shortgrass Prairie and Rocky Mountain Lower Montane Riparian Woodland and Shrubland. These ecological systems support a variety of plants and animals. A focused biological survey documenting the amphibians and reptiles found on the Base in these ecological systems was conducted during the summer of 2010. The findings of that survey are presented here and were instrumental in developing the management plan included in this report.

Ecological Systems

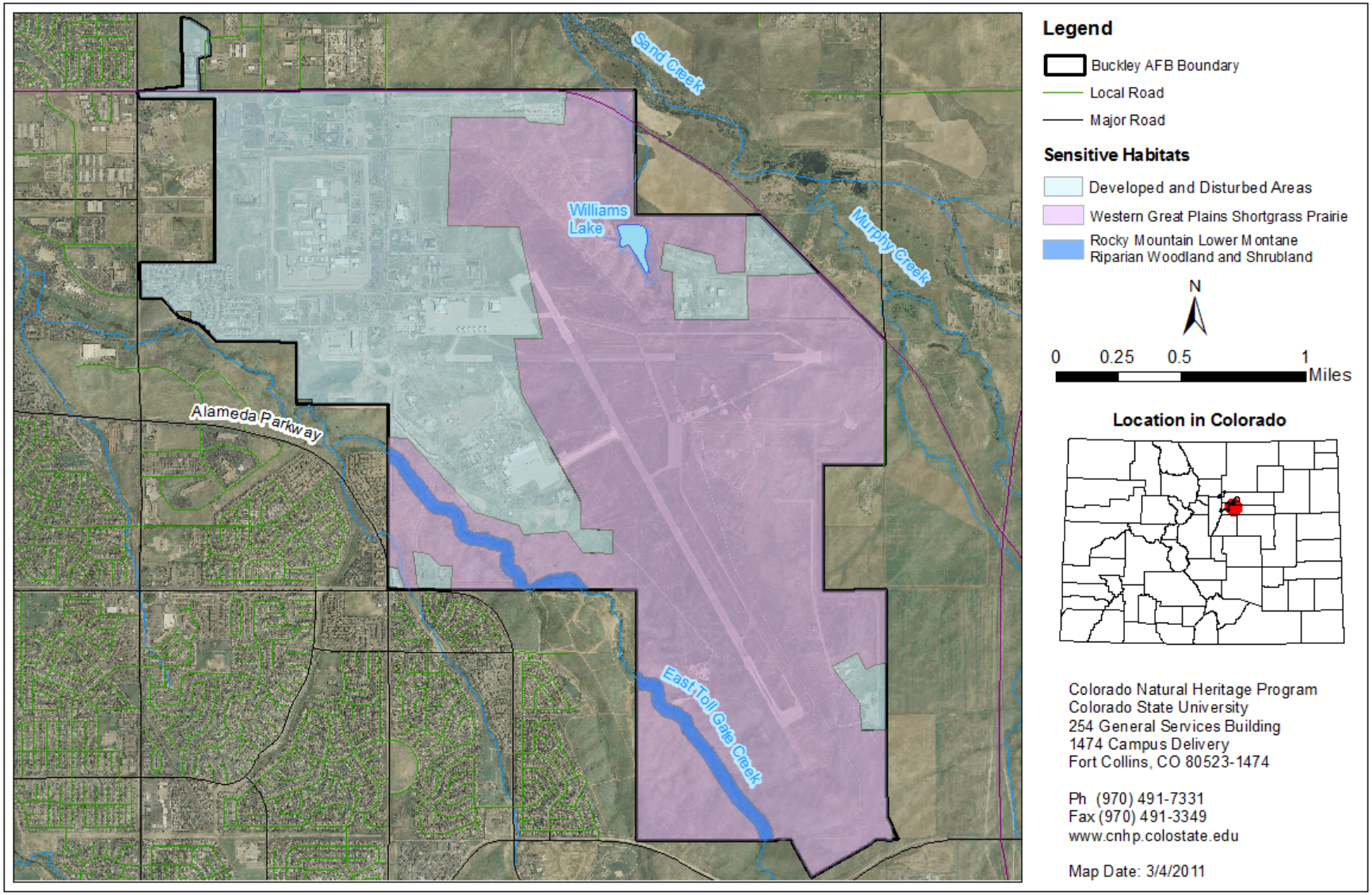
The distribution of ecological systems found on Base is defined by the drainages of the Base and limited by the developed and disturbed portions of the Base. The combined distribution of these ecological systems encompasses the undisturbed portions of the Base.

Western Great Plains Shortgrass Prairie.

The shortgrass prairie is prevalent above the drainage of East Toll Gate Creek and south of the developed northwestern portion of the base containing residential housing, office complexes, and military infrstructure. The grassland at the Base is distributed on flat plains including the area of the airstrip. This plant community's distribution is defined by the location of favorable soils that allow seedling survival.

The shortgrass prairie at the Base is dominated by blue grama grasses (*Bouteloua gracilis*) and associated native graminoid species include buffalograss (*Buchloe dactyloides*), needle and thread grass (*Hesperostipa comata*), prairie Junegrass *(Koeleria macrantha*), western wheatgrass (*Pascopyrum smithii)*, sand dropseed (*Sporobolus cryptandrus*), sideoats grama (*Bouteloua gracislis*), and salt grass (*Distichlis spicata*). There are a number of exotic species present in this system including crested wheatgrass (*Agropyron cristatum*), smooth brome (*Bromus inermis*), cheatgrass (*Bromus tectorum*), Kentucky bluegrass (*Poa pratensis*), allysum (*Allysum parviflorum*), and rye grass (*Secale cereale*), among others.

Figure 1. The ecosystems and disturbed areas containing military infrastructure, residential housing, and office buildings at Buckley AFB.



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This system in combination with the associated wetlands represents one of the richest areas, in the United States, for prairie birds. Grassland bird species may constitute one of the fastest declining vertebrate populations in North America and a healthy shortgrass prairie system should support viable populations of endemic grassland birds. Other animals found on healthy shortgrass prairies include pronghorn, , prairie dog complexes, and other Great Plains mammals. Historically, such areas would also have been populated by bison in sufficient numbers to support populations of wolves.

Fire and grazing constitute the primary processes impacting this system. However, fire is less important in this system compared to other Western Great Plains prairie systems. Conversion to agriculture and pastureland with subsequent irrigation has degraded and extirpated this system in some areas of its range.

Rocky Mountain Lower Montane Woodland and Shrubland.
At Buckley AFB this system occurs within the flood zone and immediate streambank of East Toll Gate Creek. The system is dominated by cottonwood (*Populus deltoides*) and narrowleaf willow (*Salix exigua*). A number of invasive plant species occur within this system including musk thistle (*Caduus nutans*), diffuse knapweed (*Centaurea diffusa*), Canada thistle (*Cirsium arvense*), Russian olive (*Elaeagnus angustifolia*), and dandelion (*Taraxacum officinale*), among others.

This system is dependent on a natural hydrologic regime, especially annual to episodic flooding. These woodlands and shrublands grow within a continually changing alluvial environment due to the ebb and flow of the creek, and riparian vegetation is constantly being “re-set” by flooding disturbance.

The importance of riparian areas to wildlife has long been emphasized. Various figures are often quoted, emphasizing the small percentage of the landscape occupied by riparian vegetation and the large percentage of animal species that rely on this habitat. Riparian habitats represent less than 1 percent of the total acreage of public lands in the 11 western states, about 72% of all reptiles, 77% of all amphibian species, 80% of all mammals, and 90% of all bird species which occur regularly in the western U. S. routinely use riparian areas for food, water, cover or migration routes (Grahame and Sisk 2002). Birds use this habitat for nesting, cover, resting, migration stopover areas, and migration corridors (Samson and Knopf 1996). This system has the richest avian species component of any of Colorado's habitats. There are many small mammals, too numerous to name here that use riparian areas for foraging, nesting, and as dispersal and migration corridors. Crayfish and small fish are also present within the ephemeral pools present in the streambed of East Toll Gate Creek.

The Base also includes the riparian habitat of Williams Lake and associated wetlands that support amphibians, turtles, fish and which is visited by numerous species of waterfowl.

METHODS

Drift fence transects were used to capture amphibians and reptiles at Buckley AFB. Drift fences are a highly effective method for sampling animals in herpetological field research (Wilson and Gibbons 2009). Drift fence trapping is a passive method, accumulating animals over time and usually uses pitfalls and/or funnel traps to restrain animals that enter the trap on their own volition. In this research pitfall

traps were the method by which animals were restrained. Animals accumulate in the pitfall traps, and traps are then censused on a regular basis by field researchers. Passive trapping methods, like drift fences, are time and effort intensive, but yield high capture rates and standardized samples compared to other methods like opportunistic sampling and visual searches (Wilson and Gibbons 2009).

Drift fences are vertical barriers that intercept the intended trajectory of animals moving from one location to another and guide the animals toward a pitfall bucket, funnel trap, or other capture device (Gibbons and Semlitsch 1981) (Figure 2). To locate the drift fence transects, Buckley AFB was divided into five sub-areas; a developed area (including the air field), north sampling area, south sampling area, west sampling area, and east sampling area. A random sample of eight drift fence transects, stratified by riparian and upland habitat were placed within the boundaries of the four sampling areas (north, south, east, and west), two transects per area (Figure 3). Because riparian habitat was not represented in the east sampling area it contained two upland transects resulting in a total of five upland and three riparian transects (Figure 3). To avoid conflicts with breeding burrowing owls, upland sites South Upland1 and East Upland2 were moved from their randomly selected location (Figure 3). To prevent animals from crawling under the drift fence, the fence was buried 2 to 4 inches into the ground.

In addition to installing drift fence transects, ocular and auditory surveys were conducted at Williams Lake and East Toll Gate Creek. The entire shoreline of Williams Lake was walked and East Toll Gate Creek was walked from where it enters Buckley AFB at Mississippi Avenue to where it exits at the west boundary of the Base. For each species, a tally of individuals and their location of observation were kept.

In this report, herpetofauna names follow the nomenclature of Crother (2008).

Figure 2. Schematic of drift fence transect with large pitfall traps. Figure adapted from Gibbons and Semlitsch (1981).

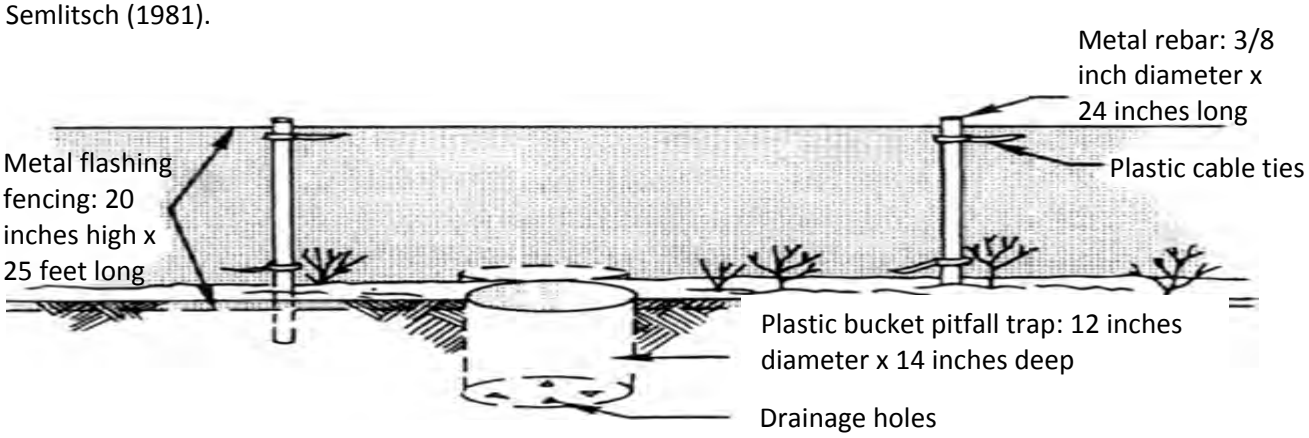
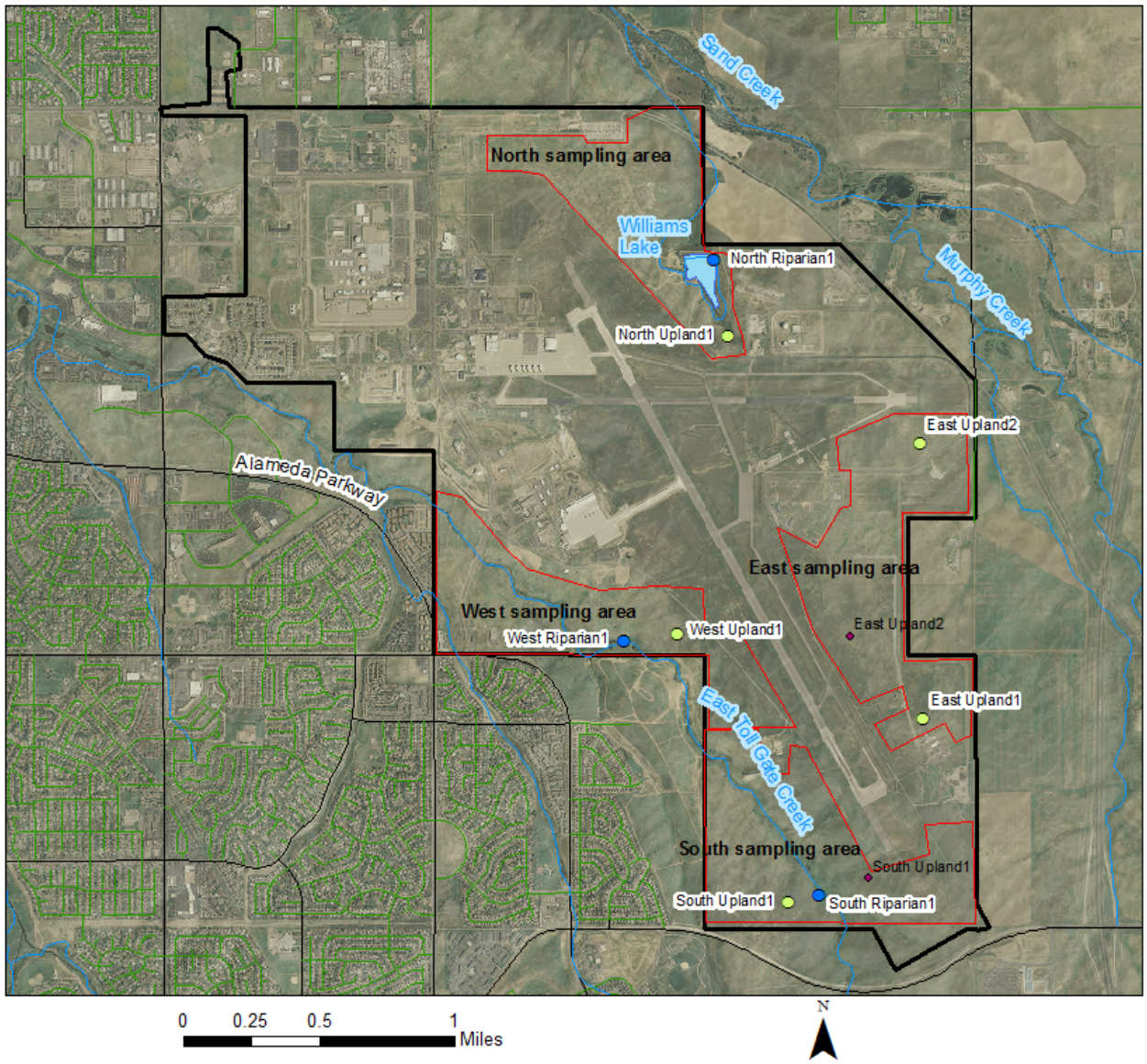


Figure 3. Randomly selected locations of the eight drift fence transects at Buckley AFB. Transects, East Upland2 and South Upland1 where relocated from their randomly selected locations because of conflicts with nesting Burrowing Owl.



RESULTS

The drift fence transects and accompanying pitfall traps were open for 36 nights, at four different time periods, from June 6th to September 20th, 2010:

- four nights from June 6th to July 2nd
- eight nights from July 20th to 28th
- 11 nights from August 9th to 20th
- 13 nights from September 7th to 20th

East Toll Gate Creek was surveyed on June 10th and 30th while Williams Lake was surveyed on June 10th and July 1st.

Eleven species of amphibians, snakes, lizards, fish, snails, or amphipods were found during the survey of Buckley AFB (Figure 3, Table 1). Because the aquatic habitats at Buckley AFB are limited to Williams Lake and to the ephemeral pools of the intermittent stream, East Toll Gate Creek, only two amphibian species were found (Figure 3). Six reptile species were found, but relatively few individuals were found with two reptiles, the Lined Snake, *Tropidoclonion lineatum*, and Western Painted Turtle, *Chrysemys picta bellii*, documented by the observation of a single individual (Figure 3). Illustrated life cycles of the amphibian and reptile species found at Buckley AFB can be found in Appendix 1.

Of the species found at Buckley AFB one species of lizard is tracked and one species of snake is watchlisted by the Colorado Natural Heritage Program (Table 2) (see Appendix 1 for a discussion of Heritage methodology). These species were the Northern Many-lined Skink (*Plestiodon multivirgatus multivirgatus*) and Lined Snake. One species of amphibian, the Bullfrog (*Lithobates catesbeiana)*, is introduced to the State and is most widespread in eastern Colorado, but is extending its range through continued introductions and subsequent expansion.

The Northern Many-lined Skink was a common inhabitant of the shortgrass prairie at Buckley AFB. Adults were found during the month of June at multiple drift fence transects and juveniles were observed during August and September at multiple transects, documenting its status as a breeding population. The results of the drift fence study indicate that the Many-lined Skink formed a significant component of the reptile community at Buckley AFB. It was the most widely distributed and abundant reptile documented at the Base. Many-lined Skinks comprised nearly 60% of the reptiles encountered at drift fence transects. Four other reptile species considered common and not of conservation concern were documented at Buckley AFB (Table 1). This skink is locally common in some areas and occurs throughout eastern Colorado north of the Arkansas River.

The Lined Snake was documented by the observation of only one individual at Drift Fence Transect South Riparian2. Lined Snakes inhabit damp areas and riparian habitat in plains grassland (Hammerson 1999). Populations of this snake occur in scattered locations throughout eastern Colorado.

The Bullfrog was common at Williams Lake with over 20 individuals documented. Adults were found in June and both adult and juvenile Bullfrogs were found during the July 1st survey. Bullfrogs are introduced to Colorado and have been implicated in the decline of Northern Leopard Frogs, *Lithobates pipiens*, a native Colorado amphibian that is historic to the area (Hammerson 1999).

Figure 3. The location of amphibian and reptile species found at Buckley AFB.

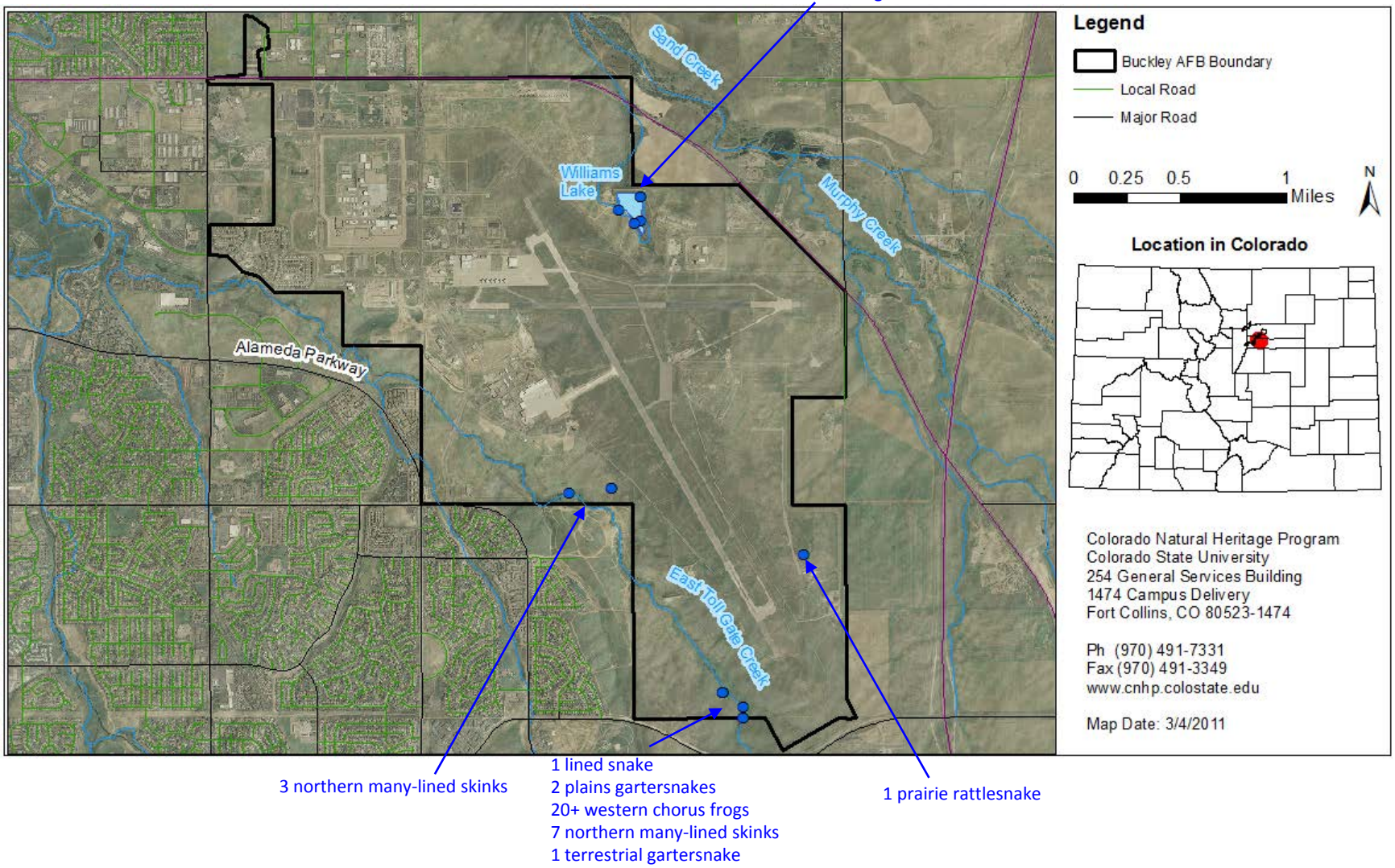


Table 1. Relative abundance of amphibians, reptiles, fish, snails, and amphipods documented at Buckley AFB. Universal Transverse Mercator coordinates are in NAD83.

Date	Scientific Name	Common Name	Location	Count	UTME	UTMN
Amphibians						
6/28/2010	*Pseudacris maculata*	Western Chorus Frog	S Riparian1	15-25	521955	4396247
7/1/2010	*Lithobates catesbeiana*	Bullfrog	Williams Lake	6	521012	4396330
9/15/2010	*Lithobates catesbeiana*	Bullfrog	Williams Lake	15-20	521130	4396232
Lizards						
7/1/2010	*Plestiodon multivirgatus multivirgatus*	Northern Many-lined Skink	W Riparian	1	520642	4394194
7/27/2010	*Plestiodon multivirgatus multivirgatus*	Northern Many-lined Skink	S Riparian2	1	521800	4392694
8/15/2010	*Plestiodon multivirgatus multivirgatus*	Northern Many-lined Skink	S Riparian2	1	521800	4392694
8/16/2010	*Plestiodon multivirgatus multivirgatus*	Northern Many-lined Skink	S Riparian2	1	521800	4392694
8/18/2010	*Plestiodon multivirgatus multivirgatus*	Northern Many-lined Skink	W Upland	1	520963	4394228
9/8/2010	*Plestiodon multivirgatus multivirgatus*	Northern Many-lined Skink	S Riparian2	1	521800	4392694
9/9/2010	*Plestiodon multivirgatus multivirgatus*	Northern Many-lined Skink	W Upland	1	520963	4394228
9/9/2010	*Plestiodon multivirgatus multivirgatus*	Northern Many-lined Skink	S Riparian2	1	521800	4392694
9/13/2010	*Plestiodon multivirgatus multivirgatus*	Northern Many-lined Skink	S Riparian2	1	521800	4392694
9/17/2010	*Plestiodon multivirgatus multivirgatus*	Northern Many-lined Skink	S Riparian2	1	521800	4392694
Snakes						
6/28/2010	*Crotalus viridis*	Prairie Rattlesnake	E Upland1	1	522411	4393729
6/30/2010	*Thamnophis radix*	Plains Gartersnake	East Toll Gate Creek	1	521957	4392583
6/30/2010	*Thamnophis elegans*	Terrestrial Gartersnake	N Riparian1	1	521178	4396437
7/28/2010	*Thamnophis elegans*	Terrestrial Gartersnake	S Riparian2	1	521800	4392694
8/9/2010	*Crotalus viridis*	Prairie Rattlesnake	N Riparian1	1	521178	4396437

Date	Scientific Name	Common Name	Location	Count	UTME	UTMN
8/10/2010	*Tropidoclonion lineatum*	Lined Snake	S Riparian2	1	521800	4392694
8/18/2010	*Thamnophis radix*	Plains Gartersnake	S Riparian2	1	521800	4392694
Turtles						
6/10/2010	*Chrysemys picta*	Painted turtle	Williams Lake	1	521175	4396247
Fish						
6/30/2010	*Pimephales promelas*	Fathead Minnow	East Toll Gate Creek	12	519534	4394978
7/01/2010	*Pimephales promelas*	Fathead Minnow	Williams Lake	100s	521111	4396258
6/10/2010	*Pimephales promelas*	Fathead Minnow	Williams Lake	100s	521086	4396308
Snails						
6/10/2010	*Physa gyrina*	Pewter Physa	East Toll Gate Creek	25-30		
6/10/2010	*Lymnaea elodes*	Marsh Pond Snail	East Toll Gate Creek	5-10		
Amphipods						
6/10/2010		Amphipod	East Toll Gate Creek	35-50		

Table 2. Reptiles found at Buckley AFB that are tracked by the Colorado Natural Heritage Program.

Scientific Name	Common Name	CNHP Rank	Count	Tracking Status
Lizard				
Plestiodon multivirgatus multivirgatus	Northern Many-lined Skink	G5T5S4	10	Full Tracking
Snake				
Tropidoclonion lineatum	Lined Sanke	G5S3	1	Watchlisted

The Western Chorus Frog, *Pseudarcris maculata*, was the only other amphibian found at Buckley AFB. A breeding congregation of Western Chorus Frogs was heard calling in East Toll Gate Creek where the creek enters Buckley AFB at its southern boundary.

The Plains Gartersnake, *Thamnophis radix*, and Terrestrial Gartersnake, *Thamnophis elegans*, were found at multiple riparian drift fence transects at Buckley AFB. Both of these snakes are common at virtually any permanent or semipermanent flowing or nonflowing body of water in the plains of eastern Colorado (Hammerson 1999).

Two Prairie Rattlesnakes, *Crotalus viridis*, were also found at Buckley AFB. One each at an upland and riparian drift fence transect. The Prairie Rattlesnake is a common inhabitant of nearly every terrestrial habitat within its broad geographic and elevational range in Colorado. Grasslands are a typical habitat of the Prairie Rattlesnake.

DISCUSSION

The diversity of the herpetofauna at Buckley AFB is probably greater than that documented in this report. Several species found throughout much of east-central Colorado (Hammerson 1999) and in habitats present at Buckley AFB were not found during this survey. Species with high potential to occur at Buckley AFB, but that were not documented, include the Barred Tiger Salamander, *Ambystoma mavortium*, Woodhouse's Toad, *Anaxyrus woodhousii*, Common Lesser Earless Lizard, *Holbrookia maculata*, Racer, *Coluber constrctor*, Western Hognose Snake, *Heterodon nasicus*, Northern Water Snake, *Nerodia sipedon*, Bullsnake, *Pituophis catenifer sayi*, and Plains Black-headed Snake, *Tantilla nigripes*. Species whose ranges overlap Buckley AFB, but for which the habitat at Buckley is marginal and therefore are less likely to occur include the Plains Spadefoot, *Spea bombifrons*, Great Plains Toad, *Anaxyrus cognatus*, Six-lined Racerunner, *Aspidoscelis sexlineatus*, Milk Snake, *Lampropeltis triangulum*, and Common Gartersnake, *Thamnophis sirtalis*.

Suitable habitat for the Northern Leopard Frog does exist at Buckley AFB at Williams Lake. The Northern Leopard Frog is declining throughout its range in Colorado, they are sensitive to populations of the introduced Bullfrog, and a large population of Bullfrogs occupies the lake. This has probably resulted in the extirpation of leopard frogs at the lake. Bullfrogs can impact Northern Leopard Frogs through intense predation, predatory or competitive larval interactions, and transmission of parasites and pathogens (Kliesecker et al. 2001). Ephemeral ponds such as those in East Toll Gate Creek also offer suitable habitat for Northern Leopard Frogs, however, none were found in the creek.

With eight species, or 12% of the State's amphibian and reptile species, Buckley AFB contains a low number of native Colorado herpetofauna within its 3,300 acre boundary. Of the 68 species of Colorado herpetofauna, only 26 have ranges that overlap Buckley AFB and 31% of these species are represented at the Base, making Buckley AFB moderately species-rich in herpetofauna. Only 13% of eastern Colorado's amphibians (2 of 15 species), one third or more of its turtles (1 of 3 species, 33%) and snakes (4 of 11 species, 36%), and less than one quarter of its lizards (1 of 5 species, 20%) were found at Buckley AFB. Surprisingly, none of the toads, spadefoots, or salamanders with overlapping ranges (four in all) were documented at the Base and the Northern Leopard Frog also was not documented.

The riparian area along East Toll Gate Creek contained native willow, cottonwood, and herbaceous vegetation, but also contained invasive vegetation including thistle and curly dock. During surveys, pooled water, surface flows, and shoreline vegetation creating suitable habitat for amphibians were observed, but much of the watercourse contained abundant algae. The amount of algae indicates an elevated level of nutrient enrichment, possibly attributable to fertilizer inputs from rainwater runoff from lawns and roads in the surrounding urban landscape. Excessive runoff from the urban landscape is also apparently elevating sediment loads in East Toll Gate Creek and these disturbances have probably impacted amphibian communities at the Base. Williams Lake also contained excessive algal blooms during mid and late-summer. This abundant algae in combination with the invasive bullfrog population at the lake has probably impacted the native amphibian population. That toads, spadefoots, and leopard frogs were not documented at Buckley AFB is probably attributable to these factors.

No lizards other than the Northern Many-lined Skink were documented at Buckley AFB. Four additional lizard species have ranges that overlap the Base including the Common Lesser Earless Lizard, *Holbrookia maculata*; Prairie Lizard, *Sceloporus undulates*; Short-horned Lizard, *Phrynosoma hernandesi*; and Six-lined Racerunner, *Aspidoscelis sexlineata*. The absence of lizards may in part be related to the lack of suitable microhabitat at the Base including areas of shrub cover, sandy soils, and rocky outcrops that the undocumented lizards require. For example, the Six-lined Racerunner prefers areas with shrub cover (personnel observation of the author), the Lesser Earless Lizard is found in sandy soils, and Prairie Lizards like rocky areas (Hammerson 1999). The Short-horned Lizard is sensitive to development and is absent from the Denver metropolitan area because of habitat degradation and increased levels of vehicular mortality (Hammerson 1999). This might explain its absence from Buckley AFB.

Today, Buckley AFB contains fewer species of herpetofauna than probably occupied the site in historic times. Although a moderately diverse community of herpetofauna still occupies the Base, urban development has resulted in habitat loss, degradation, and fragmentation with subsequent declines in herpetofauna diversity in the immediate region. This in combination with increased nutrient and sediment loads to aquatic systems, the lack of suitable microhabitat, and the introduction of the highly competitive and predaceous Bullfrog have all probably caused a decline in herpetofauna diversity at the Base. Still, two reptiles of conservation concern, the Northern many-lined Skink and Lined Snake were documented at Buckley AFB; suggesting that the Base acts as a surrogate reserve or a refugia for these reptiles, in what otherwise is a highly modified urban/exurban landscape.

AMPHIBIAN AND REPTILE BIRD/AIRCRAFT STRIKE HAZARD (BASH)

The abundance and richness of reptile species found on Base suggest their overall numbers are low. The predators of snakes and lizards are poorly studied. However, no raptors are known as obligate predators of reptiles, though eagles and hawks do prey upon them. Current data suggest that reptile population sizes at Buckely AFB are not contributing to BASH at Buckley AFB.

Amphibians are prey resources for aquatic birds and raptors. In Colorado, herons and Swainson's Hawks are known to predate Bullfrogs, and Western Chorus Frogs are preyed upon by a broad range of Colorado's resident birds including passerines, herons, and grebes (Hammerson 1999). The population of Bullfrogs established at Williams Lake and the Western Chorus Frog population documented in East Toll Gate Creek at the south end of the Base can then attract avian predators. Consequently, there is potential for the current populations of these two amphibians to contribute to BASH at Buckley AFB. It is not possible to state with certainty, the degree of threat that this potential represents.

AMPHIBIAN AND REPTILE MANAGEMENT PLAN

INTRODUCTION

Amphibian and reptile management at Buckley AFB requires conserving grassland, aquatic, and riparian habitat. Amphibians and reptiles at Buckley AFB include a variety of snakes, lizards, and frogs adapted to the natural habitats on Base. The Base has native populations of herpetofauna that are surviving within a developed urban/exurban landscape. This plan discusses sensitive nonlisted species and sensitive

habitats. Natural resource management is critical to the maintenance of the Base's biodiversity. Biodiversity is important to the military mission because management of natural resources helps keep the 460 Space Wing and its subgroups in compliance with the ESA, DoD and Air Force Instructions, and other environmental laws. It also helps minimize further declines in the populations of nonlisted sensitive species that might then require further protection under the Federal ESA.

The purpose of this plan is to allow fulfillment of the 460 Space Wing mission while ensuring maintenance and enhancement of the natural habitats on Buckley AFB for sensitive Amphibians and Reptiles. It is hoped that this plan will fully support the Air Force mission by establishing conditions that encourage a self-sustaining, healthy ecosystem that supports the biodiversity of amphibians and reptiles found at Buckley AFB.

ROLES AND RESPONSIBILITIES

The Natural Resource Manager (NRM) is responsible for the stewardship of wildlife and their habitats on Buckley AFB. The NRM has been responsible for implementing surveys for amphibians and wildlife throughout Buckley AFB. The amphibian and reptile data reported on in this document has contributed substantial information on the abundance and distribution of sensitive amphibian and reptile species at Buckley AFB. This data was instrumental in formulating the management strategies of this plan. The data on distribution and abundance of herpetofauna at Buckley AFB is also useful to State and Federal agencies for determining the sensitivity of these species in the State of Colorado.

Management of wildlife at Buckley AFB has multiple objectives including addressing opportunities for effective management of amphibian and reptile populations. Rather than focusing on individual species, management efforts should be focused on conservation, restoration, protection, and enhancement of habitats. Management of amphibians and reptiles includes passive management such as on- and off-Base education, and active management, which includes control of nuisance species and habitat management for reduction of BASH.

Management used at Buckley AFB for amphibians and reptiles should use an adaptive approach. Adaptive management is a central concept in Ecosystem Management. It is "a willingness to approach all management decisions as experiments to be tested. Rather than prescribe a management scenario, the manager working in an adaptive fashion tests possible solutions to problems in a scientific, experimental way, complete with controls. …under the adaptive management scenario, a final, prescriptive solution to a problem is never accepted, and the door is always left open to new ideas, new data, and revision of plans when better approaches are possible." (Leslie et al. 1996).

The NRM works closely with other offices of the 460 Space Wing to ensure minimization of impacts to habitats and wildlife and to minimize the impact of wildlife on mission activities. In particular, the Base is discussing draining Williams Lake to control bird populations and consequently reduce BASH. Williams Lake is an artificially developed water source that provides water to wildlife. In the semi-arid climate of eastern Colorado developed water sources can be critical to sustaining amphibian populations.

APPLICABLE REGULATIONS

The regulatory documents pertinent to this management plan include the *Sikes Act*; Department of Defense (DoD) Instruction 4715.3, *Environmental Conservation*; Air Force(AF) Instruction 32-7064, *Integrated Natural Resources Management*; AF Instruction 91-202, *Mishap Prevention Program (Bird-Aircraft Strike Hazard)*; AF Instruction 32-1053, *Pest Management*; *National Environmental Policy Act*; DoD Instruction 4715.9, *Environmental Planning and Analysis*; Executive Order (EO) 11990, *Protection of Wetlands*; EO 11988, *Floodplain Management*; and the *Council on Environmental Quality* regulations. These environmental documents detail the requirements for managing, protecting, maintaining, and promoting the environment including fish, wildlife, and plant communities on properties under the jurisdiction of the Federal and State governments.

SENSITIVE NON-FEDERALLY LISTED AMPHIBIANS AND REPTILES

Buckley AFB manages species under consideration for listing under the State and Federal endangered species acts, and can choose to manage for other species considered sensitive by other agencies like the Colorado Natural Heritage Program (CNHP). Although protection of nonlisted species is not mandatory on Federal installations, management of these species contributes to the overall maintenance of their natural populations and reduces the likelihood that these species will need additional legislative protection in the future under the ESA or State laws. There are no Federal or State listed species on Buckley AFB. In total, eight species of amphibians, snakes, and lizards were found during the survey of Buckley AFB (Table 1). Abundance for these species included one individual (one snake and one turtle), 2 individuals (three snakes), 10 individuals (Northern Many-lined Skink), and over 20 individuals (two frogs). Two of the reptile species found at Buckley AFB are tracked as sensitive species by CNHP, the Northern Many-lined Skink and Lined Snake. The Heritage program ranks the Northern Many-lined Skink as apparently secure in Colorado (S4) and the Lined Snake as vulnerable (S3). Globally, both species are demonstrably secure (G5) and are four and three rank levels, respectively, removed from G1 (critically imperiled) and G2 (imperiled) species discussed in the DoD species at risk reported on by NatureServe (2004). The Northern Leopard Frog, designated by the Colorado Division of Wildlife as a State species of "special concern" (Heritage Rank G5S3) was not found on the Base, but a population of the non-native Bullfrog introduced to the State of Colorado was found at Williams Lake.

Non-Federally listed species can be managed through the use of general conservation measures. These measures include surveys of sensitive species to determine location and abundance, reviewing all projects that have a potential to impact sensitive species through the NEPA process, and specific conservation management policies.

These general conservation policies include restoring disturbed areas, limiting disturbance in sensitive habitats, mitigating the potential impacts of ground maintenance practices, educating base personnel, and technical review of all projects by a professional biologist. All contractor work is monitored to ensure compliances with environmental policies. Specific activities that are controlled include prohibiting off-road activities except for designated areas, during emergencies, and specifically

approved mission requirements; prohibiting dumping and littering; and actively controlling unleashed dogs.

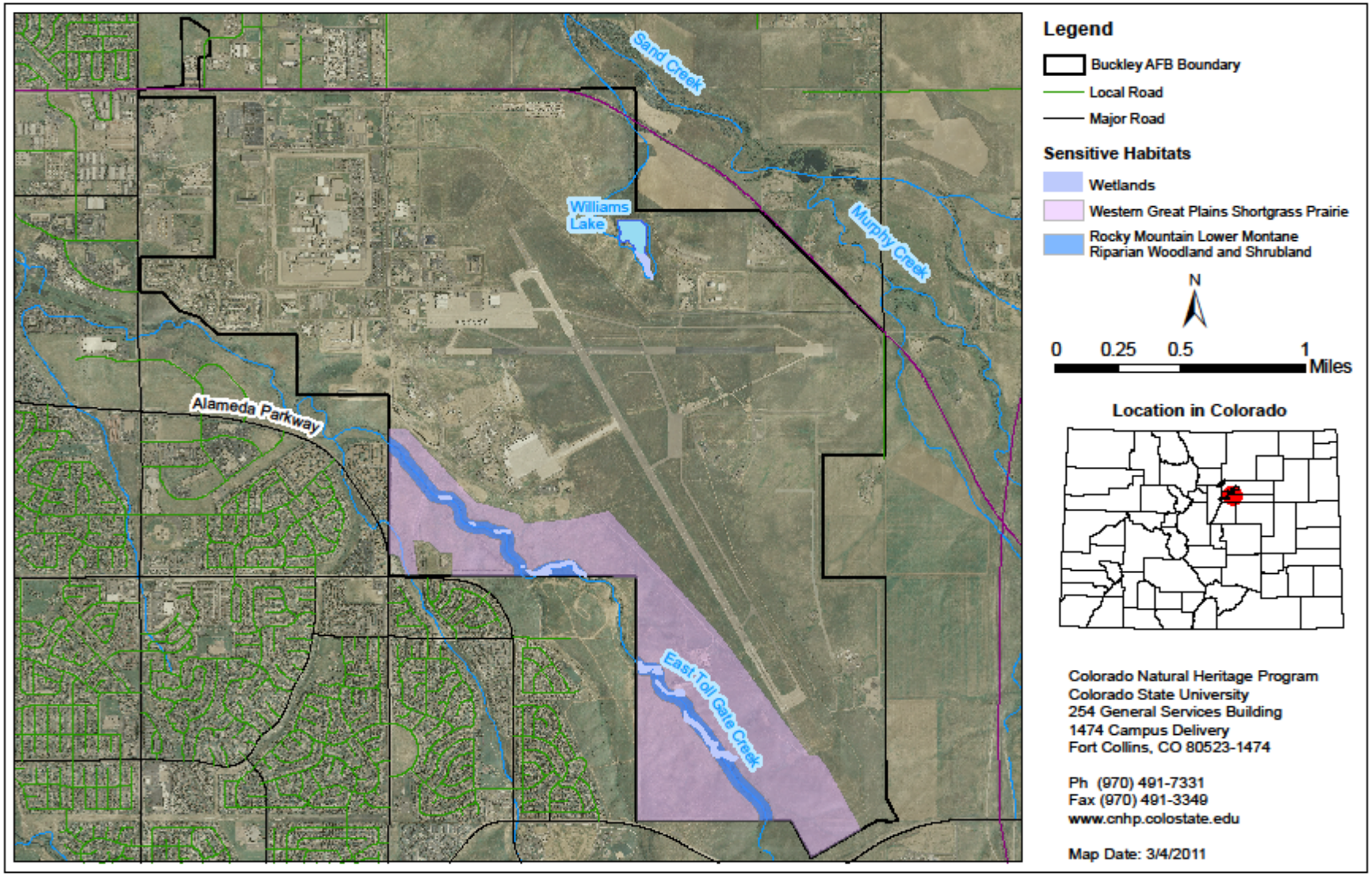
Sensitive Habitats

Sensitive habitats include those areas designated by the USFWS as critical habitat protected by the Endangered Species Act, sensitive ecological areas as designated by state or federal rulings, and areas that support sensitive animal populations. There is no critical habitat protected under the ESA at Buckley AFB. Sensitive habitats Buckley for non-federally listed species include ecological systems that are important seasonal use areas for the sensitive reptiles found on the Base (e.g., migration routes, breeding areas, crucial summer/winter habitats). Wetlands are the only other sensitive habitat on the Base (Innovative Technical Solutions 2010).

Within the boundary of Buckley AFB sensitive habitat includes areas of shortgrass prairie and riparian habitat that supports two state sensitive reptile species, the Northern Many-lined skink and Lined Snake (Figure 4). Sensitive wetland habitat exists along East Toll Gate Creek and at Williams Lake (Figure 4), both these areas contain habitat suitable for amphibians. An analysis has not been completed on wetlands of Figure 4 to determine if any meet the jurisdictional wetland guidelines under Section 404 of the Clean Water Act, but all are potential habitat for amphibian species.

Most sensitive habitats on Base currently have compatible land uses that do not notably degrade these areas. In areas where mission activities are near sensitive habitats, procedures are in place to minimize the effects of an action on the habitat. These procedures include controlling the extent of activities that reduce natural habitats through appropriate exclusion. Threats to natural sensitive habitats are greater from unauthorized entry into sensitive habitat, presently managed by excluding all foot traffic and vehicle travel by Base personnel in sensitive wetland areas.

Figure 4. Sensitive wetlands and habitat for the Northern Many-lined Skink (*Plestiodon multivirgatus multivirgatus*) and Lined Snake (*Tropidoclonion lineatum*) at Buckley AFB.



AMPHIBIAN AND REPTILE MANAGEMENT PRACTICES

Management of amphibians and reptiles has multiple objectives that include addressing opportunities for effective management of their populations. Rather than focusing on individual species, management efforts should focus on conservation, restoration, protection, and enhancement of sensitive habitats. Suggested amphibian and wildlife management practices include passive management such as on- and off-Base education, and active management, which include control of nuisance species (i.e. non-native plants and BullfrogS), habitat management and revegetation.

Key Issues/Goals

Habitat loss/rehabilitation, biodiversity conservation, populations' status, education, and exotic species

Goal: Reduce habitat loss.

Objective 1. Review all project activities to minimize their impacts to sensitive habitats.

Objective 2. Site all projects within previously disturbed areas to the greatest extent possible.

Objective 3. Restore sensitive habitats that have been disturbed.

Objective 4. Review and analyze revegetation projects in sensitive habitat to determine levels of success and the cost benefit of different restoration procedures.

Objective 5. Provide high quality stocks of locally adapted seed and plants to support revegetation projects.

Goal: Conserve biodiversity on Base.

Objective 1. Maintain and/or restore connective corridors between natural areas. Isolated patches of habitat in a fragmented landscape impair the movement and dispersal of herpetofauna. Establishment of corridors and habitat that increase survival of herpetofauna moving among habitats will greatly enhance the conservation of most species.

Objective 2. Conduct Baseline inventories and updates of amphibian and reptile species.

Objective 3. Protect, maintain and/or restore seasonal wetland and the connective corridors between them to maintain ecosystem functions (to include maintenance of the hydrologic flows on East Toll Gate Creek when it does not impact the Base's military mission).

Objective 4. Continue to promote programs that enforce conservation of natural resources on Base.

Goal: Monitor sensitive amphibian and reptile species.

Objective 1. Use long-term plots and selected sites to monitor population size and distribution**.**

Objective 2. Confer with the USFWS and CDFG on sensitive species that may be proposed for listing.

Objective 3. Document habitat requirements for listed and sensitive nonlisted species.

Objective 4. Support the intent of the migratory bird conventions (E.O. 13186).

Objective 5. Use inventory and monitoring data to implement an adaptive management strategy.

Goal: Mitigate the impacts of military testing/training and support activities.

Objective 1. Work with proponents to ensure the development and implementation of appropriate mitigation measures and species monitoring efforts for training activities that may have an adverse impact on herpetofauna and/or their habitat. Habitat loss is the most evident threat to herpetofauna.

Objective 2. Consider the timing of testing and training events and if possible, adjust action times/dates to minimize impacts to herpetofauna. Herpetofauna at Buckley AFB are active from March through October and are more vulnerable to adverse impacts during this period. It may be possible to schedule testing and training activities to meet the military objectives while providing maximum protection to the herpetofauna. Avoid conducting activities in sensitive habitats.

Objective 3: During Trenching/Excavation Activities:

(i) Minimize the amount of open trench at any given time; keep trenching and back-filling crews close together.

(ii) Schedule trenching projects in the cooler months (October – March), whenever possible, to avoid the time frames when herpetofauna are most active and susceptible to entrapment in trenches.

(iii) Inspect and remove herpetofauna from trenches/excavations that are left open overnight and prior to back-filling.

(iv) Install escape ramps at intervals of 100 yards (or closer) along the entire length of an open trench/excavation site. Have at least one escape ramp per open trench/excavation site. Escape ramps can be short lateral trenches sloping to the surface or wooden planks extending to the surface. The slope for escape ramps should be less than 45^{o}.

Goal: Mitigate the impacts of ground disturbance and erosion associated with construction projects in or near areas containing sensitive habitat.

Objective 1. Minimizing the amount of area disturbed and the length of time barren ground is left exposed during construction activities to limit erosion.

Objective 2. Utilize Best Management Practices (BMPs) and general sediment and erosion controls (stabilization). This may include temporary seeding, mulching, sod stabilization, and creation of vegetative buffer strips using native seeds and seedlings during construction;

Objective 3. Install Low Impact Development (LID) structures to divert or store flow, or limit runoff to reduce sedimentation and erosion.

Objective 5. When restoring disturbed surface areas utilize xeriscaping to minimize pesticide use, erosion, flooding, and future maintenance.

Objective 4. Support efforts to author/coauthor papers for scientific journals presenting research/project results.

Goal: Control pests and invasive species.

Objective 1. Comply with all Federal, State, and local laws and regulations pertaining to pest management and pesticide use, to include ensuring contractor personnel are State certified applicators.

Objective 2. Inventory and map the distribution and abundance of nonnative, invasive plant species (*e.g., Salsola kali, Verbascum thapsus*). Non-native plants can out-compete native plants and affect habitat quality.

Objective 3. Develop species-specific management plans for priority species.

Objective 4. Review and evaluate plans and make adaptive management adjustments.

Objective 5. Maximize safety and minimize pesticide use and potential hazards to humans, amphibians and reptiles and their sensitive habitat.

Objectives 6. Prevent the introduction of noxious plant and animal species to the Base to the greatest extent possible.

Objective 7. Prioritize sensitive areas that require invasive plant and animal management.

Objective 8. Control non-native animal species. A number of non-native species, both plant and animal, have detrimental effects on herpetofauna. Bullfrogs and other amphibians introduced into areas where they are not native can adversely impact local populations of native amphibians through predation and competition. Feral cats (*Felis silvestris*) and dogs (*Canis familiaris*) can deplete local populations of reptiles.

Objective 9. Educate Base personnel on invasive plant and animal species impacts to the environment.

Goal: Mitigate the impacts that installation ground maintenance has on amphibians and reptiles

Objective 1 Avoid mowing along the edge of lakes, ponds, rivers and streams. Maintain a healthy vegetative buffer around these areas to provide habitat and dispersal corridor. The larger the buffer, the greater the benefits will be for herpetofauna. Consult with the installation natural resources manager to determine an adequate buffer width.

Objective 2. Minimize, reduce or avoid use of pesticides and other chemicals in and around water bodies. Such chemicals can adversely affect amphibians, especially larval forms.

Goal: Promote and provide educational opportunities for the Buckley AFB natural resources program.

Objective 1. Provide information to Buckley AFB personnel and selected surrounding communities to improve the understanding of Buckley AFB's mission and natural resources stewardship efforts.

Objective 2. Take advantage of available technology to enhance natural resources educational outreach.

Objective 3. Support requests from local youth groups and schools to encourage natural resources conservation.

Objective 4. Support efforts to author/coauthor papers for scientific journals presenting research/project results.

Goal: Bullfrog control and eradication.

Year 1

Objective 1. Reduce the survival of metamorphic and juvenile bullfrogs by draining Williams Lake during the breeding season (March to October) (Adams and Pearl 2007).

Objective 2. Eradicate adult bullfrogs by capturing adult frogs during March through October during their period of activity. Capturing should be conducted at night using battery powered, hand-held spotlights. Bullfrogs become paralyzed in the bright light and are then easily captured either by hand or shooting. The Bullfrogs are pithed and their stomach contents are analyzed. A target of removing approximately 100 to 200 Bullfrogs per year over the next 5-10 years should substantially reduce the predation effect on other species of frogs.

Year 2

Objective 3. Document the success of year 1 management activities by refilling Williams Lake during the spring and monitoring the lake for Bullfrogs from the March through October.

Objective 4. Eradicate any Bullfrogs documented as present in year 2 by repeating objectives 1 and 2 of year 1.

Years 3 through 5

Objective 5. Monitor Williams Lake for Bullfrogs and repeat objectives 1 and 2 of year 1 if any are documented. If Bullfrogs are documented and analysis of the distribution of Bullfogs in the surrounding area may be needed to assure reinvasion by overland dispersal is not occurring (Adams and Pearl 2007).

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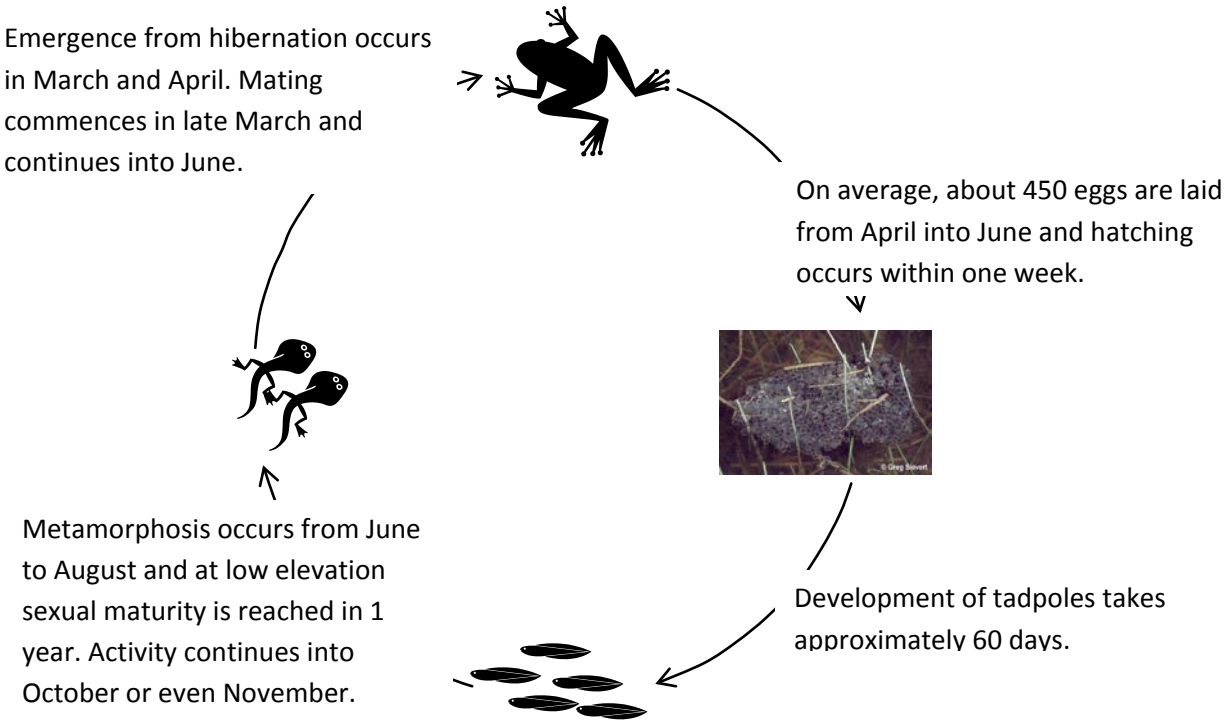
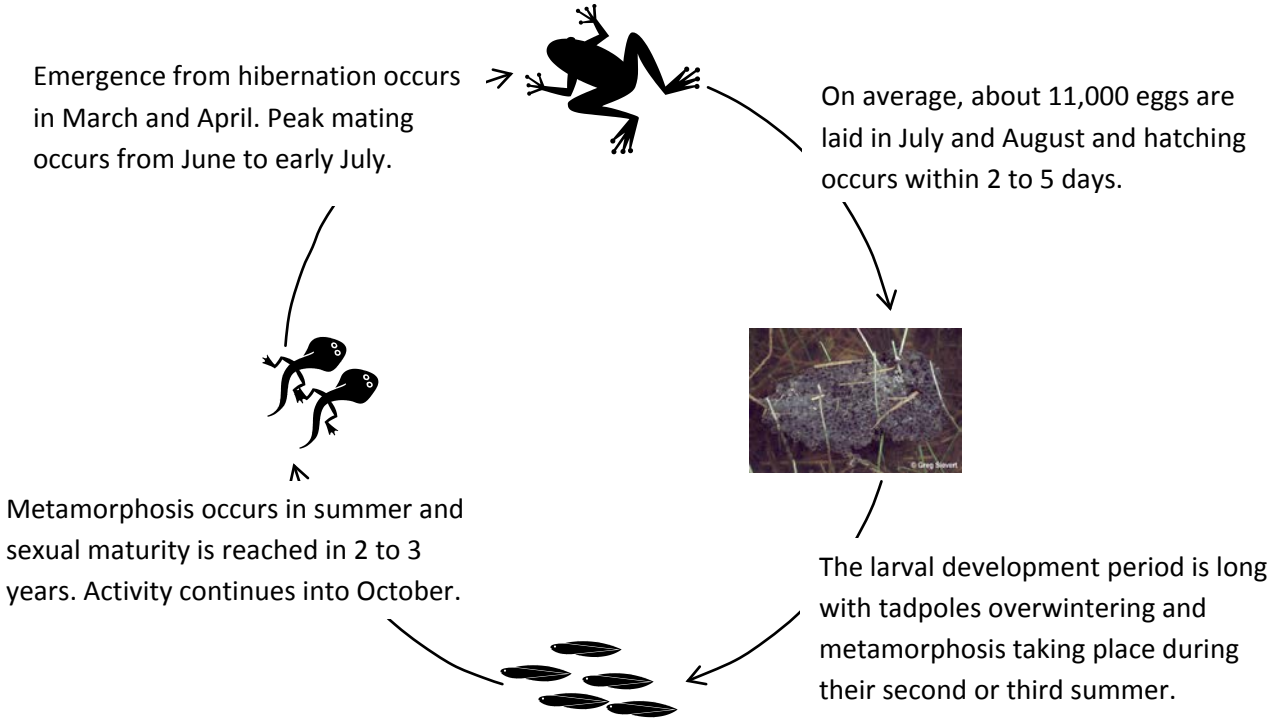
APPENDIX 1

Amphibian and Reptile Life Cycles

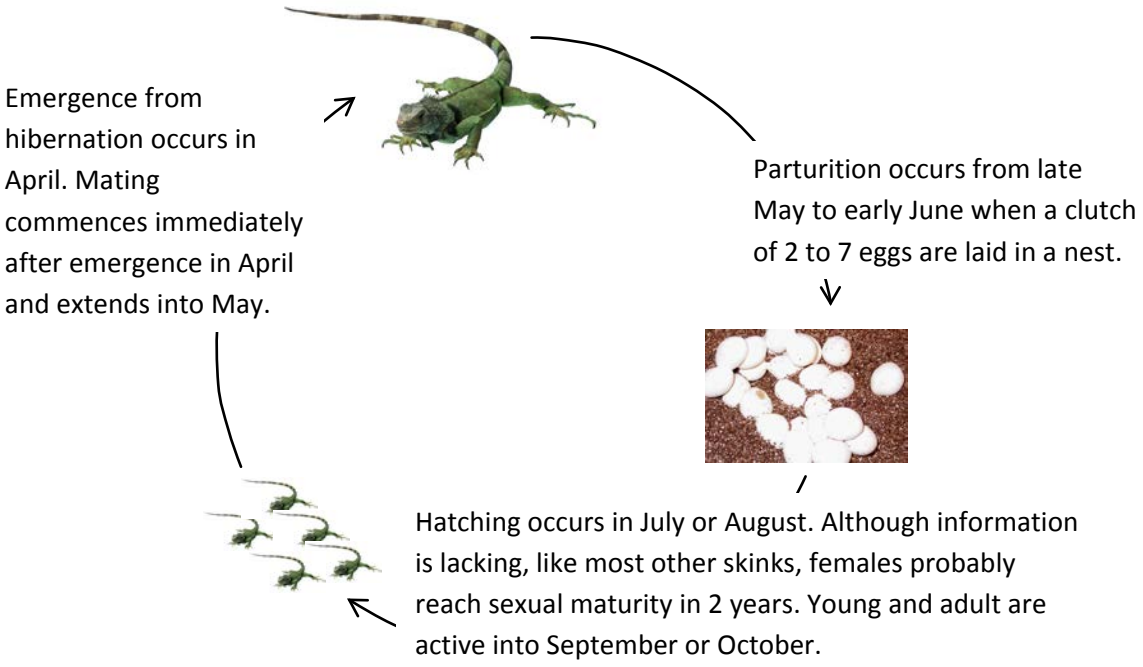
Life Cycle of the Western Chorus Frog (*Pseudacris maculata*)



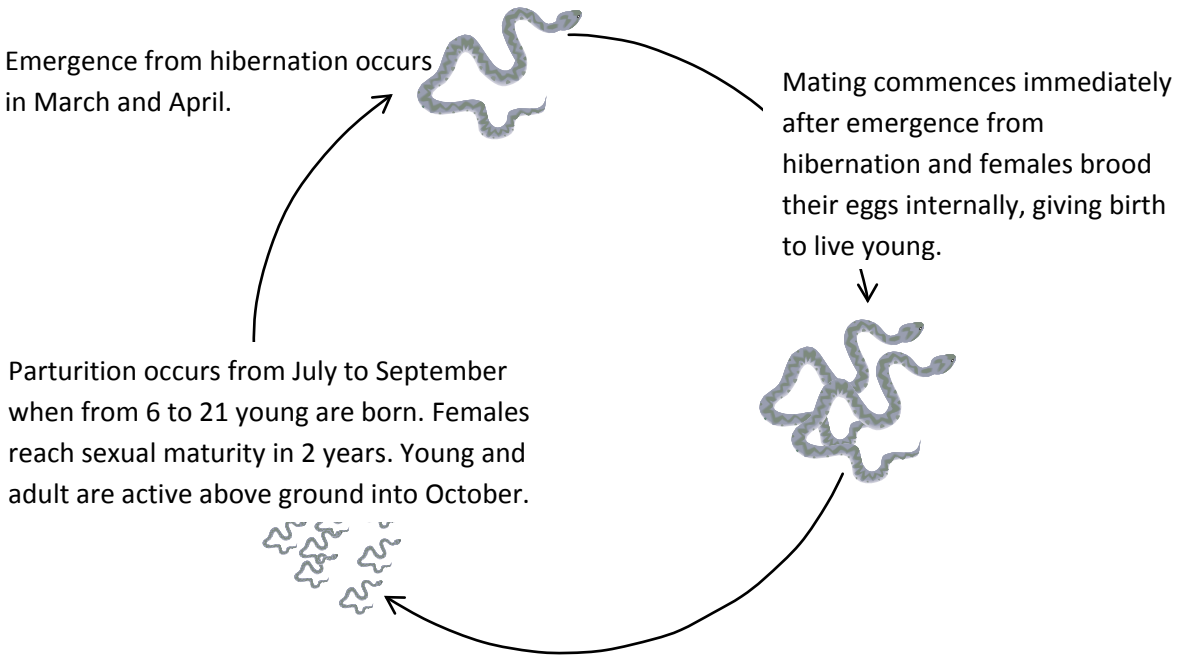
Life Cycle of the Bullfrog (*Lithobates catesbeiana*)



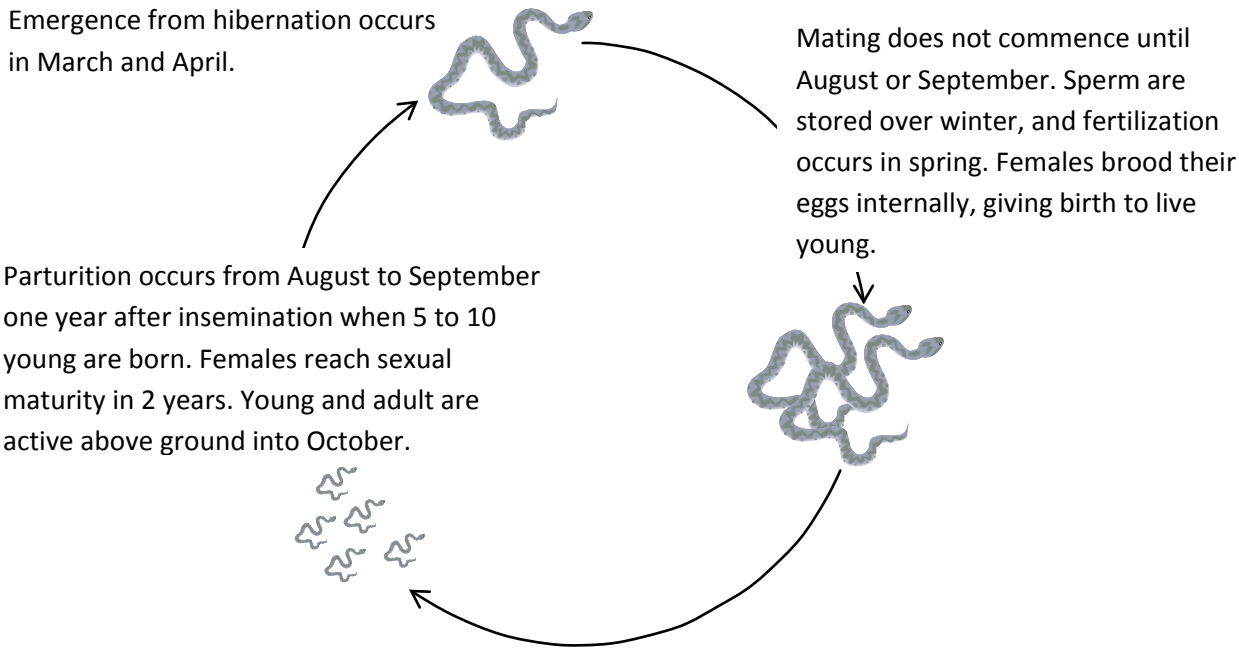
Life Cycle of the Northern Many-lined Skink (*Plestiodon multivirgatus multivirgatus*)



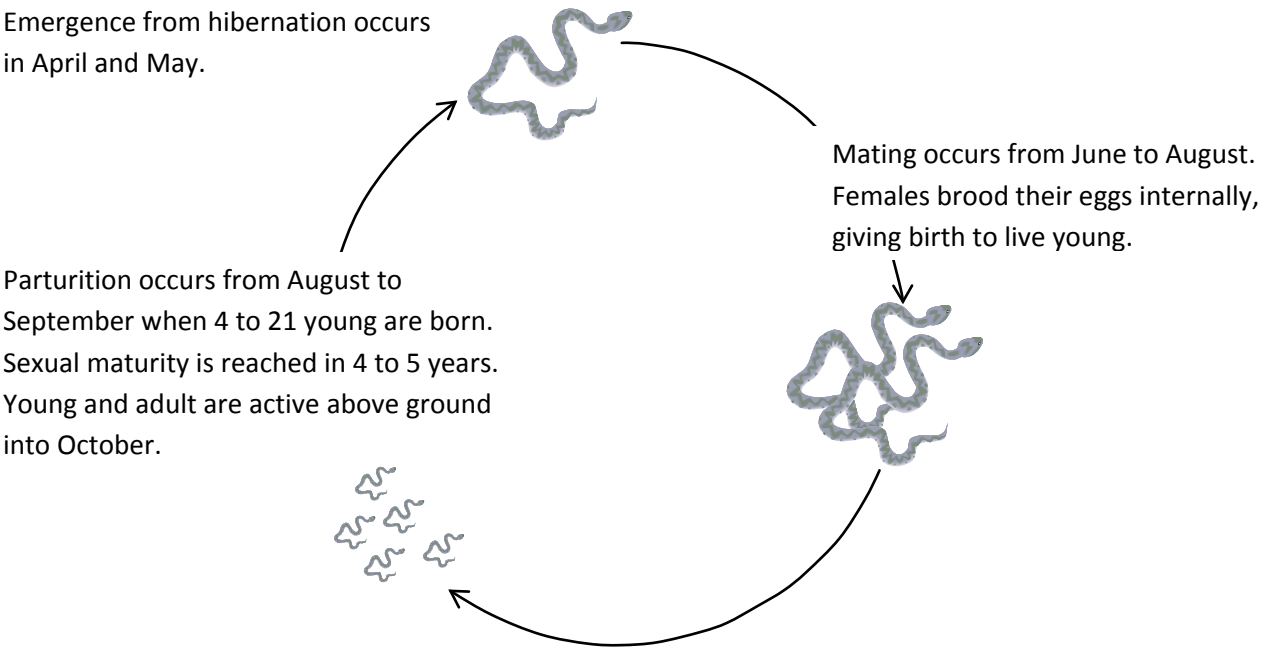
Life Cycles of the Terrestrial Gartersnake (*Thamnophis elegans*) and Plains Gartersnake (*Thamnophis radix*)



Life Cycle of the Lined Snake (*Tropidoclonion lineatum)*



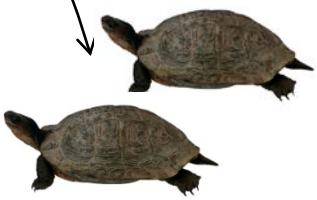
Prairie Rattlesnake (*Crotalus viridis*)



Painted Turtle (*Chrysemys picta*)

Emergence from hibernation occurs in March or April.

Mating usually occurs from March to April, but may take place in summer and fall as well.



Nesting and parturition occurs from mid-May to mid-July when a clutch of 6 to 21 eggs are laid in a nest.

Hatching occurs in late summer and new hatchlings remain in the nest over their first winter, emerging in late march to June of the following summer.