

Amphibians & Reptiles

Introduction

The American Southwest, including the Chihuahuan Desert Inventory and Monitoring (I&M) Network (CHDN), is well known for its abundance and diversity of reptiles. The area is less well known for its amphibians, but they are abundant in some habitats, particularly during favorable weather conditions. The Chihuahuan Desert supports more than 170 herpetofauna (reptile and amphibian) species, and the Chihuahuan Desert Ecoregion (a larger area not strictly defined by the desert itself) supports approximately 217 native species (Fitzgerald et al. 2004). Some animals that are typical of the Chihuahuan Desert (but which may also occur outside of the area) include the Mohave rattlesnake (*Crotalus scutulatus*), coachwhip (*Masticophis flagellum*), New Mexico whiptail (*Aspidocelis neomexicana*), red-spotted toad (*Bufo punctatus*), and Trans-Pecos ratsnake (*Bogertophis subocularis*). At least 18 reptile species are endemic to the Chihuahuan Desert, but there are no endemic amphibian species. The ranges of several

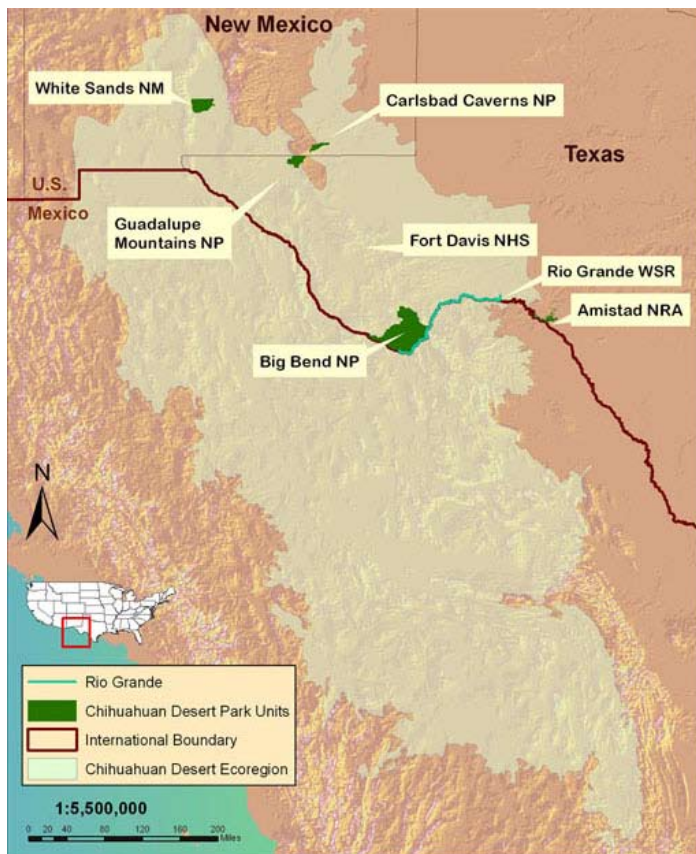


Figure 1. Locations of CHDN parks within the Chihuahuan Desert Ecoregion.

OVERVIEW



Couch's spadefoot

COURTESY: COLORADO DIV OF WILDLIFE

lizards are centered in the Chihuahuan Desert, including the Texas banded gecko (*Coleonyx brevis*), Texas horned lizard (*Phrynosoma cornutum*), greater earless lizard (*Cophosaurus texanus*), Western marbled whiptail (*Aspidoscelis marmorata marmorata*), and several species of spiny lizards (*Sceloporus* spp.).

Amphibians and reptiles are important components of aquatic and terrestrial ecosystems. Amphibians constitute an important part of the food web; they consume insects and other invertebrates, and they are prey for a long list of fish, reptile, bird, and mammal species, and even some predatory aquatic insects. Reptiles too serve as both predators and prey for many animals, such as small mammals, birds, and other reptiles. The occurrence of amphibians is associated with healthy wetland habitats. Amphibians serve as indicators of ecosystem health because their permeable skin and complex life histories make them particularly sensitive to environmental disturbance and change. Reptiles and amphibians are also of aesthetic value to visitors of the national park units within the CHDN.

Amphibians and reptiles are, together, referred to as herpetofauna or "herps." Most herpetofauna species lay eggs, although some give birth to live young. They are ectotherms, meaning they are unable to regulate heat within their own bodies and warm up or cool off through behavioral means (e.g., basking or seeking shade). Although this places limits on their distribu-

tion and times of activity, it allows them to live on less energy than mammals or birds of similar size. Amphibian and reptile species may occupy similar habitats and are similarly vulnerable to habitat degradation and other threats. Herpetofauna populations may exhibit dramatic, natural fluctuations in site occupancy, distribution, abundance, and species richness.

Distribution and Life History

The location of the parks in the CHDN and the extent of the Chihuahuan Desert in both the U.S. and Mexico are shown in Figure 1. Not only are there a large number of herpetofauna species in the CHDN, there are a number of resources that describe their distribution and life history. Thus, rather than duplicating such material here, we refer readers to some of the alternative sources (see the last section of the overview, “Sources of Distribution and Life History Information”). It is not our intent to endorse any particular source, but to provide a sampling of what is available. Additionally, recent herpetofauna surveys have been conducted in the parks of the CHDN; the results of these inventories are discussed in the “Management and Monitoring Activities” section of the overview. Lists of federally threatened and endangered species at individual parks can be obtained online at the NPS ESA Database (<http://www.nature.nps.gov/biology/endangeredspecies/database/search.cfm>).

Ecology

Amphibians and reptiles may occupy similar habitats and can be found in most habitat types. Some species use different habitats at different times of the year. Some turtles, for example, spend most of their time in the water, but must move to land to lay eggs. Many salamanders inhabit upland habitats for most of the year, but require temporary or permanent wetlands or aquatic sites to breed and lay eggs. Additionally, many herpetofauna species become less active during periods of extreme cold or heat, and at such times they seek out pro-

tected sites. Depending on the species and location, amphibians may need sites for burrowing in moist soil or wet areas to keep their skin moist (Marks 2006). Near wetlands and riparian areas, amphibians use a variety of upland microhabitats, including leaf litter, woody material, small mammal burrows, and boulders and cracks in rocks.

From a study in Big Bend National Park (NP; i.e., Dayton et al. 2004), researchers found that soil type appeared to be a good indicator of the presence or absence of four common desert anurans (frogs and toads)— Couch’s spadefoots (*Scaphiopus couchii*), red-spotted toads (*Bufo punctatus*), Texas toads (*Bufo speciosus*), and Western green toads (*Bufo debilis insidior*). The species were disproportionately associated with soils characterized as frequently inundated with a relatively high clay content. Species richness and abundance were highest in Tornillo and Glendale-Harkey soils; almost half of all the anurans detected were found in these two soil types, but the soils comprised only 12% of the available soil along the research transects. Of the species found on Tornillo and Glendale-Harkey soils, the vast majority were Couch’s spadefoots and Texas toads, both species that burrow.

Reptiles require sites that contain shelter from the heat and basking areas in the sun. Microhabitats used during times of extreme cold or heat include rock piles or outcroppings, animal burrows, woody material, and brush piles. Many snakes and lizards would also find these suitable areas for nesting. A description of adaptations of amphibians and reptiles for living in desert environments is found in Van Devender (2000). These adaptations include the ability to excavate deep burrows where the animal may stay for substantial periods of time (e.g., Couch’s spadefoot, which is aided in digging by spades on its hind feet). Some reptiles, such as the Gila monster (*Heloderma suspectum*, which occurs in the Chihuahuan Desert but not in the CHDN), store water in the fatty tissues of their tails. Adaptations also exist for living in loose, wind-blown sand. For example, the fringe-toed lizard (*Uma* spp.) gains traction while running across dunes with the fringe-like scales on the elongated toes of its back feet.

Amphibians and reptiles are both important members of aquatic and terrestrial ecosystems. Both groups serve as both predators and prey, and species that inhabit both ecosystems serve to transfer energy between the two systems. Amphibians are viewed as indicators of wetland ecosystem health. They are sensitive to a variety of threats and, thus, can serve as early indicators of ecosystem change when monitored over long time scales. Changes in amphibian populations can often be linked to one of the following causes, all of which suggest a decrease in overall ecosystem health: pollution, introduced species, drought, habitat destruction, disease, and ultraviolet radiation. Amphibian populations may exhibit measurable changes



PHOTO: © ROBERT SHANTZ

Texas horned lizard



NPS PHOTO

Texas banded gecko

in site occupancy, distribution, abundance, species richness, disease occurrence, and malformations. These changes have cascading effects on other aspects of the ecosystem, such as predator, prey, and competitor populations, energy flow, and nutrient cycling (Stebbins and Cohen 1995).

Activity and behavior of both amphibians and reptiles are affected by local weather conditions during the year. For example, lower rainfall and higher temperatures can significantly affect microhabitat in an area and reduce the likelihood of observing amphibians, and, to a lesser extent, reptiles, for some period of time. This may result in lower recorded population levels during subsequent seasons and years. Similarly, daily activity of reptiles may be affected by rain and/or cold weather. These effects of local weather conditions can hamper short-term studies of herpetofauna, especially in the dry Southwest (Johnson and Lowe 1979, Lowe and Holm 1991). Effects of drought on herpetofauna are discussed further in the section below under "Drought."

Threats and Concerns

Declines in amphibian and reptile populations have been and are being observed. Herpetofauna across the globe face threats from both known and unknown sources (Gibbons et al. 2000). Disease may now be as great a cause of amphibian decline as habitat destruction. Potential causes of herpetofauna decline in the Southwest include habitat loss and degradation, invasive species, drought, legal and illegal collecting, disease, and other causes (e.g., chemical contamination, ultraviolet radiation).

Habitat Loss and Degradation

Habitat loss and degradation is one of the greatest threats to amphibian and reptile populations. Habitat loss/degradation occurs from a variety of sources, including urban/suburban development, aquatic habitat alteration from water withdrawals and stream diversions, water pollution, and off-road ve-

hicle use in terrestrial habitats. Declines in both population levels and species diversity have been attributed to habitat loss and degradation. Development can negatively affect habitat by destroying sites or degrading their quality, and by creating barriers or hazardous zones (e.g., a road) between important habitat features. Loss and degradation of habitat can disrupt population connectivity, diminishing the rate of dispersal and recolonization such that local populations are unable to persist through natural catastrophes or population fluctuations. Urban development also increases conflicts between venomous species and humans (Sullivan et al. 2004, Nowak et al. 2002).

Many studies have reported high rates of amphibian and reptile mortality on roads. Amphibian populations are most susceptible to high rates of road-kill when migrating en masse between habitat patches. Reduced anuran density and population abundance, lower probabilities of occurrence, and adverse population genetic effects have been attributed to roads. Reptiles, such as snakes, sometimes prefer sunning on warm, smooth surfaces such as roads. A year-long study in a Texas wildlife management area found road traffic affected reptiles extensively in the fall and spring and amphibians in the spring and summer. In the spring, 83% of amphibians observed were found dead on the road (Coleman et al. 2008).

Invasive Species

Non-native invasive species are another threat to herpetofauna populations. Non-native invasive species may act as predators of or competitors with native species. Bullfrogs (*Rana catesbeiana*), for example, occur in at least two parks in the CHDN (Carlsbad Caverns and Big Bend NPs; Prival and Goode [2005]). At Carlsbad Caverns NP, the bullfrog has been documented and studied at Rattlesnake Springs (Krupa 1998). At this location, the non-native was found to out-number the Rio Grande leopard frog (*Rana berlandieri*) 50% of the time in the spring pool and on every occasion counted in the stream (at ratios of 7:1 to 20:1). A Rio Grande leopard frog or tadpole was found in only a few bullfrog stomachs (out of ~85 bullfrogs collected), but the analysis showed that the bullfrogs do consume leopard frogs. Adult leopard frogs captured dur-



PHOTO: KELLY MCALLISTER

Bullfrog



PHOTO: ©JAMES BORGMAYER

Rio Grande leopard frog

ing the study were either young, newly transformed adults or large, old adults; middle size classes were missing, possibly due to predation by bullfrogs (Krupa 1998). At Big Bend NP, bullfrogs have been found along the Rio Grande and in the Beaver Pond at Rio Grande Village (Dayton 2005), but not in the interior of the park. A non-native treefrog, *Hyla cinerea*, native to southeastern North America, was recently discovered at Big Bend NP. The frogs are currently found in/around two ponds in the park (Beaver Pond and Spring 4 Pond in Rio Grande Village) and are consuming a variety of terrestrial arthropods (Leavitt and Fitzgerald 2009).

Non-native fish can also be a major problem for native aquatic amphibians and reptiles. Non-native fish compete with or eat native fish that are needed by the herpetofauna species, or they may eat the herpetofauna themselves. In Carlsbad Caverns NP, non-native green sunfish (*Lepomis cyanellus*), as well as largemouth bass (*Micropterus salmoides*) and Western mosquitofish (*Gambusia affinis*) have been found in the pond and natural channel at Rattlesnake Springs (Krupa 1998; Carlsbad Caverns NP 2007). Krupa stated in 1998 that if the green sunfish (the largemouth bass was not there at the time) was to establish in the spring pool it could adversely impact the Rio Grande leopard frog by consuming tadpoles. A project was undertaken in 2007 to remove the exotics from the pond, pool, irrigation ditch, and natural channel, and more than 150 fish were removed (Carlsbad Caverns NP 2007). After the project Rio Grande leopard frogs and their egg masses, as well as freely swimming native fish, were observed in the pond.

A non-native reptile known to occur in the CHDN is the Mediterranean gecko (*Hemidactylus turcicus*) (Prival and Goode 2005). It has been found in at least two of the parks in the network (Amistad NRA and Big Bend NP). Occurring throughout urban areas in the southern U.S., this species was first observed at Amistad after 1977 (Prival and Goode 2005). Although it is commonly found on buildings near lights (where it is attracted by insects), it is found on natural cliff faces at Amistad NRA. At the present time, this non-native species is not thought to threaten native species.

The introduction of non-native plant species may threaten some reptiles. Alteration of habitat (e.g., changes in habitat structure and native plant community composition) has negatively affected the desert tortoise (*Gopherus agassizii*) in the Sonoran Desert. The increase of invasive plants (e.g., red brome [*Bromus rubens*] and buffelgrass [*Pennisetum ciliare*]) has led to increased fire frequencies, to which the tortoise and the plants/habitat upon which it depends are not well-adapted (Esque 2003). A recent study in Big Bend NP found that non-native plants are becoming more abundant in some areas studied. The plants found that are of most concern are buffelgrass, King Ranch bluestem (*Bothriochloa ischaemum*), Johnson grass (*Sorghum halepense*) and Lehmann lovegrass (*Eragrostis lehmanniana*) (Leavitt 2007). Leavitt recommends that future research should consider the impacts of non-native plants on the diversity and density of herpetofauna.

Drought

Amphibian and reptile populations are sensitive to fluctuations in the amount and timing of precipitation. Drought has been implicated as the cause of drastic declines in frog populations. In addition to direct effects on survival and reproduction, drought can adversely affect amphibians by interacting with other factors, such as disease, UV-B radiation, and exposure to contaminants. Although drought is a natural phenomenon, climate changes including drought could be occurring faster than organisms can adjust. Climate change is cited consistently as one of the main potential causes of amphibian population declines. Temperatures have increased 0.8 degrees celcius in the West since the 1950s, and they are predicted to rise by 2-5 degrees in the next century (Hansen et al. 2001). Drought frequency is predicted to increase by 66-90% (Gitlin et al. 2006).

Drought adversely affects amphibians because of their dependence on pooled surface water for reproduction. When a breeding pond dries up prior to the onset of metamorphosis,



Ornate box turtle

COURTESY: COLORADO DIV OF WILDLIFE

the entire reproductive effort for the year is lost. At ponds reduced in size because of drought, an increase in larval density can negatively influence larval survival by slowing development. In addition, pond drying can result in early metamorphosis, which is linked to small body size and decreased survival rates in juvenile frogs. Post-metamorphic amphibians that use terrestrial habitats for non-breeding activities can also be adversely affected by drought. The loss of body water through evaporation must be offset through absorption of water from wet or moist substrates. Amphibians must rehydrate frequently, as death results from desiccation. Amphibians crowded into limited habitat also may be more subject to disease or parasite epidemics.

Drought impacts desert reptiles because there is less free water for them and their prey. Prey numbers typically decline during drought, and many reptiles rely on their diets to obtain water. If they can not drink free water, they may die from desiccation if they can not eat enough. A behavior of some reptiles, which may be especially important for survival in the desert where rainwater may not accumulate (Repp and Schuett 2008), is that of harvesting and drinking water from their own bodies (e.g., from a pool of water within a snake's coils). Repp and Schuett (2008) reported on western diamond-backed rattlesnakes (*Crotalus atrox*) harvesting and drinking rainwater during an extended drought.

Legal and Illegal Collecting

Legal and/or illegal collecting of herpetofauna may also affect some populations within the Chihuahuan Desert region, although the magnitude of this problem is unclear (in part due to a lack of information on the collection and sale of nongame species). For instance, based on data for Texas in 1999, nearly 5,000 amphibians and nearly 10,000 reptiles (not including rattlesnakes for rattlesnake roundups) were reported to be collected by 53 nongame permit holders (Fitzgerald et al. 2004). With regard to international trade in reptiles from the Chihuahuan Desert region in the U.S., Fitzgerald et al. (2004) note that the export of live snake and lizard species does not appear to be of significant concern, but that the trade in parts or products of a small number of species may be of greater concern. The trade in parts or products is more likely to involve wild-caught adult animals, including venomous species. The Western diamond-backed rattlesnake, for example, is exported in various forms, particularly as meat. Although collection and trade may not be a significant threat for the majority of herpetofauna species in the Chihuahuan Desert region of the U.S., over-collecting may be impacting local populations of some species with particular vulnerabilities and/or life history characteristics (e.g., those that are long-lived, have a low reproductive rate, or with fragmented ranges; Fitzgerald et al. 2004).



Trans-Pecos ratsnake

NPS PHOTO, DAVE PRIVAL

Diseases

Chytridiomycosis

The disease chytridiomycosis is caused by a recently identified species of parasitic fungus (*Batrachochytrium dendrobatidis*), known as the amphibian chytrid fungus. Chytridiomycosis is considered a major threat to amphibians worldwide, causing population declines and species extinctions. Much remains unknown about the disease. The water-dependent fungus attacks amphibian skin and is believed to be able to persist in aquatic environments without amphibians. Amphibian larvae are not lethally affected, but they can carry the fungus in mouthparts and toe tips during later stages of development. Some amphibian species can carry the fungus without being killed by it, and they may serve as vectors of the pathogen to more susceptible species. The responses of amphibian populations infected with the fungus range from no perceptible impact, to mass mortality events, to severe decline without recovery. Reports of the disease in the Southwest include infections in lowland leopard frogs (*Rana yavapaiensis*), Chirichahua leopard frogs (*Rana chiricahuensis*), and canyon tree frogs (*Hyla arenicolor*) in eastern, central, and southern Arizona (Bradley et al. 2002). The disease has also been detected in Texas (Gaertner et al. 2009).

Ranavirus

The genus Ranavirus (family Iridoviridae), only recently discovered, causes disease in amphibians, reptiles, and fish. Amphibian ranaviruses are considered a global threat to amphibian populations due to their high virulence and rapid expansion to areas with previously unexposed populations. Ranavirus is associated with mass mortalities in amphibians, particularly larvae and recently metamorphosed juveniles, with death rates reaching 100%. Death is thought to result from organ failure due to tissue necrosis and possibly from secondary bacterial infections. Ranavirus can be spread in various ways, including

through infected food, water, human handling, introduction of fish and amphibians (e.g., released bait and pets), and boats and fishing gear. The disease is thought to be particularly associated with disturbed or degraded habitats and high amphibian densities. Susceptibility to disease may be influenced by many factors, including chemical exposure and temperature. Ranavirus has not been shown to cause local or species extinctions, but because ranavirus outbreaks sometimes kill all or most of an entire year class in a population, the persistence of local amphibian populations could be threatened by episodic die-offs.

Other Potential Threats

Because pollutants have reduced the thickness of the protective ozone layer in the atmosphere, increased amounts of ultraviolet (UV) radiation are reaching the Earth's surface. UV radiation levels have increased substantially over the last 30 years, with most of the increase occurring in the mid- and high-latitudes (NASA 2010). Amphibians may be more vulnerable to harmful effects of UV radiation than other kinds of animals due to their "naked" skin and shell-less eggs. Adverse effects of UV-B include interference with intracellular functions, impaired transcription of DNA, and interactions with chemicals that make them more toxic. Field and laboratory studies have demonstrated increased mortality, deformities, and susceptibility to fungal disease. There is debate over whether or not UV-B is a main factor in currently observed amphibian declines, but researchers share concern about ozone depletion and the consequences of increasing levels of UV-B. Of particular concern is the potential for UV-B to interact in complex ways with contaminants, climate (e.g., drought), and disease.

Chemical contaminants come from many sources and can have direct and indirect effects on herpetofauna (Gibbons et al. 2000). Amphibians may be exposed to chemical hazards through direct uptake from water or by ingestion of contaminants in soils, sediments, and food items. They may be unusually susceptible to toxins due to their permeable skin and protracted development in the aquatic environment. Many aquatic snakes and other aquatic/semi-aquatic reptiles may also be susceptible to contaminants. Knowledge about the effects of contaminants on amphibians is scarce, and reptiles have been studied even less (Gibbons et al. 2000). Effects of contaminants on reptiles are known primarily from observations of turtles and crocodilians.

Increased temperatures resulting from climate change could affect some reptiles and amphibians. Evidence for effects on freshwater turtles includes increased juvenile growth rates, earlier ages at maturity, and changes in sex ratios (Frazer et al. 1993). Crocodilians and some turtles may be affected the most, because of their temperature-dependent sex determina-

tion. Altered sex ratios could affect population demographics and persistence. Reptiles and amphibians could also be affected by climate change if changes occur in hibernation periods. The absence of a long hibernation period could result in starvation over the winter or changes in gonadal development. An increase in summer temperatures could render burrows unusable and result in desiccation.

Management and Monitoring Activities

Recent surveys for amphibian and reptile species have been conducted in CHDN parks. In 2003 and 2004, the University of Arizona (i.e., Prival and Goode 2005) conducted an inventory of herpetofauna in the six parks of the CHDN—Amistad NRA, Big Bend NP, Carlsbad Caverns NP, Guadalupe Mountains NP, Fort Davis National Historic Site (NHS), and White Sands National Monument (NM). Little was known about reptiles and amphibians in some of the parks prior to the University of Arizona inventory. The primary objectives of the inventory were to document herpetofauna species, map the distribution of the species found, and determine an approximate relative abundance for each species. The inventory results will aid in future monitoring in the parks. A summary of the results of the project are presented below.

Other efforts to document and/or study the reptiles and amphibians in the CHDN parks have also taken place. In some of the parks inventories had been conducted prior to those in 2003-2004, and some parks had existing species checklists. Such information available for the parks includes:

- a checklist of species at Carlsbad Caverns NP (2007);
- a study of the herpetological community at Rattlesnake Springs (Carlsbad Caverns NP) and an assessment of the abundance of the native Rio Grande leopard frog and the introduced bullfrog (Krupa 1998);
- a study of the distribution of anurans in the Big Bend region and an examination of how abiotic and biotic factors shape the composition and structure of anuran communities (Dayton 2005);
- a checklist of amphibians and reptiles at Big Bend NP (Easterla 2002);
- a study to reassess a lizard survey at Big Bend NP (Leavitt 2007); and
- a checklist, with notes, of herpetofauna at White Sands NM (2002);
- information (with photographs) on herpetofauna at White Sands NM based on observations made from 1971-1977 (McKeever 2009).

- some older inventories at various parks (e.g., LoBello [1976] at Amistad NRA, and Grace [1980] at Guadalupe Mountains NP).

Herpetofauna Inventory at CHDN Parks

As noted above, the inventory of the six CHDN park units was conducted in 2003 and 2004. This section summarizes the findings of the inventory by park. Complete lists of the species recorded in each park during the surveys are available in Prival and Goode (2005).

Amistad NRA—Amistad NRA is located in a transition zone between three major plant communities: the Chihuahuan Desert, Edwards Plateau, and Tamaulipan Shrubland (see Figure 1 for location). Three major rivers and the Amistad Reservoir occur in the NRA. Herpetofauna searches were mostly focused along the eastern shore of the reservoir. The animals recorded belonged to 45 species; of the four herpetofauna groups, snakes accounted for the greatest number of species (Table 1). Some species recorded included the Rio Grande leopard frog (*Rana berlandieri*), Blanchard's cricket frog (*Acris crepitans blanchardi*), Merriam's canyon lizard (*Sceloporus merriami merriami*), Texas greater earless lizard (*Cophosaurus texanus texanus*), Texas nightsnake (*Hypsiglena torquata jani*), Western ribbonsnake (*Thamnophis proximus*), Rio Grande cooter (*Pseudemys gorzugi*), and red-eared slider (*Trachemys scripta elegans*). Four state-threatened species were found at Amistad NRA (Table 2), as well as one non-native species. See the section on non-native species under "Threats" for a discussion of this and other non-native species. Eighty-two percent of the species likely to occur at the park unit were recorded during the inventory.

Big Bend NP—Big Bend NP is the largest protected area of Chihuahuan Desert in the U.S. The park has a substantial range in elevation, which leads to a diversity of plants and animals. The Prival and Goode inventory focused on three mountain ranges that had not been previously surveyed—the Sierra Quemada, the Sierra del Caballo Muerto, and the Mesa de Anguila. Additionally, the inventory was focused on reptiles, because another study (Dayton 2005) was being conducted on amphibians. Fifty-nine species were recorded during the inventory, with the highest proportion of these being snakes (Table 1). Some of these species included the Rio Grande leopard frog, red-spotted toad (*Bufo punctatus*), Big Bend Canyon lizard (*Sceloporus merriami annulatus*), Chihuahuan greater earless lizard (*Cophosaurus texanus scitulus*), Western diamond-backed rattlesnake (*Crotalus atrox*), Western coachwhip (*Masticophis flagellum testaceus*), Texas nightsnake, and yellow mud turtle (*Kinosternon flavescens*). Although amphibians were not the focus of this inventory, the species recorded during the inventory were the same ones

Table 1. The number of herpetofauna species documented during the Prival and Goode (2005) inventory of CHDN parks in 2003-2004.

Park	# Species	# Amphib Spec.	# Lizard Spec.	# Snake Spec.	# Turtle Spec.
Amistad NRA	45	9	15	17	4
Big Bend NP	59	9	21	26	3
Carlsbad Caverns NP	46	8	15	20	3
Fort Davis NHS	29	5	12	11	1
Guadalupe Mtns. NP	48	7	18	21	2
White Sands NM	28	6	10	11	1

Table 2. State-listed and non-native herpetofauna species documented during the Prival and Goode (2005) inventory of CHDN parks.

Park Unit	State-listed Species	Non-native Species
Amistad NRA	Texas horned lizard (<i>Phrynosoma cornutum</i>), Texas indigo snake (<i>Drymarchon melanurus erebennus</i>), Trans-Pecos black-headed snake (<i>Tantilla cucullata</i>), Berlandier's tortoise (<i>Gopherus berlandier</i>)	Mediterranean house gecko (<i>Hemidactylus turcicus</i>)
Big Bend NP	Texas horned lizard, Reticulate banded gecko (<i>Coleonyx reticulatus</i>), Trans-Pecos black-headed snake, Texas lyresnake (<i>Trimorphodon biscutatus wilkinsonii</i>)	Mediterranean house gecko, American bullfrog (<i>Rana catesbeiana</i>)
Carlsbad Caverns NP	Gray-banded kingsnake (<i>Lampropeltis alterna</i>), Mottled rock rattlesnake (<i>Crotalus lepidus lepidus</i>), Rio Grande cooter (<i>Pseudemys gorzugi</i>)	American bullfrog
Fort Davis NHS	Texas horned lizard	None recorded
Guadalupe Mtns. NP	Texas horned lizard, Hernandez's short-horned lizard (<i>Phrynosoma hernandesi hernandesi</i>)	None recorded
White Sands NM	None recorded	None recorded

documented during the extensive surveys of Dayton (2005) in lowland, upland, and river habitats at Big Bend NP. Four state-listed species were found at Big Bend (Table 2), as well as two non-native species (Prival and Goode 2005). Eighty-six



PHOTO: ©JAMES BORGMEYER

Painted desert glossy snake

percent of the species likely to occur at the park unit were recorded during the inventory.

Carlsbad Caverns NP— Although Carlsbad Caverns NP is located in the Chihuahuan Desert, it contains several elements of Sierra Madreal, Rocky Mountain, and Great Plains affinity and is characterized by steep limestone canyons. Few permanent sources of water occur in the park aside from Rattlesnake Springs, a wooded riparian area. The park experienced well-below-normal levels of rainfall during the spring and summer 2003 survey, but in 2004 it received 4.5 times the amount of precipitation that it received during the same months of 2003.

During the inventory, individuals representing 46 species were recorded (primarily snakes and lizards; Table 1). Some of these species included the Couch's spadefoot, Southwestern fence lizard (*Sceloporus cowlesi*), Chihuahuan spotted whiptail (*Aspidoscelis exsanguis*), common checkered whiptail (*Aspidoscelis tessellata*), Northern black-tailed rattlesnake (*Crotalus molossus molossus*), striped whipsnake (*Masticophis taeniatus*), Sonoran gophersnake (*Pituophis catenifer affinis*), and ornate box turtle (*Terrapene ornata ornata*). Three state-listed species were found, as well as one non-native species (only at Rattlesnake Spring; Table 2). Researchers documented 92% of the species on the park's 2002 reptile and amphibian checklist.

Fort Davis NHS— Fort Davis NHS is located in the highly diverse Davis Mountains. The park is of a small enough size that most of it was able to be surveyed by Prival and Goode (2005). A total of 29 species, mostly lizards and snakes, were recorded during the inventory (Table 1). Some of these species included the canyon treefrog (*Hyla arenicolor*), Big Bend tree lizard (*Urosaurus ornatus schmidtii*), Chihuahuan spotted whiptail, Northern crevice spiny lizard (*Sceloporus poinsettii poinsettii*), Texas nightsnake, Central Texas whipsnake (*Masticophis taeniatus ornatus*), Western black-necked gartersnake

(*Thamnophis cyrtopsis cyrtopsis*), and ornate box turtle. One state-threatened species was found during the inventory, and no non-native species were found (Table 2). At least 57% of the species likely to occur on the NHS were observed during the inventory; however, this percentage may be an underestimate because the original species list covered the entire Davis Mountains area and probably included too many species.

Guadalupe Mountains NP— Guadalupe Mountains NP, located in the Chihuahuan Desert (Figure 1), is a diverse area in terms of habitats, plants, and animals. The park contains reliable springs, sand dunes, and forests. The focus of the inventory was McKittrick Canyon, a diverse riparian area, and the Salt Basin Dunes area, characterized by creosote flats, gypsum and quartz dunes. Low levels of precipitation occurred in 2003 and 2004. Forty-eight species were recorded during the inventory (Table 1), including the Rio Grande leopard frog, Plains spadefoot (*Spea bombifrons*), Chihuahuan spotted whiptail, Southwestern fence lizard, common side-blotched lizard (*Uta stansburiana*), Western diamond-backed rattlesnake, Northern black-tailed rattlesnake, ring-necked snake (*Diadophis punctatus*), and desert box turtle (*Terrapene ornata luteola*). Two species found in Guadalupe Mountains NP were listed as state-endangered (Table 2), but no non-native herpetofauna species were detected. About 87% of the reptile and amphibian species likely to occur in the park were observed. Of note, nine species that were not previously documented in the park were found during the inventory.

White Sands NM— White Sands NM, located in the Tularosa Basin of the Chihuahuan Desert (Figure 1), is part of the largest white gypsum dune field in the world. On the western side of the park are desert scrub habitat and a large playa. The areas on the west were accessed by crossing the White Sands Missile Range, which had related regulatory requirements that somewhat hampered the survey effort. Animals from 28 species were recorded during the inventory (Table 1), including the Western green toad (*Bufo debilis insidiosus*), red-spotted toad, Western marbled whiptail (*Aspidoscelis marmorata marmorata*), little white whiptail (*Aspidoscelis gypsi*), Plains striped whiptail (*Aspidoscelis inornata llanuras*), green prairie rattlesnake (*Crotalus viridis viridis*), and painted desert glossy snake (*Arizona elegans philipi*). No state-listed or non-native species were found at the monument during the inventory. About 74% of the reptile and amphibian species likely to occur in the NM were documented.

Sources of Distribution and Life History Information

Field Guides and Species References

Field guides for herpetofauna range from general guides to



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Western green toad

those specializing in particular geographic areas or taxonomic groups. Here are a few field guides or books with species accounts covering parts or all of the Southwest:

A Field Guide to Western Reptiles and Amphibians. 2003. The Peterson Field Guide Series. Third Edition. Text and Illustrations by R. Stebbins. Houghton Mifflin Company.

Amphibians and Reptiles of New Mexico. 1996. By W. Degenhardt, C. Painter, and A. Price. University of New Mexico Press. Albuquerque, New Mexico.

Amphibians and Reptiles of Texas. 2000. By J.R. Dixon. Texas A&M University Press, College Station.

Texas Snakes, A Field Guide. 2005. By J.R. Dixon and J.E. Werler. Univ. Texas Press, Austin.

Lizards of the American Southwest, a photographic field guide. 2009. Edited by L.C. Jones and R.E. Lovich. Rio Nuevo Publishers, Tucson, Arizona.

Electronic Resources

A sampling of resources available on the internet include:

eNature – URL: <http://www.enature.com/fieldguides/>

eNature's core content consists of wildlife information about almost 6,000 individual species and is the same data set used to create the printed Audubon Field Guides.

PARC Links – URL: http://www.parcplace.org/other_links.html

PARC (Partners in Amphibian and Reptile Conservation) is a partnership for the conservation of herpetofauna and their habitats. The PARC website page listed above contains numerous links, including those for herpetological journals, research labs, atlases, and regional resources. A few links of particular interest are noted here.

AmphibiaWeb (<http://www.amphibiaweb.org>) provides information on the conservation, natural history, and taxonomy of amphibians. Searches can be conducted by state, and photos of species are available for viewing.

The National Amphibian Atlas (www.pwrc.usgs.gov/naa) website, maintained by the Patuxent Wildlife Research Center of the U.S. Geological Survey, provides species distribution maps.

Southwest PARC (<http://chelydra.unm.edu/swparc/index.html>) is a working group focused on implementing the PARC mission in the Southwest.

Centennial Museum, University of Texas at El Paso –

URL: <http://museum.utep.edu/chih/NHCD/herps.htm>

This website contains information on the Chihuahuan Desert and its amphibians and reptiles. Available information includes photographs, distribution data and maps, species lists, and some natural history information.

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