

BEFORE THE SECRETARY OF THE INTERIOR

PETITION TO LIST THE
EASTERN DIAMONDBACK RATTLESNAKE (*CROTALUS ADAMANTEUS*)
AS THREATENED UNDER THE ENDANGERED SPECIES ACT



CENTER FOR BIOLOGICAL DIVERSITY

COASTAL PLAINS INSTITUTE

PROTECTING ALL LIVING SPECIES

ONE MORE GENERATION

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Pursuant to Section 4(b) of the Endangered Species Act (“ESA”), 16 U.S.C. § 1533(b); Section 553(e) of the Administrative Procedure Act, 5 U.S.C. § 553(e); and 50 C.F.R. § 424.14(a), the Center for Biological Diversity, Coastal Plains Institute, Protecting All Living Species, and One More Generation hereby petition the Secretary of the Interior, through the United States Fish and Wildlife Service (“FWS”), to list the eastern diamondback rattlesnake (*Crotalus adamanteus*) as a threatened species and to designate critical habitat to ensure recovery. Population numbers of the eastern diamondback rattlesnake have sharply declined and the range of the species has contracted. The snake is now rare or absent in significant portions of its range in the southeastern U.S. Habitat loss and direct mortality from automobiles and people are the most important factors in the decline of eastern diamondback rattlesnake.

The Center for Biological Diversity (“Center”) is a non-profit, public interest environmental organization dedicated to the protection of native species and their habitats through science, policy, and environmental law. The Center is supported by over 320,000 members and on-line activists throughout the United States. The Center and its members are concerned with the conservation of endangered species, including the eastern diamondback rattlesnake, and the effective implementation of the ESA.

The Coastal Plains Institute (“CPI”) is a nonprofit organization in Florida. Its main purpose is the preservation of the biotic diversity of the Coastal Plain of the southeastern United States. CPI believes its main objective can best be achieved through two activities: education and research. It is hoped that through these activities the biotic diversity of the Coastal Plain will be preserved forever.

Protecting All Living Species (“PAL”) is an informal organization consisting of citizens of south Georgia and north Florida that was founded to advocate for the elimination of hunting of the eastern diamondback rattlesnake for the purpose of display and killing at the two remaining Georgia “rattlesnake roundups.”

One More Generation (“OMG”) is a nonprofit 501(c)(3) organization dedicated to the preservation of endangered species and our environment. OMG was founded by two students of

the Fayette Montessori School in Fayetteville, Georgia. The founders are Carter (10) and his sister Olivia (8.5), who are both extremely passionate about animals and conservation. OMG works with various agencies around the world seeking to provide the more than 1,000 species currently listed as endangered or on the threatened list with the resources needed to ensure they survive at least One More Generation . . . and beyond.

EXECUTIVE SUMMARY

The eastern diamondback rattlesnake warrants listing as a threatened species under the Endangered Species Act because it is likely to become an endangered species within the foreseeable future in all or a significant portion of its range. The eastern diamondback rattlesnake is absent or extremely rare across large portions of its former range. It has likely been extirpated in Louisiana, is endangered in North Carolina, has limited range in South Carolina, Alabama, and Mississippi, and has become uncommon in much of Florida. It is also declining in Georgia. In short, the area of occupancy, number of subpopulations, and population size is sharply declining throughout its range. Although the exact magnitude of declines is unknown, experts agree that the species is suffering substantial range-wide declines.

In addition, an analysis of threats facing the snakes demonstrates that these declines will continue unless the eastern diamondback receives federal protection. Specifically, the species meets at least three of the factors for determining whether a species is threatened:

The present or threatened destruction, modification, or curtailment of the eastern diamondback rattlesnake's habitat or range

The eastern diamondback rattlesnake requires open-canopy habitats and once thrived in the longleaf pine savannas that covered the southeastern United States during pre-settlement times. But today, less than two or three percent of the original longleaf pine habitat coverage remains, and remaining habitat is becoming ever more fragmented. As such, loss of longleaf pine savannas is the single most important factor affecting the survival of the eastern diamondback rattlesnake. Vehicle strikes in remaining habitat fragments are also a significant source of mortality.

Overutilization for commercial, recreational, scientific, or educational purposes

Exploitation by humans is having a severe impact on remaining eastern diamondback rattlesnake populations. Thousands of the rattlesnakes are killed each year for the skin trade with no limits on annual harvest. Many others are killed maliciously or out of fear. Gruesome "rattlesnake roundups" offer hunters prizes for capturing snakes, which are displayed at local festivals and then killed. Scientists agree that killing by humans is a major factor threatening the species.

Inadequacy of existing regulatory mechanisms

Eastern diamondbacks are wholly unprotected in South Carolina, Georgia, Florida, Mississippi, Alabama, and Louisiana. Unlimited numbers of the snakes may be killed in these states, and as such, the lack of regulatory mechanisms facilitates overexploitation of the species. Only North Carolina protects the snake as an endangered species. The habitat of the eastern diamondback rattlesnake is also inadequately protected. Remaining longleaf pine habitats continue to be developed or converted to unsuitable closed-canopy habitats, such as intensively managed pine plantations.

In combination, these factors demonstrate that the eastern diamondback rattlesnake warrants listing as threatened species under the ESA. A prompt decision on ESA listing is required to ensure that the species is not beyond recovery before listing takes place.

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I. INTRODUCTION

The Eastern diamondback rattlesnake (*Crotalus adamanteus*) is the largest rattlesnake in the world (Timmerman and Martin 2003, p. 2). Despite the robust appearance of this venomous snake, the eastern diamondback poses little threat to public safety. More people are killed each year by bee stings and lightning strikes (Timmerman and Martin 2003, p. 18). And the proportion of people who are snake bitten while engaging in outdoor activities is very low. Those most likely to be bitten are snake handlers who either keep venomous snakes in captivity or work with them professionally (Means 2011).

The species historically ranged along the coastal lowlands of southeast North Carolina to extreme eastern Louisiana, including all of Florida and its keys (Means 1986). Although once abundant in longleaf pine ecosystems across the southeastern United States, its population size across its range has declined precipitously in the last several decades and its range has contracted. As a habitat specialist, the snake is dependent on open-canopy forest, as such, and habitat destruction and fragmentation are the principal cause of the snake's decline. Malicious killing by humans, collection for the commercial skin trade, and vehicle strikes are also major factors contributing to the decline of the species (Means 2010, p. 66). Because the species has a slow life history with long birth intervals and long gestation periods, it is particularly susceptible to overexploitation by humans (Waldron et al. 2008, p. 2478).

To qualify for listing as a threatened or endangered species, the species does not need to be imperiled across all of its range. The ESA provides for listing when a species is threatened with endangerment or extinction across a significant portion of its range. 16 U.S.C. § 1532(6); 16 U.S.C. § 1532(20). Here, the eastern diamondback rattlesnake is absent or extremely rare across a significant portion of its range. It has likely been extirpated in Louisiana, is endangered in North Carolina, has limited range in South Carolina, Alabama, and Mississippi, and has become uncommon in much of Florida (Martin and Means 2000, p. 21). It is also declining in Georgia (Georgia DNR 2011). Experts agree that the species is suffering substantial declines rangewide (Timmerman and Martin 2003, pp. 41, 47; Waldron et al. 2008, p. 2478; Waldron et al. 2006; Martin and Means 2000, p. 21; Steen et al. 2007, p. 763).

II. NATURAL HISTORY AND BIOLOGY OF THE EASTERN DIAMONDBACK RATTLESNAKE

A. Taxonomy and Species Description

The eastern diamondback rattlesnake was described in 1799 (Beauvois 1799). It is the largest venomous snake in the United States and Canada, recognized by its large size, dorsal pattern of diamonds, yellowish unpatterned belly, dark tail with rattle, and infrared-sensitive pit between the eye and nostril (NatureServe 2010). Although two other species of rattlesnakes are found within the geographical distribution of the eastern diamondback rattlesnake, these species are generally smaller and have different coloration and pattern (Timmerman and Martin 2003, p. 2).

The pattern on the upper surface of the eastern diamondback rattlesnake consists of 18-20 crisply delineated diamonds aligned apex to apex down the midline of the back (NatureServe 2010). The diamonds are formed by a one-scale thin yellow line enclosing dense black pigment about 1-2 scales wide (NatureServe 2010). Beginning on the neck and running about 2/3-3/4 of way to the level of the vent, the diamonds grade rapidly into a series of olive-brown scales flecked with black pigment (NatureServe 2010). Often the olive-brown color alternates with black, suggesting bands (NatureServe 2010). Belly scales are yellowish and display either no pattern or only a light brownish mottling (NatureServe 2010). The side of the face is black with two thin yellow lines that run obliquely forward from the angle of the jaw and enclose the eye in a sort of black mask (NatureServe 2010). The background color of the snake varies but is usually brownish (Timmerman and Martin 2003, p. 2). The olive-brown tail is marked with 3 to 6 often poorly defined dark rings (Timmerman and Martin 2003, p. 2). The rattlesnake is so well camouflaged that it is often difficult to discern the snake from its background (Timmerman and Martin 2003, p. 6).

Newborn snakes are 12 to 18 inches long (30 to 46 cm) and the typical size range of adults is 4 to 5 feet (1.2 to 1.5 m) (Timmerman and Martin 2003, p. 2). Diamondbacks in the 6 foot range are considered quite large (Timmerman and Martin 2003, p. 2). Besides being the longest rattlesnake in the world, it is also one of the most robust (Timmerman and Martin 2003, p. 2). An average adult weighs 4 to 5 pounds (1.8 to 2.3 kg), but a big snake may weigh 12 pounds or more (6.8 kg) (Timmerman and Martin 2003, p. 2). Males grow larger than females (Timmerman 1989; Berish 1992). Individuals can be sexed externally by counting the subcaudal scales. Females possess 20-27 subcaudals, males 26-33 (Ernst and Barbour 1989).

B. Distribution

The historic range encompasses the Coastal Plain of the southeastern United States from North Carolina to south Florida, and west to Mississippi and the Florida parishes of Louisiana, at elevations extending from near sea level to around 500 meters (Mount 1975; Dundee and Rossman 1989; Palmer and Braswell 1995; Ernst and Ernst 2003; Campbell and Lamar 2004). It may have occurred even as far north as southwestern Tennessee and northeastern North Carolina (Martin and Means 2000, p. 20). At the broadest spatial scale, the historic range of the eastern diamondback rattlesnake is largely congruent with the historic distribution of the longleaf pine ecosystem (Waldron et al 2008, p. 2478; Martin and Means 2000, p. 20).

The area of occupancy, number of subpopulations, and population size is declining throughout the snake's range (Nature Serve 2010). The range has contracted because of habitat loss from agriculture, silviculture, urbanization, and plant succession resulting from fire suppression (Timmerman and Martin 2003, p. 9). The northern perimeter of the range has been shrinking southward, and the western and northeastern ends of the distribution are shrinking toward the middle of the range. Range contractions are known from Louisiana, Mississippi, and South and North Carolina (Nature Serve 2010; Martin and Means 2000). The species is likely gone from Louisiana, endangered in North Carolina, and scarce in South Carolina (Dundee and Rossman 1989; Palmer and Braswell 1995; Means 2011). The large populations reported for Pinellas and many other Florida counties in the mid-20th century are severely reduced or extirpated (Means 2011). The only large remaining subpopulations can be found in the northern

Florida peninsula, eastern and southern Florida panhandle, and southwestern Georgia (Timmerman and Martin 2003). Figure 1 shows the historic range of the snake.

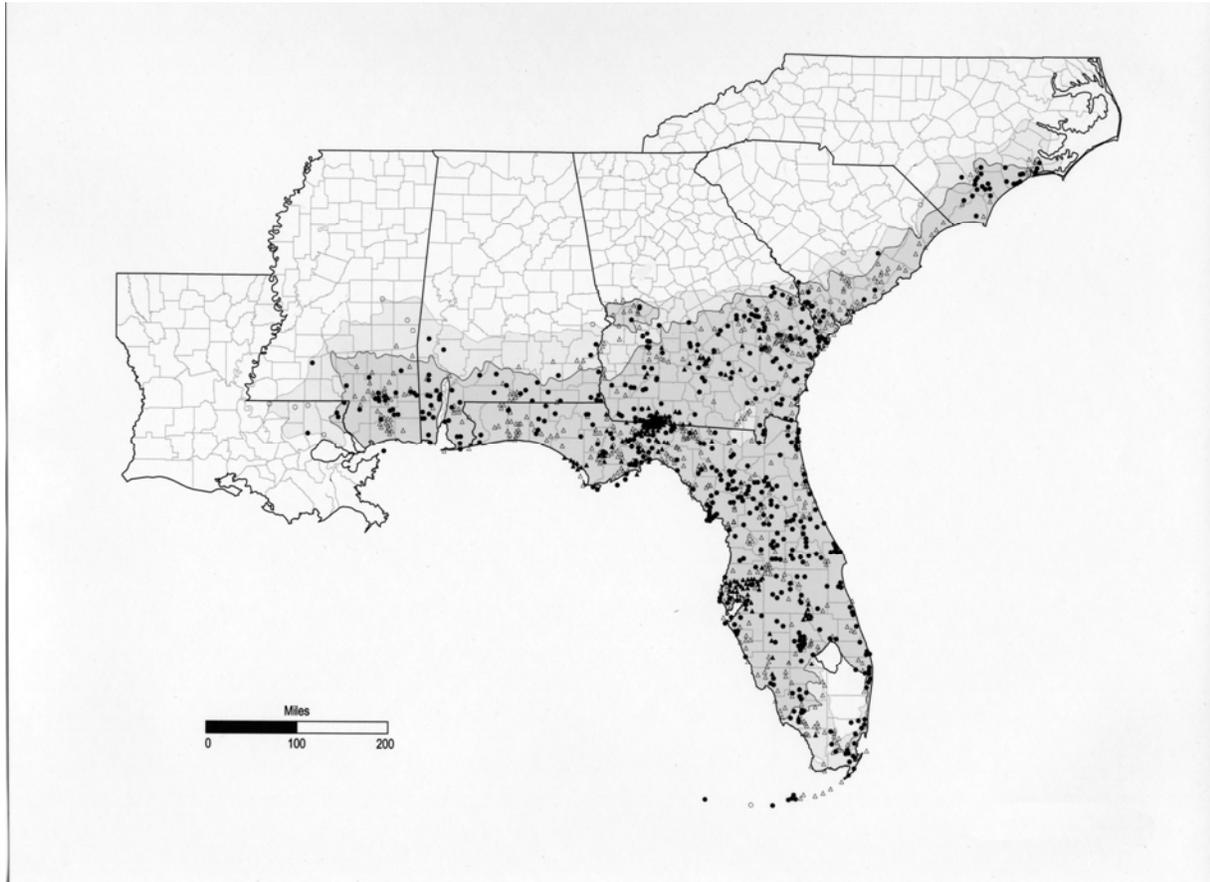


Figure 1. Map of the southeastern U.S. showing the historic range of eastern diamondback rattlesnake (Martin and Means 2000). Records are indicated as follows: solid circles – museum records; solid triangles – authors’ records; hollow triangles – locations from personal communications; hollow circles – museum or other records with imprecise locality data; dark shading – open-canopy habitats favored by the snakes dominate the presettlement landscape; light shading – favorable open-canopy habitats occurred as a minor component in a mosaic.

In North Carolina, it formerly occurred in the middle Coastal Plain but apparently never in the North Carolina Fall Line sandhills, and it is not known on North Carolina barrier islands (NatureServe 2010). The eastern diamondback rattlesnake is now restricted to the Lower Coastal Plain south of the Neuse River (NatureServe 2010; Martin and Means 2000, p. 17). The population density is extremely low in North Carolina (Timmerman and Martin 2003, p. 9). The eastern diamondback was once known to occupy Croatan National Forest, but it has not been documented on any lands in North Carolina managed by the U.S. Forest Service, National Park Service, or U.S. Fish and Wildlife Service in the last ten years (Adkins Giese 2011).¹

¹ In December of 2010, the Center for Biological Diversity submitted a request under the Freedom of Information Act, 5 U.S.C. § 552 (“FOIA”), to the National Park Service, U.S. Fish and Wildlife Service, U.S. Forest Service, and Bureau of Land Management. Among other

In South Carolina, the eastern diamondback is patchily distributed in undeveloped areas in the lower and middle Coastal Plain and occurs on Edisto Island and three smaller barrier islands (NatureServe 2010; Martin and Means 2000, p. 17). Although now much reduced in abundance, it has been found in quail plantations in Jasper, Hampton, Beaufort, and Colleton counties, and in a portion of Francis Marion National Forest in Berkeley County (Martin and Means 2000, p. 17). Despite the fact that South Carolina has numerous National Park Service lands and national wildlife refuges within the historic range of the snake, only the Ace Basin National Wildlife Refuge has any records of the snake from the last ten years (Adkins Giese 2011).

In Georgia, the species range includes the Coastal Strand and Barrier Island region of the Atlantic coast (Martin and Means 2000, p. 14). The extent of the current range is probably essentially unchanged from presettlement times but much of the habitat within the range has been destroyed and its distribution is highly fragmented (Martin and Means 2000, p. 15). The largest population is found in southwestern Georgia (Martin and Means 2000, p. 15). In the last ten years, the eastern diamondback has been known to occupy Blackbeard National Wildlife Refuge, Harris Neck National Wildlife Refuge, Cumberland Island National Seashore, and Fort Pulaski National Monument. But in that same period the snake has not been documented within any other of the numerous federally managed public lands in Georgia (Adkins Giese 2011).

In Florida, the presettlement range was essentially statewide including the barrier islands and keys (Martin and Means 2000, p. 15). An enormous amount of habitat has been lost in the Florida peninsula during the last half of the twentieth century, and the eastern diamondback rattlesnake has become rare or disappeared completely from many sites (Martin and Means 2000, p. 16). But a considerable amount of flatwoods and dry-prairie country in south-central Florida is in conservation lands and the eastern diamondback rattlesnake occurs there at low densities (Timmerman and Martin 2003, p. 9). It is most abundant in the arc of dry prairie and pine savanna extending from Sarasota and Charlotte counties near the southwest coast to Lake Okeechobee, and north from Lake Okeechobee to Volusia County (Martin and Means 2000, p. 16). In the last ten years, it has been known to be present on the following national wildlife refuges in Florida: St. Marks, Lower Suwannee, Loxahatchee, Okefenokee, Boss-Terrestris, Florida Panther, Hobe Sound, Chassahowitzka, Raccoon Key, National Key Deer, Lake Whales Ridge, and St. Vincent (Adkins Giese 2011). Additionally, it is present on the following lands managed by the National Park Service: Canaveral National Seashore, Everglades National Park, Timucuan Ecological and Historical Preserve, Fort Mantenza National Monument, Big Cypress National Preserve, Biscayne National Park, and Gulf Islands National Seashore (Adkins Giese 2011). Florida has three national forests within the range of the snake but none have any records of the snake from the last ten years (Adkins Giese 2011). Florida encompasses half of the species current range (Timmerman and Martin 2003, p. 41).

things, the FOIA request sought all documents discussing the presence of eastern diamondback rattlesnakes on public lands managed by these agencies. The responses to this FOIA request are on file with Collette Adkins Giese and available upon request.

In Alabama, the eastern diamondback does not range to the Fall Line but occurs in the lower Coastal Plain where longleaf pine and wiregrass dominated the uplands originally (NatureServe 2010). It is primarily found in the southwestern part of the state, in southern Washington and northern Mobile counties, mainly in the area where gopher tortoises (*Gopherus polyphemus*) occur (Timmerman and Martin 2003, p. 9; Martin and Means 2000, p. 13). It has also been recorded from Dauphin Island (NatureServe 2010). Although Martin and Means (2000) suggested that the snake is likely still found in Conecuh National Forest located near the central part of Alabama's southern boundary, the forest has no records of the snake from the last ten years. In fact, the only federal land in Alabama with a record of the snake from the last ten years is the Bon Secour National Wildlife Refuge on the Fort Morgan peninsula of south Alabama (Adkins Giese 2011).

In Mississippi, the eastern diamondback may have ranged to the limits of the longleaf pine forest, but it was not known to Mississippi's barrier islands (NatureServe 2010). Today, the species is uncommon and the range has contracted and is confined mainly to the longleaf pine hills and pine flats regions (NatureServe 2010; Timmerman and Martin 2003, p. 43). It occurs principally in the southeastern portion of the state, east and northeast of the eastern tip of Louisiana (NatureServe 2010). Martin and Means (2000, p. 13) reported that the snake was present in the central and southern sections of De Soto National Forest, but the forest has no records from the last ten years (Adkins Giese 2011). The state's three national wildlife refuges within the historic range also lack any records of the snake from the last ten years (Adkins Giese 2011).

In Louisiana, the eastern diamondback rattlesnake is likely extirpated. It is possible that it may exist in extreme northeastern Louisiana, but it is so rare that it is functionally extinct in Louisiana (Timmerman and Martin 2003, pp. 9, 20, 43; Martin and Means 2000, p. 11). The snake was last observed in Louisiana in 1995 (Louisiana Department of Fisheries and Wildlife 2010). Historically, it was confined to the easternmost three of the seven Florida parishes and never was reported from Louisiana barrier islands (NatureServe 2010).

C. Habitat

Eastern diamondback rattlesnakes require large tracts of open-canopy habitats (Means 2006; Steen et al. 2007, p. 762; Means 2011). Open-canopy conditions favor the development of an herbaceous groundcover that are important to the eastern diamondback because its primary prey species, rodents and rabbits, are terrestrial animals that depend upon primary productivity at ground level (Means 2011).

Although the snake can survive in other open-canopy habitats, the principal native habitat of the eastern diamondback rattlesnake in presettlement times was longleaf pine savannas (Means 2006; Martin and Means 2000, p. 20). Longleaf pine savannas are characterized by longleaf pine but included an array of open-canopy habitats (Waldron et al. 2008, pp. 2479-80; Martin and Means 2000, p. 20). Longleaf pine savannas once occupied about 62% of the uplands of the Coastal Plain and about 40% of the regional landscape (Ware et al. 1993).

The once abundant longleaf pine savannas that characterized the southeastern U.S. have been degraded and destroyed. Intensive logging from 1870 to 1930 removed virtually all the remaining virgin longleaf pine forest in the South (Ware et al. 1993). Since then, fire suppression and silviculture practices have degraded much of the habitat. Much of what is left of the original longleaf pine habitat is now ruderal vegetation such as shortleaf/loblolly pine, old field successional forest, or pine plantations, which becomes unsuitable for the snakes when the canopies close. Means (2011) explained that his studies never located the snakes in pine plantations older than 12 years.

Longleaf pine savannas must be maintained by frequent fires. Naturally ignited by lightning during spring and early summer, these flatwoods historically burned at intervals ranging from 1 to 4 years (Clewell 1989, p. 226). Remnant eastern diamondback rattlesnake populations are associated with areas under management practices that include regular prescribed fire, which maintains an open-canopy savanna structure (Waldron et al. 2008, p. 2481). In the absence of fire, these communities undergo succession to other forest types whose structural features are unsuitable for eastern diamondbacks and other pine forest inhabiting reptiles (Means and Campbell 1982). Specifically, fire suppression allows the development of close canopied forest with a dense shrub layer that shades the ground and prevents the establishment of the herbaceous ground cover required by its prey.

Today, nearly all of the old growth longleaf pine savannas are gone, and the eastern diamondback survives wherever vestiges of its native habitats still exist or where open-canopy, ruderal forests and grasslands that mimic the native vegetations have developed (Means 2011). Most of these natural habitat vestiges are altered, and the best that can be found in large patches are the second-growth tracts of longleaf pine (Means 2011). The principal large tracts of second growth longleaf pine are found mostly on publicly owned lands in the Coastal Plain, especially national forests, military bases, state forests and parks, and a few wildlife refuges (Means 2005, p. 76). Regardless of habitat type, eastern diamondback rattlesnakes are observed most often in large tracts of land (Steen et al. 2007, p. 762). Unfortunately, most of the remnant native longleaf pine habitats are threatened and even the open-canopy ruderal habitats that are tolerated by the eastern diamondback rattlesnake are being destroyed (Means 2011).

Shelters from fire and cold are important microhabitats for the eastern diamondback rattlesnake (Martin and Means 2000, p. 18). The eastern diamondback rattlesnake seeks subterranean overwintering shelters throughout its range with the exception of extreme southern Florida and the Florida keys (Timmerman and Martin 2003, p. 8). It uses the burrows of the federally protected gopher tortoise (*Gopherus polyphemus*), as well as the nine-banded armadillo (*Dasypus novemcinctus*) (Timmerman and Martin 2003, p. 8). Fire-burned, pine-stump holes are sought, as well as natural cavities at the bases of hardwoods (Timmerman and Martin 2003, p. 8; Means 2005, p. 74). Wind-fallen trees often form suitable sites for overwintering shelters, especially where the roots have pulled out of the soil (Timmerman and Martin 2003, pp. 8-9). During the fall, gravid females use underground shelters as parturition sites (Butler et al. 1995).

D. Biology

Mating occurs in late summer and early fall (Timmerman and Martin 2003, p. 15). The duration of the mating period at a given locality lasts 6 to 8 weeks (Timmerman and Martin 2003, p. 15). Ovulation apparently occurs in the late spring of the following year with births centered on late August and ranging from late July to early October (Timmerman and Martin 2003, p. 15). A gravid female may retire to a natal shelter a month or two before parturition where she will bear live young (Timmerman and Martin 2003, p. 15). The mother and her newborn snakelets likely stay at the parturition site for 7 to 10 days (Butler et al. 1995). Some burrow commensals, such as the Florida mouse (*Peromyscus floridanus*) may be important prey for newborn rattlesnakes (Timmerman and Martin 2003, p. 24).

The natural lifespan of an eastern diamondback rattlesnake is probably 15 to 20 years but evidence from the field indicates that few individuals today live past 10 years, likely due to exploitation for the skin trade, vehicle strikes, and other anthropogenic threats (Timmerman and Martin 2003, p. 15). Females reproduce only at two to four year intervals, depending on the geographic location, age of the snake, and productivity of the environment (Tennant and Bartlett 2000; Timmerman and Martin 2003). Female eastern diamondback rattlesnakes reach sexual maturity at somewhere between 2 to 6 years of age (Timmerman and Martin 2003, p. 16). As a result, an individual female may produce few young during her lifetime. Reported clutch sizes range from 4 to 32 (Timmerman and Martin 2003, p. 16). Because the species has a slow life history with long birth intervals and long gestation periods, it is particularly susceptible to overexploitation by humans (Waldron et al. 2008, p. 2478).

The eastern diamondback rattlesnake is an ambush predator that feeds on a wide variety of small mammals and some birds (Timmerman and Martin 2003, p. 6). The bulk of its prey consists of rabbits (*Sylvilagus* species), cotton rats (*Sigmodon hispidus*), and gray squirrels (*Sciurus carolinensis*) (Timmerman and Martin 2003, p. 6; Waldron et al. 2006, p. 418). The eastern diamondback rattlesnake hunts from a tight coil – remaining motionless – waiting to capture prey that comes within striking distance (Timmerman and Martin 2003, p. 6). The snake is terrestrial, hunting almost exclusively on the surface of the ground (Timmerman and Martin 2003, p. 6). As a member of the pit viper family, it is able to hunt in total darkness and identify warm-blooded prey via infrared detection (Timmerman and Martin 2003, p. 6). It may spend as much as one week coiled in the same hunting position (Timmerman and Martin 2003, p. 6). The species has been characterized as holotemporal, which means that it is ready to capture prey at all times (Timmerman 1989).

Timmerman (1995) found that home ranges for females averaged 46.5 hectares and males averaged 84.3 hectares and that the species does not defend a territory. It does not den communally.

E. Population Status

The presettlement population of the eastern diamondback has been estimated to be about 3.08 million individuals (Means 2011), but no sound baseline information exists (Timmerman and Martin 2003, p. 19). The current population size is also unknown but several thousand are

likely killed each year for the skin trade (NatureServe 2010). It is unlikely that the current population exceeds 100,000 (Means 2011). Therefore, it is likely that the current population is just three percent of the historical population.

Based on more than 30 years of field work in southeastern United States, Martin and Means (2000) observed severe local declines in eastern diamondback rattlesnake populations. Moreover, most experts believe that the species is suffering substantial range-wide declines (Timmerman and Martin 2003, pp. 41, 47; Waldron et al. 2008, p. 2478; Waldron et al. 2006; Martin and Means 2000, p. 21; Steen et al. 2007, p. 763; South Carolina DNR 2005, p. 14; Hammerson 2007). The rate of decline is unknown but it may exceed 10 percent over three generations (NatureServe 2010).

The species has likely been declining since the 1930s (Timmerman and Martin 2003, p. 19). Size records of thousands of eastern diamondback rattlesnakes purchased by the Ross Allen Reptile Institute demonstrate that the average snake length dropped by about a foot between the 1930s and the 1960s (Timmerman and Martin 2003, p. 19; Diemer Berish 1998, p. 556). The most serious population declines, however, have happened more recently, probably since the 1970s, as the human population burgeoned in the southeastern United States (Timmerman and Martin 2003, p. 19). By the 1980's, the eastern diamondback population had become so depleted that biologists reported that years had passed without seeing snakes in areas where they once could catch several snakes in one day (Means 2011).

The size and numbers of eastern diamondback rattlesnakes collected at "rattlesnake roundups" also provides an indicator of population status (Means 2009, p. 134). Since at least the mid-1980s, a steady decline is evident in all four roundups in the southeastern United States for the weights of prize-winning eastern diamondback rattlesnakes collected (Means 2009, p. 134; Means 2006, p. 171). Despite a cash prize incentivizing capture of the largest snake possible, the largest snake collected for the Whigham, Georgia roundup in January of 2011 weighed only 6.4 pounds, which is just slightly above the reported average adult mass, and small for a species which can weigh up to 12 pounds. Declining size means fewer older snakes and therefore has negative implications for the reproductive success of local populations (Means 2009, p. 137). Heavily harvested populations are skewed to smaller and less productive animals (Enge 1993), as clutch size is correlated with the body size of the mother (Kardong 1996).

There has also been a decline in the numbers of eastern diamondback rattlesnakes brought in to the roundups (Means 2009, p. 134; Timmerman and Martin 2003, p. 19). That the declines are true declines and not a result of reduced hunting effort is supported by statements made by snake hunters and roundup officials, who explain that they had to increase their effort and expand the area where they searched because the snakes are so rare (Means 2009, p. 134-37). The number of snakes brought in to the Whigham, Georgia roundup in January 2011 was the lowest number in the history of the event, at 82 snakes, down from a high of 583 in 1992. Due to the increased difficulty of finding snakes, the city of Opp, Alabama in 2011 publicized a bounty of \$8 per foot for all rattlesnakes brought in to the event (Bolling 2011).

The bulk of the intact range with large populations occurs in north Florida and south Georgia (Martin and Means 2000, p. 21). Even within Florida, experts agree that the status of

the species is vulnerable. In 1994, an informal panel of 10 Florida snake experts agreed that the eastern diamondback rattlesnake was a vulnerable species with three panelists believing that the species should be listed as threatened within the state (Timmerman and Martin 2003, p. 21). Martin and Means (2000, p. 21) considers the species to be endangered throughout the balance of its historical range. The species is included on the IUCN Red List of Threatened Species (Hammerson 2007). It has likely been extirpated in Louisiana, is endangered in North Carolina, has limited range in South Carolina, Alabama, and Mississippi, and has become uncommon in much of Florida (Martin and Means 2000, p. 21; Means 2011). It is also declining in Georgia (Georgia DNR 2011).

In summary, although the exact magnitude of declines is unknown, it is certain that substantial declines are occurring. And the analysis of threats provided below demonstrates that these declines will continue unless the eastern diamondback receives federal protection. As such, the species is at risk of becoming an endangered species in all or a significant portion of its range in the foreseeable future and qualifies as a threatened species.

III. THREATS ANALYSIS

Section 4 of the Endangered Species Act and its implementing regulations (50 C.F.R. Part 424) set forth the procedures for adding species to the federal list of endangered and threatened species. FWS may determine a species to be endangered or threatened due to one or more of the five factors described in section 4(a)(1) of the Act. Each of these factors is discussed below.

A. Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

In pre-settlement times, the eastern diamondback rattlesnake thrived in the longleaf pine savannas that covered the southeastern United States. But today, less than two or three percent of the longleaf pine savanna habitat remains (Ware et al. 1993; Platt 1999; Noss et al. 1995; Martin and Means 2000, p. 20). Although the snakes do not require longleaf pine savannas to live, they do require open-canopy forests that allow development of an herbaceous groundcover. These open-canopy habitats are becoming increasingly rare, as humans convert remaining open-canopy forests into intensively managed closed-canopy pine plantations, residential and commercial development, and agriculture. Scientists agree that obliteration of longleaf pine savannas is the single most important factor affecting the survival of the eastern diamondback rattlesnake (Timmerman and Martin 2003, p. 21; Waldron et al. 2006, p. 419; Waldron et al. 2008, p. 2478; Martin and Means 2000, p. 21; Means 2011).

In addition, much of the remaining longleaf pine habitats are becoming degraded in the absence of fire. Without active fire management, remnant longleaf pine ecosystems convert into closed canopy forests and become unsuitable for snakes. In the past 200 years, human settlement of the Coastal Plain has drastically altered the normal, summertime fire cycle. Not only have wildfires been actively suppressed following ignition, but roads, towns, agricultural fields, and other developments have impeded the widespread, weeks-long fires that swept the Coastal Plain regularly in pre-settlement times (Means 2011). The disruption of the natural fire cycle has

resulted in an increase in slash and loblolly pine on sites formerly dominated by longleaf pine, an increase in hardwood understory, and a decrease in herbaceous ground cover (Wolfe et al. 1988, p. 132; Yager et al. 2007, p. 428). On public lands, prescribed burning is a significant part of many habitat management plans. However, implementation of prescribed burning has been inconsistent due to financial constraints and limitations of weather (drought, wind direction, etc.) that restrict the number of opportunities to burn. 74 Fed. Reg. 6702 (Feb. 10, 2009).

The historical extent of longleaf pine ecosystems was approximately 37 million hectares (Frost 1993). Most of the old-growth longleaf pine forests were logged between the 1890s and 1930s (Means 2005, p. 76). In a region-wide survey, Means (1996) reported that less than 4000 hectares (ca. 0.01%) of old-growth longleaf pine remained throughout the historical range of the species. Five years later, that figure was cut in half (Varner and Kush 2001).

The second growth longleaf pine forest that replaced these old growth forests grew up around the rot-resistant old-growth stumps that provided excellent shelter for eastern diamondback rattlesnakes (Means 2005, p. 76). But in the past century, most of the old-growth pine stumps have been extracted to produce turpentine, rosin, and pine oil (Means 2005, p. 76). The loss of these subterranean refuges provided by the stumps of longleaf pine may be one important reason for the decline of the eastern diamondback rattlesnake and other large snakes (Means 2005, p. 78).

While the snakes do not depend on old-growth forests, even the extent of second-growth longleaf pine habitats has been greatly reduced. By the 1960s and 1970s, longleaf pine savannas were exceedingly rare and patchily distributed (Frost 1993). Habitat loss continued through the remainder of the twentieth century and longleaf pine savannas became virtually absent over much of the historic range (Waldron et al. 2008, p. 2481). Over a decade ago, scientists estimated that second-growth longleaf pine amounts to no more than about 776,000 hectares (ca. 2%) (Means and Grow 1985; Means 1996). That figure is undoubtedly less today.

Remaining open-canopy forest habitat is becoming ever more fragmented across its range (Martin and Means 2000, pp. 10, 21; Palmer and Braswell 1995; Tennant 1997). Because of this fragmentation, automobile traffic appears to be a “very significant source of mortality” for adult snakes (Timmerman and Martin 2003, pp. 22, 40). No studies exist that address the population impact of road-kills on eastern diamondback populations, but Means (2011) concludes that “road kills have a serious negative effect on eastern diamondback populations, particularly where habitat is fragmented and reduced to small patches by roads.” The snakes are highly susceptible to road mortality because they maintain large annual ranges of approximately 400 ac (162 ha) and can make single moves in one day of 0.8–1.6 km (0.5–1.0 mi) (Means 2011).

Major roads present formidable impediments if not complete barriers to movement and gene flow (Martin and Means 2000, p. 21). In east Texas, a population of large snakes including the timber rattlesnake (*Crotalus horridus*) was reduced by 50 percent or more to a distance of 450 m from roads with moderate use (Rudolph et al. 1999). And in Kansas and North Carolina, timber rattlesnakes were reported as traveling parallel to roads (Fitch 1999; Sealy 2002). Similar avoidance responses to roads probably are exhibited by the eastern diamondback rattlesnake (Means 2011).

Habitat destruction will continue as the human population in the southeastern U.S. continues to grow. For example, in Florida, future urban development may result in the loss of about 283,300 ha (700,000 ac) or 20 percent of the remaining gopher tortoise habitat by 2060 (Florida Fish and Wildlife Conservation Commission 2008, p. 4). Such projections for the gopher tortoise are useful for the eastern diamondback rattlesnake because both species depend on open-canopied habitats with herbaceous ground cover. Other studies have predicted a loss of up to 50 percent of forest lands in central Florida and up to 25 percent in north Florida and southeast Alabama (Prestemon and Abt 2002, p. 18).

To be sure, the human population nearly doubled in the southeast in the last several decades. Southeastern states experienced significant human population growth from 2000-2009, with the population of Georgia increasing by 17 percent, Florida by 14 percent, North Carolina by 13 percent, and South Carolina by 10 percent (U.S. Census Bureau 2009). Metropolitan areas in the southeast are among the fastest growing in the nation (Dodd 1997). The population of Raleigh, North Carolina expanded by 31 percent from 2000-2009, with other metropolitan areas also experiencing significant population growth: Atlanta 24 percent, Charlotte 24 percent, Jacksonville 16 percent, Tampa 14 percent, and Birmingham 5 percent (U.S. Census Bureau 2009). Population in the southeast is expected to increase to 78.2 million people by the year 2020, representing a nearly 30 percent population increase over a 25-year period (Tennessee 1997).

Overall, decreases in the area of private timberland in natural forest management types are expected occur because of increases in pine plantations and the liquidation of forests to accommodate urban development (Prestemon and Abt 2002, p. 21; Bailey and Smith 2007, p. 8). Early-aged pine plantations may provide open, grassy habitat that can be utilized by eastern diamondbacks for several years, but these populations are typically short-lived because within a decade pine canopies shade out ground vegetation (Auffenberg and Franz 1982, p. 111). Means (2011) never observed eastern diamondbacks in pine plantations over 12 years old.

Given this ongoing development pressure and other habitat threats, maintaining the species into the future will require a system of large publicly and privately owned refugia in which healthy function of native ecosystems is the primary management goal (Timmerman and Martin 2003, p. 23). Active management with fire is also required to maintain the open-canopy forest that the snakes require (Means 2011). But just a fraction of eastern diamondback habitat is in either public ownership or some type of permanent or long-term conservation status.

America's Longleaf Initiative (Initiative) is a collaborative and voluntary effort (involving more than 20 organizations and agencies) that seeks to "define, catalyze, and support coordinated longleaf pine conservation efforts" (America's Longleaf Initiative 2011). In March 2009, the Initiative released the Range-Wide Conservation Plan for Longleaf Pine (Longleaf Pine Plan). The Longleaf Pine Plan calls for an increase of between 1.4–3.2 million ha (3.4–8.0 million ac) of additional longleaf pine forests within 15 years. It includes guiding principles, strategies, and cross-cutting approaches that are intended to be implemented through collaborative, voluntary efforts. The Longleaf Pine Plan also calls for habitat improvement in existing longleaf forests by seeking an increase from 0.6– to 1.2 million ha (1.5–3.0 million ac)

in the “desired longleaf woodland/open understory condition,” using prescribed burning, mechanical treatments, and commercial thinning. It is acknowledged by the Initiative that approximately 80 percent of the restoration will need to occur on private lands.

Some funding has been provided as part of the Initiative. For example, American Recovery and Reinvestment Act (ARRA) funding was provided in 2009, in the amount of \$8.975 million, to the United States Department of Agriculture (USDA) Forest Service, Southern Region for longleaf restoration. State Foresters in North Carolina, South Carolina, Georgia, Alabama, and Florida each received \$1.74 million to help address key items in the Longleaf Pine Plan. And other specifically funded projects are described in the 12-Month Finding on a Petition To List the Gopher Tortoise as Threatened in the Eastern Portion of Its Range. 76 Fed. Reg. 45130, 45142 (July 27, 2011). Yet constraints on funding limit land management activities that would benefit the eastern diamondback rattlesnake. And the benefits of the Initiative are uncertain because participation is purely voluntary. *See id.*

In sum, habitat loss, fragmentation and direct mortality from automobiles are important factors in the decline of eastern diamondback rattlesnakes throughout their range (Means 2009, p. 139). These are expected to continue in the future because of inadequate regulations, as described in further detail below. Some efforts have been taken to restore or protect longleaf pine savannas but these efforts are limited by available funding and are purely voluntary.

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

The eastern diamondback rattlesnake is one of the most heavily persecuted reptiles in the eastern United States (Timmerman and Martin 2003, p. 41). Humans kill eastern diamondback rattlesnakes for their skins and parts, but they are also killed for recreation and out of fear. Exploitation by humans is having a severe impact on remaining eastern diamondback rattlesnake populations (Martin and Means 2000, p. 21; Means 2009, p. 139; Means 2011).

A market for eastern diamondback rattlesnakes has existed for decades. In 1936, eastern diamondback snake meat was being canned as a strange delicacy, requiring 5,000 fresh rattlesnakes per year to fill the demand by 1948 (Snyder 1949). The snakes have also been exploited for venom extraction. The Ross Allen Reptile Institute supplied most of the venom to U. S. laboratories during the development of antivenom in the early days of 1929-1940 and for the production of antivenom during World War II (Hylander 1951). Ross Allen believed he had been responsible for the harvest of about 75,000 rattlesnakes over his career (Means 2011). In addition, Miami Serpentarium Laboratories Inc. purchased thousands of eastern diamondback rattlesnakes over a 60-year period from the late 1940s for the purpose of venom extraction (Means 2011).

The rattlesnake skin trade likely takes thousands of eastern diamondbacks each year with no limit placed on annual harvest (Timmerman and Martin 2003, p. 22). Skin dealers have a huge network of pick-up stations where they advertise for people to bring in killed snakes to be frozen until the dealers can make the rounds and pick up the carcasses.

The largest numbers of eastern diamondback rattlesnakes killed for the skin trade occurs in north Florida (Martin and Means 2000, p. 16). The Florida Game and Fresh Water Fish Commission implemented a commercial dealer reporting system in 1990 (Diemer Berish 1998, p. 551). The program lasted four years and was then discontinued (Means 2011). Analysis of reptile dealer reports from 1990 to 1994 show that 42,788 eastern diamondback rattlesnakes were purchased by Florida hide dealers and taxidermists, primarily from Georgia, Alabama, and Florida (Timmerman and Martin 2003, p. 40; Enge 1993). Today, the total take of eastern diamondback rattlesnakes for the skin trade is likely much less due to the increasing rarity of the snakes.

It is estimated that 15 percent of eastern diamondback rattlesnakes entering the skin trade have originated from “rattlesnake roundups” (Fitzgerald and Painter 2000, p. 235). In rattlesnake roundups, rattlesnakes are collected in competitions for prizes (Timmerman and Martin 2003, p. 22). Objectionable roundup activities include the slaughter of live snakes in front of crowds, harassment of captive snakes to promote hissing and strikes, holding of snakes in overcrowded pens that crush many individuals, and transport of snakes in tightly-packed crates where many die of overheating and dehydration (Means 2010, p. 65-66). At least 23 roundups were held for the purpose of downsizing populations of the eastern diamondback rattlesnake (Means 2011). Three rattlesnake roundups remain within the range of the eastern diamondback rattlesnake: Opp, Alabama; Claxton, Georgia; and Whigham, Georgia (Means 2010, p. 66). Economic motives are the driving force behind roundups today (Fitzgerald and Painter 2000). But the original purpose of the rattlesnake roundups was to eliminate the species locally or at least reduce its numbers.

Intensive collecting for roundups is affecting eastern diamondback rattlesnake populations (Diemer Berish 1998, p. 556). Means (2009) analyzed 50 years of data for the four longest running roundups involving the eastern diamondback rattlesnake. He found that over the past couple of decades, the total number of captured rattlesnakes has declined from about 600 to 200 annually, a drop of 67 percent. The size of the largest prize-winning snakes has dropped dramatically, by approximately 20 percent since 1985. He concludes that the snake’s reproductive rates are not sustaining local populations and that hunters have been forced to expand the areas hunted (Means 2010, p. 66). When coupled with habitat loss and ongoing year-round collection for the skin trade, roundups are adding to the overall decline of the species (Means 2009, p. 139; NatureServe 2010). Rattlesnake roundups, themselves, have accounted for the loss of about 2,000 eastern diamondback snakes per year.

Most severely affected by the roundups are the eastern diamondback rattlesnakes associated with the larger gopher tortoise colonies (Martin and Means 2000, p. 21). Hunters that gather rattlesnakes for roundups often utilize the practice of pouring gasoline or ammonia through a hose placed deep inside the burrow of the gopher tortoise in winter (Fitzgerald and Painter 2000, p. 239). *See also* 76 Fed. Reg. 45154 (12-month finding for the gopher tortoise). This practice often kills the rattlesnakes outright and impacts the other fauna inhabiting burrows (Speake and Mount 1973; Means 2010, p. 65). This means that the numbers of snakes collected for rattlesnake roundups likely underestimates the number of snakes actually killed by hunters (Means 2011).

The gassing of tortoise burrows is now prohibited throughout the gopher tortoise's range but enforcement is lax and the practice continues (Means 2010, p. 67). An ESPN Outdoors feature from 2010 shows photographs of snake hunters in Whigham, Georgia carrying hoses used to shoot gas into tortoise burrows and drive snakes to the surface (ESPN 2010). A forum on Georgia Outdoor News (2008) offers advice on how to catch snakes using gasoline, and the Savannah Morning News included a photograph of a man pouring a substance into a gopher tortoise burrow to flush the rattlesnake out (Landers 2007). It is clear from these recent media accounts that the practice of hunting rattlesnakes by gassing tortoise burrows continues. In January 2010, four men who were using hoses to hunt snakes before the Whigham roundup were apprehended by Georgia Department of Natural Resources' enforcement officers (Georgia Department of Natural Resources 2010). *See also* 76 Fed. Reg. 45154 (12-month finding for the gopher tortoise).

Yet many eastern diamondback rattlesnakes entering the commercial trade are found sporadically and opportunistically, rather than from hunting, and include many road-killed and nuisance snakes (Fitzgerald and Painter 2000, p. 239; Diemer Berish 1998, p. 552). The fall breeding season of the eastern diamondback rattlesnake, when they exhibit maximal surface activity, coincides with several game hunting seasons, which increases the likelihood of encounters between humans and rattlesnakes. Many persons interviewed by Diemer Berish (1998, p. 552) indicated that they would kill rattlesnakes anytime they encountered them and would kill them even if they could no longer sell them.

In sum, human exploitation is a primary threat to the eastern diamondback rattlesnake and has contributed significantly to the decline of the species.

C. Disease or Predation

The eastern diamondback rattlesnake has a long list of likely natural predators, including ungulates, raccoons, opossum, dogs, cats, raptors, storks, and other snakes (Timmerman and Martin 2003, p. 17; Means 2011). Natural predation does not appear to be a threat to the snake, but humans are without a doubt contributing to the decline of the eastern diamondback rattlesnake, as discussed above. Disease does not appear to be a threat to the eastern diamondback rattlesnake.

D. Inadequacy of Existing Regulatory Mechanisms

Lack of Habitat Protection

As explained above, obliteration of longleaf pine savannas is the single most important factor affecting the survival of the eastern diamondback rattlesnake. Fortunately, there are numerous ongoing initiatives and incentives to restore longleaf pine forests within the eastern diamondback's range. Restoration efforts vary from large-scale actions on federal lands to voluntary silvicultural management practices being undertaken by industrial and private timber landowners (Jones and Dorr 2004, p. 463; Plum Creek 2010, p. 5). But nearly all of the efforts to protect these habitats are purely voluntary and without dedicated funding, which means that it is

uncertain whether these actions will continue in the future.² In addition, none of the efforts to restore longleaf pine are specifically aimed at protecting eastern diamondbacks. As a consequence, and as demonstrated below, inadequate regulatory mechanisms are a threat to the eastern diamondback.

Federal

It has been estimated that thirty-four percent of remaining longleaf pine is in federal ownership. 76 Fed. Reg. 45141. Agencies including the Department of Defense, U.S. Forest Service, and the Department of the Interior manage these lands. Regulations governing habitat protection under each of these ownerships is discussed below.

The Department of Defense (DOD) must conserve and maintain native ecosystems, viable wildlife populations, federal and state listed species, and habitats as vital elements of its natural resource management programs on military installations, to the extent these requirements are consistent with the military mission (DOD Instruction 4715.3). Amendments to the Sikes Act (16 U.S.C. § 670 et seq) require each military department to prepare and implement an integrated natural resource management plan (INRMP) for each installation under its jurisdiction. Each INRMP must provide for wildlife, land and forest management, wildlife-oriented recreation, wildlife habitat enhancement, wetland protection, sustainable public use of natural resources that are not inconsistent with the needs of wildlife resources and enforcement of natural resource laws (16 U.S.C § 670a). DOD regulations define the INRMP requirements and mandate that plans be revised every 5 years and that they ensure the military lands suitable for management of wildlife are actually managed to conserve wildlife resources (DOD Instruction 4715.3).

But these regulatory mechanisms on DOD lands are inadequate to protect the eastern diamondback rattlesnake. First, we are aware of no guidelines adopted by the DOD or any military department that are specifically implemented to benefit the eastern diamondback. Second, while there have been efforts to restore and protect longleaf pine, see 76 Fed. Reg. 45142, none of these include binding commitments or dedicated funding. Third, these efforts occur on just a fraction of the eastern diamondback's range.

The U.S. Forest Service manages the national forests within the range of the eastern diamondback rattlesnake. The Forest and Rangeland Renewable Resources Planning Act (16 U.S.C. § 36), as amended by the National Forest Management Act of 1976 (16 U.S.C. §§ 1600–1614), requires that each national forest be managed under a forest plan which is revised every 10 years. This legal framework is inadequate to protect the snake, however, because no forest management guidelines are specifically aimed at protecting the snakes. The eastern diamondback is not a Management Indicator Species and is not listed as a sensitive species for any national forest.

² The benefits that these efforts may provide for eastern diamondbacks, as well as the certainty of effectiveness and implementation, must be evaluated consistent with the Policy for Evaluation of Conservation Efforts (PECE). 68 Fed. Reg. 15100 (March 28, 2003).

Although not specific to the eastern diamondback, some national forests implement conservation measures aimed at protecting longleaf forest. But for the reasons explained below, these conservation measures also inadequately protect the snakes.

First, these measures vary widely among the national forests, and many national forests within the range of the eastern diamondback have not adopted land management practices to protect and restore longleaf pine.

Second, some of the conservation measures that are being implemented have not been formally adopted and therefore are not legally enforceable. For example, the DeSoto National Forest (Mississippi) has recently adopted a practice of regenerating only longleaf pines on longleaf sites. However, these guidelines were never formally adopted through Forest Supervisor signature and do not represent official objectives of the national forests in Mississippi. 76 Fed. Reg. 45149.

Third, many of the national forests in the eastern diamondback's range are without documented eastern diamondback populations, and as such, it is unclear whether the snake will benefit from longleaf pine conservation measures. For example, the plan for the national forests in Alabama calls for the restoration and maintenance of mature longleaf forest on about 22,500 ha (55,000 ac) on the Conecuh National Forest over the next 30 years. Management activities include: prescribed fire, timber harvest to restore native overstory species (longleaf), timber thinning in mature longleaf stands, chemical treatment and eradication of cogongrass, propagation for future restoration needs, native grass seed collection, and educational efforts through outreach and interpretation. *Id.* But the Conecuh National Forest has no records of the snake from the last ten years.

The Department of the Interior administers the National Wildlife Refuge System and the National Park System. Various National Wildlife Refuges and National Park Service lands have documented the presence of eastern diamondback rattlesnakes, and eastern diamondback habitat within these public lands is protected from destruction due to urban development. But the protection of these occupied habitats is insufficient to ensure the survival of the snake. First, eastern diamondbacks are not indicator species for the refuges or park system lands, so specific management goals and objectives have not been established for the snakes. Second, just a fraction of historically occupied habitat is protected by the refuge or national park system. Third, many refuges and park system lands lack suitable longleaf pine habitats. Fourth, even within those public lands with protected longleaf pine habitats, management activities to maintain those habitats are constrained by budgetary limitations, and as explained above, without active management with fire, these habitats undergo succession to closed canopy habitats that are unsuitable for the snake. And again, most conservation actions that are done within these public lands to protect longleaf pine are purely voluntary without dedicated funding.

State

It is estimated that 11 percent of remaining longleaf pine is in state or local ownership. 76 Fed. Reg. 45141. Habitat for the eastern diamondback is inadequately protected under state law or on state lands.

To begin, we are unaware of any state regulations providing permitting oversight or requiring conservation benefit to eastern diamondbacks. The eastern diamondback receives some benefit from state regulations protecting gopher tortoise habitat, but these are inadequate to protect the snake because only Florida has any such regulations. *See* 76 Fed. Reg. 45150 (summarizing regulatory mechanisms for gopher tortoise habitat and concluding that they are insufficient for protect the tortoise).

Next, some state lands benefit from practices aimed at maintaining longleaf pine. For example, in Georgia, 12,500 ha (30,889 ac) of longleaf pine are permanently protected on state parks, wildlife management areas, natural areas, public fishing areas, and historic sites. Beneficial land management on these properties include prescribed burns and planting of longleaf pines and warm season grasses. *See* 76 Fed. Reg. 45143 (describing activities on state lands within the range of the gopher tortoise aimed at protecting longleaf pine). But these efforts do not adequately protect eastern diamondbacks because they are not specifically aimed at protecting the snakes, are voluntary and occur on just a fraction of its habitat.

We are aware of no local rules or regulations protecting eastern diamondbacks or their habitat.

Private Lands

The majority of remaining longleaf pine is on private lands, where habitat is being rapidly lost. 76 Fed. Reg. 45141. Most private landowners continue to regenerate longleaf pine sites to offsite species, such as slash (*Pinus elliottii*) and loblolly (*Pinus taeda*) pines, because of planting difficulties with longleaf pine.

Modest conservation value is derived from voluntary participation and certification under the Sustainable Forestry Initiative and internal conservation measures of the forest industry. In addition, the Nature Conservancy's Southern Forest Project is targeting the acquisition of about 24,000 ha (61,000 ac) of longleaf pine habitat in Florida, Georgia, and Alabama. Eastern diamondbacks are likely to benefit from these acquisitions, but the amount of habitat that will be conserved and distribution of extant diamondback populations on these properties is not known. *Id.* And again, these efforts are purely voluntary and therefore are not adequate to protect the snakes.

Benefits Received Through Protection of Gopher Tortoise and Eastern Indigo Snake Habitat

Eastern diamondback rattlesnakes receive some benefit from the fact that they are dependent on the same ecosystem as the federally-protected gopher tortoise and eastern indigo snake (*Drymarchon corais couperi*). Gopher tortoises are listed as threatened wherever found west of the Mobile and Tombigbee Rivers in Alabama, Mississippi, and Louisiana (USFWS 2010a). The eastern population of the gopher tortoise (including tortoises in Florida, Georgia, and South Carolina) is a candidate species. 76 Fed. Reg. 45130, 45162 (July 27, 2011). The eastern indigo snake is listed as threatened and is found in Georgia and Florida (USFWS 2010b).

Gopher tortoises and eastern indigo snakes receive protection on the state level as well. In Mississippi, Alabama, Georgia, Florida, and South Carolina, gopher tortoises are protected as endangered species (Mississippi Wildlife Fisheries and Parks 2010; Alabama Department of Conservation and Natural Resources 2010; Georgia Rule 391-4-10-.09; Florida Fish and Wildlife Conservation Commission 2010; South Carolina Department of Natural Resources 2010). The eastern indigo snake is state listed in Georgia, Florida, and Mississippi. 43 Fed. Reg. 4026 (Jan. 31, 1978).

The principal benefit that eastern diamondback rattlesnakes could receive from federal and state protections for gopher tortoise and eastern indigo snake is habitat preservation because all of these imperiled species utilize longleaf pine ecosystems. For example, Habitat Conservation Plans and a Candidate Conservation Agreement for the gopher tortoise are likely to benefit eastern diamondback rattlesnakes, especially considering the fact that eastern diamondback rattlesnakes use gopher tortoise burrows for shelter. Details on the existing efforts to preserve habitat for the gopher tortoise are provided in the 12-Month Finding on a Petition To List the Gopher Tortoise as Threatened in the Eastern Portion of Its Range. 76 Fed. Reg. 45130, 45142 (July 27, 2011).

The level of benefit is limited, however, because neither the gopher tortoise nor the eastern indigo snake has designated critical habitat (USFWS 2010a; USFWS 2010b). In addition, as noted above, many of the conservation actions, including the Candidate Conservation Agreement for the gopher tortoise, are voluntary and lack certainty as to whether they will be implemented. Moreover, not all eastern diamondback rattlesnakes would receive the benefit of habitat protected for the gopher tortoise because the distribution of eastern diamondback rattlesnakes extends far north of the current range of the gopher tortoise (Waldron et al. 2008, p. 2481). Finally, eastern diamondback rattlesnakes can still be hunted and killed on most of the habitats protected for the gopher tortoise.

In conclusion, alteration and destruction of the longleaf pine ecosystem have caused historic losses of eastern diamondback habitat. And without adequate protections, habitat losses will continue. Efforts are being made to restore longleaf savannas, but these are occurring on just a fraction of the snake's range. In addition, it is very difficult to restore a functioning ecosystem, and ongoing and planned restoration efforts will take many years to achieve the desired vegetative community structure. And even if the habitat is restored, it is unclear whether the eastern diamondback will reoccupy those lands. In any event, the full value of these management efforts is not expected to occur for several decades. To be sure, existing habitat protections for other species native to the longleaf pine ecosystem are providing no discernible benefit to the eastern diamondback rattlesnake as the species continues to decline. In addition, it is uncertain whether these restoration efforts will continue in the future because nearly all of these efforts lack legally binding commitments or dedicated funding. An Endangered Species Act listing of the eastern diamondback, especially with a critical habitat designation, would help prompt development of practices aimed at protecting habitat for the eastern diamondback rattlesnake.

Unregulated Human Exploitation

The eastern diamondback rattlesnake receives no protection from human exploitation in Louisiana, Mississippi, Alabama, Georgia, Florida, and South Carolina (LAC 76:XV.101; Mississippi Wildlife Fisheries and Parks 2010; Alabama Nongame Regulation 220.-2-.92; O.C.G.A. § 27-1-28; Florida Fish and Wildlife Conservation Commission 2010; South Carolina Department of Natural Resources 2010). Only North Carolina protects eastern diamondback rattlesnakes as an endangered species (North Carolina Wildlife Resources Commission 2008). The species is listed as a Species of Special Concern in South Carolina, Alabama, and Florida, but these designations provide no protection (Bennett 1995; Means 1986; Enge 1993; Timmerman and Martin 2003, p. 50, South Carolina DNR 2005, p. 14).

State regulations on the collection and sale of eastern diamondback rattlesnakes are summarized below:

- In Louisiana, licenses or permits are needed to privately possess venomous snakes or sell reptiles. LAC 76:XV.101(K) (requiring permit to privately possess venomous snakes); LAC 76:XV.101(G) (requiring a reptile and amphibian collector's license to sell turtles or other reptiles and/or amphibians captured with legal commercial fishing gear or by other legal methods). License holders can take unlimited numbers of snakes.
- In Mississippi, state regulations prohibit commercialization of native wildlife and prohibit persons from possessing more than four individuals of the same species. CMSR 19-000-027. But regulations limit only the possession and sale and not the take of the species.
- Alabama provides no protection for the eastern diamondback rattlesnake (Alabama Department of Conservation and Natural Resources 2010). *See* Ala. Admin. Code r. 220-2-.92.
- In Georgia, there is a law that prohibits the taking of nongame wildlife but venomous snakes are specifically excluded. O.C.G.A. § 27-1-28.
- In Florida, a venomous reptile permit is required to possess or transport live rattlesnakes (Florida Fish and Wildlife Conservation Commission 2010). But Florida provides no limit on the number that can be taken. 68A-25.002, F.A.C. Enge (1991, 1993a, b) concluded that the eastern diamondback is the Florida species of amphibian and reptile most obviously needing of protection.
- In South Carolina, the species receives no protection under state law and unlimited numbers can be killed (South Carolina Department of Natural Resources 2010).

In other words, eastern diamondbacks are wholly unprotected in South Carolina, Georgia, Florida, Mississippi, Alabama, and Louisiana. Unlimited numbers of the snakes may be killed in these states, and as such, the lack of regulatory mechanisms facilitates overexploitation of the species.

In sum, even though exploitation by humans is having a severe impact on remaining eastern diamondback rattlesnake populations, only one of seven states within the range of the

eastern diamondback rattlesnake provide any protection for the species. As such, the inadequacy of regulatory mechanisms is a primary factor threatening the species.

E. Other Natural and Anthropogenic Factors

Climate change is an anthropogenic factor that may impact the snake in the future. Because the species is restricted to coastal areas (0-500 m above sea level), rising sea levels due to climate change may inundate some occupied habitat for the species. In addition, eastern diamondback rattlesnakes are susceptible to pesticide poisoning but the extent of this threat is unknown (Timmerman and Martin 2003, p. 21).

IX. CRITICAL HABITAT

Section 4(a)(3) of the Endangered Species Act and implementing regulations (50 C.F.R. § 424.12) require that, to the maximum extent prudent and determinable, FWS designate critical habitat at the time the species is determined to be endangered or threatened. 16 U.S.C. § 1533(a)(3)(A)(i); *see also id.* at § 1533(b)(6)(C). The Endangered Species Act defines the term “critical habitat” to mean:

- i. the specific areas within the geographical area occupied by the species, at the time it is listed . . . , on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and
- ii. specific areas outside of the geographical area occupied by the species at the time it is listed . . . , upon a determination by the Secretary that such areas are essential for the conservation of the species.

Id. at § 1532(5)(A).

Long term survival of the eastern diamondback rattlesnake will depend almost entirely upon lands set aside for conservation (Timmerman and Martin 2003, p. 41). As such, Petitioners expect that FWS will comply with the ESA’s unambiguous mandate and designate critical habitat concurrently with the listing of the eastern diamondback rattlesnake. Because of the limited range of this highly imperiled snake, all habitat utilized for breeding, shelter, movement, and foraging meet the definition of critical habitat and must therefore be designated as such.

X. CONCLUSION

Petitioners have assessed the best scientific information available regarding the past, present, and future threats faced by the eastern diamondback rattlesnake and have determined that it likely to become endangered throughout all or a significant portion of its range. Specifically, the eastern diamondback rattlesnake is threatened by the following factors: present or threatened destruction, modification, or curtailment of habitat or range; overutilization for commercial and recreational purposes; and inadequate regulatory mechanisms. Based on this information, the eastern diamondback rattlesnake must be immediately listed as a threatened species under the Endangered Species Act.

XI. LITERATURE CITED

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