SPECIES ASSESSMENT FOR LONG-BILLED CURLEW (*NUMENIUS AMERICANUS*) IN WYOMING

prepared by

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prepared for

United States Department of the Interior
Bureau of Land Management
Wyoming State Office
Cheyenne, Wyoming

January 2004

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Introduction

The Long-billed Curlew (*Numenius americanus*) is the largest bird in the sandpiper family (Scolopacidae), and one of only nine species of grassland birds that is considered endemic to the Great Plains (Dugger and Dugger 2002). This curlew species has the southernmost breeding distribution and northernmost wintering distribution of the four curlew species found in North America (Dugger and Dugger 2002). It breeds in the Great Plains, Great Basin, and intermontane valleys of the western U.S. and southwestern Canada (Dugger and Dugger 2002). The Long-billed Curlew is cinnamon-brown above, and buff below, with a very long, strongly downcurved bill (Field Guide to the Birds of North America 1999). Cinnamon-buff wing linings, which are visible in flight, are distinctive in all plumages (Field Guide to the Birds of North America 1999). The Long-billed Curlew's call is a loud, musical, ascending cur-lee (Field Guide to the Birds of North America 1999), and can be heard across short and mixed grasslands throughout the midwestern and western areas of the continent. The diet of the Long-billed Curlew consists of various invertebrates, as well as some vertebrates, including shrimp and crabs on tidal mudflats of wintering grounds and burrowing earthworms in pastures of summering grounds (Dugger and Dugger 2002). Long-billed Curlews are seasonally monogamous and both sexes incubate, and are aggressive in defense of their nests and young (Dugger and Dugger 2002). Breeding begins in late April to early May, and curlews have one brood of three to five young (Dugger and Dugger 2002).

The Long-billed Curlew once bred throughout the western grasslands and into the east, but populations have declined significantly during the past 150 years, especially wintering populations on the east coast (Dugger and Dugger 2002). Overharvest in migration areas (1850-1917) and elimination of suitable habitat are believed to be responsible for these declines (Dugger and Dugger 2002). Today, the species is considered vulnerable throughout its range, and continued

habitat loss is thought to be the greatest threat to population stability. Long-billed Curlew numbers in Wyoming have also decreased over the last century. The Long-billed Curlew has been documented as breeding in only a few locations in Wyoming (less than 10) within the last 15 years. It now only breeds regularly on the irrigated meadows of the upper Green River basin near Pinedale, and has recently been extirpated from habitat converted to housing developments near Sheridan and Casper.

Natural History

Morphological Description

The Long-billed Curlew is a large, long-legged shorebird with a very long, decurved bill (Dugger and Dugger 2002). Total body length is 500-650 mm (53-66 cm) and the average adult curlew weighs 28-32 ounces (WYNDD 2003). Wingspan is 257-308 mm (91-101 cm), tail length is 104-136 mm, and bill length is 113-219 mm (Dugger and Dugger 2002). Females tend to be larger than males, especially in bill length (170 mm for females versus 139 mm for males), and they have lower-pitched calls. They have a dark brown iris and dull bluish gray feet and legs (Dugger and Dugger 2002).

Adult plumage is brown to buff throughout and tinged with a cinnamon or pink color (Dugger and Dugger 2002). Upperparts of the body are streaked and barred with dark brown, while underwing coverts and axillaries are cinnamon in coloration and the upper surface of the remiges are contrasting orange-brown (See Figure 1) (Dugger and Dugger 2002). The crown is streaked, but lacks the distinctive striping that other curlew species possess (Dugger and Dugger 2002). Plumages of the Long-billed Curlew are similar throughout the year. Long-billed Curlews are difficult to sex on the basis of size or plumage. Juveniles can be distinguished from adults by their wing-coverts, which have dark brown centers, but lack the dark brown barring and pale notches

that adults have (Dugger and Dugger 2002). Juvenal tertials are more brightly colored than in adults, with darker, wider central stripes and cinnamon-buff coloration versus grayish-buff coloration (Dugger and Dugger 2002). The bill of juveniles is also distinctly shorter than that of adults (Dugger and Dugger 2002).

The Long-billed Curlew can be distinguished from all other North American shorebirds by its large size, long decurved bill, and buffy-cinnamon color (Dugger and Dugger 2002). The cinnamon-buff wing linings of the Long-billed Curlew, which are visible in flight, are distinctive in all plumages (Field Guide to the Birds of North America 1999). Some similar curlew species encountered in North America are the Whimbrel (breeds in Alaska and northern Canada), Marbled Godwit (breeds in southern Canada, Montana, and North and South Dakota), and Bristle-thighed Curlew (breeds in Alaska) (Field Guide to the Birds of North America 1999). Only the Whimbrel breeds in some of the same areas as the Long-billed Curlew, but they all can winter in the same areas.

Taxonomy and Distribution

Taxonomy

There is some geographic variation between breeding populations of Long-billed Curlews across Canada and the United States, however, whether size differences are clinal across their range or show a distinct geographic break (e.g., step cline) remains uncertain (Dugger and Dugger 2002). The pattern of decreasing size to the north and west was postulated to have occurred as a result of isolation during the Pleistocene glaciation (Hubbard 1973).

Regarding subspecies of the Long-billed Curlew, there is some variation. Hellmayr and Conover (1948), Bull (1985), and Phillips et al. (1964) believe that the Long-billed Curlew species is monotypic, but several other authors have maintained that two subspecies exist (Bishop 1910,

Blake 1977). Whether or not individuals can be diagnosed away from the breeding grounds based on published characters is uncertain (Dugger and Dugger 2002). The two previously named subspecies from Ridgway, 1919 are as follows: *N. a. americanus* Bechstein, 1812 and *N. a. parvus* Bishop, 1910; see Dugger and Dugger 2002 for detailed range information and measurements. Further study is needed regarding the taxonomic status of subspecies of the Long-billed Curlew, and therefore the confidence rating for subspecies validity is Medium.

North American Distribution

Historically, the Long-billed Curlew bred over a much larger area than it does today (Figure 2). This included grasslands in southern Michigan, Iowa, northern Illinois, western Minnesota, southern Wisconsin, coastal Texas, and areas of Arizona (Roberts 1919, Wickersham 1902, Wayne 1910, Fargo 1934, Thompson 1890, Renaud 1980, Dugger and Dugger 2002). Even within the current breeding range, populations of Long-billed Curlews have become more isolated and restricted, especially in parts of Canada, Kansas, and the Dakota's (Dugger and Dugger 2002). The wintering distribution of the Long-billed Curlew also used to include much of the Atlantic coast from New England to South Carolina (Bent 1929). Once common during winters in Florida, Long-billed Curlews are now only rare there in the winter (Stevenson and Anderson 1994).

The Long-billed Curlew currently breeds from the southern interior of British Columbia and the prairies of Alberta and Saskatchewan, and south into the United States (Figure 2) (Campbell et al. 1990, Cannings 1999, Semenchuk 1992, Smith 1996). In the U.S. they breed from areas east of the Cascades in Washington and Oregon (Gilligan et al. 1994, Smith et al. 1997); northeastern California (Pampush 1980, Small 1994); the southern half of Idaho (Stephens and Sturts 1991); the northern half of Nevada and Utah (Nevada Breeding Bird Atlas unpublished *in* Dugger and Dugger 2002, Walters et al. 1983); throughout most of Montana (Montana Bird Distribution

Committee 1996); throughout the western two-thirds of Wyoming (Oakleaf et al. 1992); the southwestern corner of North Dakota (Stewart 1975); the western half of South Dakota (Peterson 1995); northwestern and north-central Nebraska (Bicak 1977); the eastern plains of Colorado (Nelson 1998); the extreme southwestern corner of Kansas (Kansas Breeding Bird Atlas 1992-1997 unpublished *in* Dugger and Dugger 2002); the panhandle of Oklahoma (Shackford 1987); the northwestern panhandle of Texas (Texas Breeding Bird Atlas 1987-1992 unpublished *in* Dugger and Dugger 2002); and northeastern New Mexico (Hubbard 1978); (Figure 2). It is possible that a few may breed along the Texas coast, but this is unconfirmed at this time (Dugger and Dugger 2002).

Most Long-billed Curlews winter in the west, all along the Pacific coast to the Central Valley of California, and through the Imperial and Colorado River valleys, south to the Gulf of California (Figure 2) (Paulson 1993, Small 1994, Shuford et al. 1998). Some others winter in the east, along the Atlantic coast from South Carolina to Florida and along the Gulf Coast from Louisiana and Texas south at least as far as Honduras (Oberholser 1974, Stevenson and Anderson 1994). In Central America the Long-billed Curlew winters along the Gulf of Mexico to the Yucatan Peninsula, both coasts of Baja California, and as far south as Colima, Mexico and El Salvador (Stiles and Smith 1980, Morrison et al. 1994, Howell and Webb 1995).

The confidence rating for the distribution of the Long-billed Curlew is High.

Wyoming Distribution

Wyoming forms a large part of the core breeding range of the Long-billed Curlew's distribution (Figure 3). The Long-billed Curlew can be found scattered throughout all of Wyoming, except in heavily forested areas, during their breeding season (May-August). They occur statewide in suitable habitat, and have been documented in all counties except Big Horn and

Washakie (WYNDD 2003). There are locally dense populations in the state, in northern Sublette county, at Chapman Bench near Cody, and near the Bear River marshes in Lincoln county, but beyond these areas distribution is very sparse and patchy, with only a few pairs of curlews seen annually in many counties statewide (Cochrane and Oakleaf 1982). Breeding locations are thinly scattered across the state in suitable habitat. It appears that higher concentrations of Long-billed Curlews (breeding and non-breeding) can be found in the far western portion of the state, and this is probably related to habitat availability (WYNDD 2003). The best Long-billed Curlew population in the state at this time can be found in the upper Green River basin, from Merna to Pinedale (on the Horse Creek and New Fork Rivers) (WYNDD 2003). Recent populations have also been documented at Chapman Bench near Cody (on the south fork of the Shoshone River), on the Ham's Fork River drainage north of Kemmerer, at the Bear River marshes near Cokeville, and in Grand Teton National Park (hayfields) (WYNDD 2003). Scattered breeding pairs of Long-billed Curlews can also be found in areas of the Greater Yellowstone area where suitable habitat exists, including the National Elk Refuge, Teton Valley, Henry's Lake Flats, and the Centennial Valley (Redmond 1989, WYNDD 2003).

WYNDD has a total of 223 Long-billed Curlew records, and of these, 99 are considered to be current (less than 15 years old), and the other 124 are considered historical (Figure 3). There are a total of 68 breeding records for the state, 19 of which are current. There are 155 non-breeding records for the state, 80 of which are current. There may be more Long-billed Curlews breeding in the state than these numbers indicate, since some birds are seen during the breeding season, but there is no evidence to indicate if they are breeding or not.

Cochrane (1983) conducted the first documented surveys for Long-billed Curlews in the state, and at this time assessed their status. Since this time, the Wyoming Game and Fish Department

has conducted Long-billed Curlew surveys, one in 1987 and then every year since 1991 (WGFD 2002). Their data has shown that Long-billed Curlew numbers seem to vary greatly from year to year in the state (Table 1). In the past 20 years Long-billed Curlew numbers have fluctuated, but it seems that fewer curlews are being observed now than in 1981 and 1982 (WGFD 2002). BBS routes have been conducted at some locations in the state on a consistent basis since 1976, but the numbers of curlews detected on these surveys has fluctuated greatly, making it difficult to determine trends. Populations in the state have decreased since 1940 (Cochrane and Oakleaf 1982), and drastic population declines have been noted in specific locations in the state since the mid-1960's, especially in the eastern counties (Luce et al. 1997). Historically, Long-billed Curlews were common to abundant across the state until the early 1900's when numbers began to decline. Today, the numbers indicate fewer Long-billed Curlews breeding in the state than in previous years, but precise trend information is not known as historical data is somewhat lacking prior to 1981.

Habitat Requirements

Foraging Habitat (Microhabitat)

Long-billed Curlews feed in open prairies, usually in grassy hollows, or edges of prairie sloughs and ponds (Palmer 1967). They do not generally nest in agricultural areas, although they often forage in them throughout the breeding season (Dugger and Dugger 2002). Little information is known on microhabitat use during the breeding season. In southeastern Colorado, 55% of foraging observations occurred in short grass and 40% in crop fields (King 1978). In Oregon, Long-billed Curlews have been documented foraging in cheatgrass and freshly mowed alfalfa (Pampush and Anthony 1993), and in Idaho they foraged predominantly in grasslands (Jenni et al. 1981). Breeding Long-billed Curlews may forage inside or outside their nesting territory (Bicak 1977, Pampush and Anthony 1993).

During the nonbreeding season the Long-billed Curlew prefers firm mud substrate or high-tidal areas to soft mud, sand, or low-tidal areas (Gerstenberg 1979). A study conducted at Morro Bay, California, indicated that moist, firm mud (water <1 cm deep) was used the most during all seasons (Boland 1988). Use of rice fields was influenced by water depth, and the median water depth of flooded fields used by Long-billed Curlews in California was about 5 cm (Elphick and Oring 2000).

Summer Habitat (Breeding)

The Long-billed Curlew breeds in prairies and grassy, moist meadows, generally near water (Redmond 1989). They are known to frequent plowed fields, meadows, and pastures for nesting (King 1978, Pampush 1980, Jenni et al. 1981, Hooper and Pitt 1996). They nest primarily in short-grass or mixed-grass prairie habitat with flat to rolling topography (Dugger and Dugger 2002), and they nest in shallow depressions in the ground (Bent 1929). They have been documented nesting on the ground in flat areas with short grass, sometimes on more irregular terrain, often near a rock or other conspicuous object (Dugger and Dugger 2002). They prefer open, sparse grassland habitats with low vegetation (under 30 cm) because tall vegetation hinders foraging, encourages predation, and reduces reproductive success (Dugger and Dugger 2002). Long-billed Curlews are known to avoid habitats with trees, high densities of shrubs, and tall, dense grasses (Pampush 1981, Campbell et al. 1990, Pampush and Anthony 1993). Although taller, dense grasses tend to be used during brood-rearing when shade and camouflage are important for chicks, this may also reflect a decline in the availability of shorter habitats as the breeding season progresses (Jenni et al. 1981).

A wide variety of grassland plant communities have been used for nesting. The dominant plants in different parts of the range include common buffalo grass (*Buchloe dactyloides*), blue

grama grass (*Bouteloua gracilis*), and prickly pear cactus (*Opuntia* spp.) in Colorado (Graul 1971, King 1978); several species of bluestem (*Andropogon* spp.), needle and thread (*Stipa comata*), sixweek's fescue (*Festuca bromides*), and sand dropseed (*Sporobolus cryptandrus*) in Nebraska (Bicak 1977); cheatgrass brome (*Bromus tectorum*) and medusa-head wild rye (*Taeniatherum asperum*) in Idaho (Redmond et al. 1981); cheatgrass brome, Sandberg's bluegrass (*Poa sandbergii*), and medusa-head wild rye, but also shrubbier habitats dominated by saltgrass (*Distichlis spicata*), greasewood (*Sarcobatus vermiculatus*), or sagebrush in southeastern Washington and the Columbia and Northern Great Basins (Pampush 1980); blue grama grass, spike moss (*Selaginella densa*), fringed sagebrush (*Artemisia frigida*), golden aster (*Chrysopsis villosa*), and blackroot sedge (*Carex eleocharis*) in the Northern Great Plains (Kantrud and Kologiski 1982); and pickleweed (*Salicornia europaea*), *Bassia* spp., *Suaeda* spp., saltgrass, and pigweed (Chenopodium album) around the Great Salt Lake, Utah (Paton and Dalton 1994).

Typically, Long-billed Curlews only use agricultural areas for foraging, however, in the Great Basin they have been known to nest in agricultural fields of wheat stubble, fallow, and short, dry, cereal grain fields as well (Pampush 1980).

Wyoming Breeding Habitat

In Wyoming the Long-billed Curlew has been documented nesting in grassland communities consisting of wire grass (*Juncus balticus*) and mountain timothy (*Phleum alpinum*) (Cochrane and Anderson 1987). They were also documented using cultivated hay fields dominated by timothy (*Phleum pretense*), redtop (*Agrostis palustris*), reed canary grass (*Phalaris arundinacea*), alsike clover (*Trifolium hybridum*), milkvetch (*Astragalus* spp.), meadow foxtail (*Alopecurus pratensis*), and alfalfa (*Medicago sativa*) (Cochrane and Anderson 1987). Cochrane (1983) documented almost all of the Long-billed Curlews in this study in irrigated hay meadows. Long-billed

Curlews in Wyoming have also been documented in grasslands, sagebrush-grasslands, and riparian marsh areas (Cochrane and Oakleaf 1982)

In the Merna area, curlew densities were highest where hay meadows uniformly covered 40-60 km^2 of open, level land (Cochrane and Oakleaf 1982). Curlews at this site nested in grasses that were three to eight cm in height, and broken up by widely dispersed willow patches. They typically nested on slight hummocks in order to avoid damage from flood waters.

Spring and Fall Habitat (Migration)

A wide range of habitats are used during migration, including dry short-grass prairie, wetlands associated with alkali lakes, playa lakes, wet coastal pasture, tidal mudflats, salt marsh, alfalfa fields, barley fields, fallow agricultural fields, and harvested rice fields (Colwell and Dodd 1995, Davis 1996, Danufsky 2000). In the Playa Lakes region of Texas, >95% of flocks used sparsely vegetated wetlands (<33% vegetation cover) (Davis 1996). Within these playas, deep water (>16 cm) was not used, but shallow flooded (0-4 cm) and moderately flooded (4-16 cm) waters were used in proportion to availability (Davis 1996).

Winter Habitat

On their winter range, some Long-billed Curlews use grasslands and fields, while others seem to prefer intertidal and estuarine habitats along the coast (Redmond 1989). Along the Pacific Coast, they use tidal estuaries, wet pasture habitats, and to a lesser extent, sandy beaches (Colwell and Sundeen 2000). During high tide they will roost in high-elevation salt marshes (Danufsky 2000). Numerous studies conducted on wintering habitat in Humboldt Bay, California, determined that Long-billed Curlews regularly occurred in only tidal mudflats and salt marshes (Gerstenberg 1979, Colwell and Dodd 1995, Danufsky 2000). The use of tidal mudflats at

Humboldt Bay decreased when winter rains began, and the use of pastures surrounding the bay increased at this time (Danufsky 2000).

In California's Central Valley, Long-billed Curlews used flooded and unflooded cultivated rice fields, managed wetlands, evaporation ponds, sewage ponds, and grassland habitats (Day and Colwell 1998). They occurred more frequently in fields flooded with <16 cm of water, and median water depth in these fields was five cm (Elphick and Oring 1998). Flooded agricultural fields seemed to be used most in winter, while managed wetlands were used most in spring, and in late summer/fall miscellaneous waterways (drainage ditches, sloughs, streams, farm ponds, and reservoirs) were primarily used (Shuford et al. 1998). Surveys suggest that San Francisco Bay supports 50% of all Long-billed Curlews wintering along the Pacific coast (Page et al. 1997).

Along the southeastern coast of Texas, Long-billed Curlews almost exclusively used shallow, inundated mudflats, but they frequently moved between these intertidal flats and inland areas (Brush 1995).

The confidence rating for our knowledge of habitat use for all of the habitats listed above is High.

Territoriality and Area Requirements

Territories are relatively large (30-50 acres) and are used by both members of a pair for feeding and nesting (Redmond 1989). Territory size has been documented ranging from six to eight hectares in southeastern Washington, to 14 hectares in Idaho, with a buffer of unoccupied habitat 300-500 meters wide around the edge of the territory in Idaho (Allen 1980, Jenni et al. 1981). Not all individuals establish territories on migration or wintering grounds, but studies in California have shown that winter territories are similar in size to breeding territories (Mathis 2000). Breeding density in Idaho was about five to seven males per 100 hectares (Redmond and

Jenni 1986), and one pair per six to seven square kilometers in Saskatchewan (Smith 1996). Breeding territory densities in Washington totaled up to 15 territories in 10.4 square kilometers (Allen 1980).

Long-billed Curlews require 35-120 acres of suitable breeding and nesting habitat depending on the topographic and vegetative diversity of the area (Wildlife Habitat Management Inst. 2000). Distribution and interspersion of food and cover in the form of varying habitats determines whether or not an area can support a population of Long-billed Curlews and, the number of individuals that the population will support (Wildlife Habitat Management Inst. 2000).

Long-billed Curlews arrive on their breeding grounds in small, heterosexual flocks and individuals then quickly disperse to establish territories. Returning breeders quickly establish territories, with less agonistic interaction than first-time breeders (Allen 1980, Jenni et al. 1981). After they pair up, territory boundaries are primarily defended by the males. Long-billed Curlews are extremely territorial, especially during the breeding season. They defend their nesting territory from the prelaying of eggs through the hatching of chicks (Allen 1980, Jenni et al. 1981). Various threat displays are used to evict intruders and include supplanting and crouch-run with an aerial pursuit (Allen 1980, Jenni et al. 1981).

Non-breeding territories may be defended lightly at times by Long-billed Curlews (Colwell and Mathis 2001). A study conducted in Nebraska reported some breeders defending a feeding territory (Bicak 1977), and M. A. Colwell (pers. comm. *in* Dugger and Dugger 2002) reported Long-billed Curlews defending intertidal habitats in California as well.

Landscape Pattern

Long-billed Curlews need relatively large (30-50 acres), undisturbed territories for breeding (Redmond 1989). An appropriate landscape mosaic should consist of large, open prairies and

grassy meadows with low vegetation (under 30 cm) that are close to water (Redmond 1989). The most critical aspect of a good landscape mosaic is the proximity of foraging habitat to nesting, brood-rearing, and roosting cover (Wildlife Habitat Management Inst. (U.S.) 2000). These breeding areas should also be in close proximity to pastures, agricultural crops, and other habitats used for foraging that contain high abundances of invertebrate prey (Pampush 1980). Since Long-billed Curlews are known to avoid habitats with trees, high densities of shrubs, and tall dense grasses (Pampush 1981, Campbell et al. 1990, Pampush and Anthony 1993), the landscape mosaic should be open and free of patches of trees and dense vegetation.

Landscape mosaic is probably not as critical on wintering grounds as it is on breeding grounds. A good landscape mosaic on wintering grounds should consist of quality wintering habitat, such as intertidal, estuarine, or grassland habitat, in close proximity to cultivated rice fields and wet pastures that are used for foraging (Day and Colwell 1998).

Movement and Activity Patterns

Migration

The Long-billed Curlew is considered a neotropical migrant. They are considered short distance migrants, in comparison to other species of the genus *Numenius* (Skagen and Knopf 1993). Some individuals may migrate > 2,400 km between a northern breeding area and a southern wintering area, but no data is available relating populations in specific parts of the breeding range to specific wintering areas (Dugger and Dugger 2002). For this reason, migration patterns in Long-billed Curlews are poorly understood. A study conducted in the Colorado River delta which documented high numbers of curlews present, suggested that the region may be an important stopover area between the U.S. and coastal Mexico (Mellink et al. 1997).

Long-billed Curlews can leave their breeding grounds as early as mid June, up until late August to form flocks and migrate to coastal habitats mostly from California and Texas into Mexico (Dugger and Dugger 2002). Peak migration from wintering grounds is considered to be early August (Campbell et al. 1990). Long-billed Curlews winter in the west, from the Central Valley of California, south along the Pacific coast and through the Imperial and Colorado River valleys, and along the Gulf of California (Dugger and Dugger 2002). Some others winter in the east, from South Carolina to Florida and along the Gulf Coast from Louisiana and Texas south at least as far as Honduras (Dugger and Dugger 2002). They are generally found on tidal flats and other coastal habitats, but can also be found on inland grassland and agricultural habitats, such as those found in the Central Valley of California and in west Texas. Long-billed Curlews wintering numbers can vary considerably from year to year at many localities, thus obscuring long-term population trends. Spring migration begins as early as February in some places, but is generally considered to range from March to April (Dugger and Dugger 2002). The peak of spring migration is thought to occur in mid March in Texas and mid April in Utah (Paton et al. 1992), and most individuals have arrived on their breeding grounds by late April (Campbell et al. 1990).

Daily Activity

The Long-billed Curlew is primarily diurnal, feeding during the days and resting at roosting sites at night. On breeding grounds activity may begin about a half hour before dawn, and end at dark as birds arrive at their roosting sites (Allen 1980). Long-billed Curlews arrive on their breeding grounds in small, heterosexual flocks and individuals then disperse to establish territories in suitable habitat (Allen 1980, Jenni et al. 1981). They are predominantly solitary, but they can occur in small groups (a few hundred) during migration and at winter evening roosts.

Reproduction and Survivorship

Breeding Behavior

Long-billed Curlews are seasonally monogamous, and there is some evidence that individuals re-pair with the same mate in subsequent years (Allen 1980, Redmond and Jenni 1982). Long-billed Curlews arrive on their breeding grounds in small, heterosexual flocks and individuals then quickly disperse to establish territories (Allen 1980, Jenni et al. 1981). Some evidence suggests that previously established pairs will often arrive together, but if not, they form pairs shortly after arrival (Forsythe 1970). Unpaired males usually arrive on breeding grounds before unpaired females to establish territories. Unpaired males then begin aerial displays to advertise their single status (Allen 1980, Pampush 1981). Females arrive later and visit territories held by displaying males (Allen 1980, Jenni et al. 1981). Several courtship displays are used by Long-billed Curlews, including undulating flight displays, ground calling, ritualized scraping, and tossing (Graul 1973, King 1978, Allen 1980). Undulating flight displays and ground calling are used only by unpaired males to attract mates (Allen 1980), while ritualized scraping and tossing are nest building behaviors performed by both sexes during courtship (Graul 1973, King 1978).

During copulation males perform a courtship run, a precopulatory behavior in which they run at the females with their neck retracted, back horizontal, and head upright with wings slightly raised (Allen 1980). Males then perform a shaking behavior where they stand behind the female with wings raised out to the side, tail cocked upward, and neck outstretched (King 1978, Allen 1980). The males begin padding their feet rapidly and moving side to side behind the female, while simultaneously shaking their heads and ruffling the female's feathers with their bills (King 1978, Allen 1980). This display progresses until the female either walks away or submits to being mounted in order for copulation to begin (King 1978, Allen 1980).

The proportion of displaying males that fail to acquire mates is variable among breeding areas. In Oregon, unpaired males constituted up to 20% of the total population (Pampush 1980). In southeastern Washington (Allen 1980) and Colorado (King 1978), all males were paired in one year, but in another year unpaired males held territories as commonly as pairs. In Idaho, more males than females were always observed during spring surveys, indicating that only 79-85% of males paired each year (Jenni et al. 1981). During spring surveys conducted at 2 locations in western Wyoming, males outnumbered females 1.7:1 and 3.0:1, however it is unclear whether the high male to female ratio reflects true sex-ratio differences or just differences in the visibility of sexes during spring when females are laying eggs and incubating (Jenni et al. 1981).

Long-billed Curlews are especially vulnerable to disturbances at nesting sites during the breeding season. Disturbance can result in nest abandonment, and females generally do not return to a breeding area if it was disturbed the previous year.

Breeding Phenology

Mating

Mating usually begins shortly after arrival on the breeding grounds. In north-central Oregon this is in mid March (Pampush 1980), while in southeastern Washington (Allen 1980), southeastern Colorado (King 1978), Utah (Paton and Dalton 1994), and western Idaho (Jenni et al. 1981), breeders arrive from mid to late March. In Wyoming (Cochrane 1983), and Saskatchewan (Maher 1973), first arrivals are in mid to late April.

Pair Formation

Long-billed Curlews arrive on their breeding grounds from mid to late March in most areas of the U.S. and in mid to late April in Canada (King 1978, Jenni et al. 1981, Maher 1973). In Wyoming, they usually arrive from mid to late April in most years (Cochrane 1983). Some males and females may arrive already paired (Forsythe 1970, Allen 1980) and the unpaired individuals

begin to form pairs. The curlews immediately begin establishing territories, and courtship behavior begins and continues for 3-4 weeks (Jenni et al. 1981).

Nesting and Egg Laying

Nest building begins within 1 week of pair formation, usually early April through May (Jenni et al. 1981). Some nest-lining material is present when the first eggs are laid, but nest construction continues throughout the egg laying process. Egg laying dates vary with geographic region. The earliest documented egg laying dates from various areas are as follows: late March in north-central Oregon (Pampush 1981), early April in Idaho and southeastern Washington (Jenni et al. 1981, Allen 1980), mid April in British Columbia (Bent 1929), mid to late April in southeastern Colorado and Utah (Paton and Dalton 1994), early May in Saskatchewan and Wyoming (Maher 1973, Cochrane 1983, Roy 1996). The latest documented egg laying dates include the end of May in Colorado and Utah, early June in British Columbia (Campbell et al. 1990), and early July in Saskatchewan and Idaho. Long-billed Curlews only lay one brood of eggs per season, and clutch size is two to five eggs (usually four) (Dugger and Dugger 2002). Eggs are oval in shape and have a smooth surface texture. They are generally light beige to greenish/olive in coloration with dark olive-brown or pale purple speckles (Dugger and Dugger 2002). Eggs are laid over a period of four to seven days.

Egg Incubation

Incubation may be intermittent until the last egg of the clutch is laid, and then it begins in full (Allen 1980, Jenni et al. 1981).Young are incubated by both sexes for 28-30 days (Redmond and Jenni 1986). Females usually incubate eggs during the day and males at night (Allen 1980, Jenni et al. 1981). Evidence is lacking, but it seems that adults take shifts incubating eggs for continuous periods of time.

Hatching

Hatching is highly synchronous and estimated to take four to six hours (Allen 1980, Jenni et al. 1981). Nestlings are precocial when they hatch and they can leave the nest within a few hours of hatching, but they soon return to be brooded. Chicks are able to walk five hours after hatching, and to feed themselves 10 hours after hatching (Jenni et al. 1981). Hatching occurs in Oregon from mid May to early June (Pampush and Anthony 1993); in Wyoming from late June to early July (Cochrane and Anderson 1987); in Idaho from mid May to mid June (Jenni et al. 1981); in Washington from mid May to early June (Allen 1980); in Utah and Colorado from mid to late May (King 1978); and in Saskatchewan in early June (Renaud 1980).

Parental Care

Young are tended by both parents, and brooded at night for several days after hatching and in inclement weather. Adults may shade chicks during warm weather. Parental care primarily consists of vigilance and defense against potential predators. Adults engage in mobbing behavior from late in incubation until their chicks are three to four weeks old (Redmond 1989). Brooding seems to stop after the chicks reach about two weeks of age (Allen 1980, Jenni et al. 1981). Females generally depart when young are two to three weeks old before the young have fledged, while the males stay and tend the young until fledging at 38-45 days (Redmond 1989).

Fledging/Weaning

Young usually fledge at 38-45 days (King 1978, Allen 1980, Redmond and Jenni 1986). After hatching the young curlews begin making short movements away from the nest. By 10 days of age they often travel > one km per day for one to three days (Dugger and Dugger 2002). One brood in Saskatchewan had relocated and within six days after banding they were 6.5 km from their nest site (Sadler and Maher 1976). Fledged juveniles have been observed in Idaho by mid June and in Saskatchewan as early as July fifth (Renaud 1980).

Natal Dispersal

There is no available information regarding dispersal in Long-billed Curlews (Dugger and Dugger 2002). Males show higher site fidelity than females, who may not return if exposed to excessive disturbance or nest loss (Redmond and Jenni 1982). When sexes do return, they may not return to the same nesting territory (Redmond and Jenni 1982). There is no information regarding fidelity to nonbreeding areas and territories. Juvenile birds will sometimes disperse to wintering grounds, where they remain until they are almost two years of age (Redmond 1989). Both sexes may take a northward migration ate age two, but they do not breed until they reach three to four years of age (Redmond 1989).

Breeding in Wyoming

The breeding phenology of the Long-billed Curlew in Wyoming seems to be later than in surrounding states, probably due to the altitude and prolonged winter weather (Cochrane and Oakleaf 1982). Long-billed Curlews may pass through Wyoming during migration in April, and they generally arrive in the state to breed by May. Courtship usually begins in early to mid May and chicks are born in early to late June (Cochrane and Oakleaf 1982). The peak of the breeding season is from May 10 – June 30 (Cochrane and Oakleaf 1982). Juveniles fledge in late July to early August, before the hay is mowed (Cochrane and Oakleaf 1982). Few curlews have been reported in Wyoming after July; however, some fall migrants have been seen in the state as late as October (Cochrane and Oakleaf 1982). Phenology and vegetation growth both seem to account for the short breeding season in Wyoming.

Breeding and Nesting Habitat Requirements

There are four essential requirements for Long-billed Curlew nesting habitat: 1) short grass (< 30 cm), 2) bare ground, 3) shade, and 4) abundant invertebrate prey (Pampush 1980). Vegetation at nest sites tends to be "patchier" than typical Long-billed Curlew habitat (Pampush and Anthony

1993). In Utah, nests were reported in clumps of thick residual and growing vegetation with relatively little bare ground present (Paton and Dalton 1994). In British Columbia, preferred nest sites included flat grassy uplands or gravelly ridges and hillsides, but tall thick patches of grass and sagebrush were avoided (Campbell et al. 1990).

Females usually select the nest site from several scrapes available within the territory. Nest sites are relatively dry, flat exposed areas. In Wyoming, nest sites are more common on hummocks or higher, dryer ground (Cochrane and Anderson 1987). Nests are often located near conspicuous objects, such as cattle dung piles, rocks, and dirt mounds (King 1978, Allen 1980, Cochrane and Anderson 1987), and they are often close to (within 100-450 yards) standing water (USDA Natural Resources Conservation Service 2000). The reasons for this are not known for certain, but it is thought that they may provide shade, increase camouflage, or facilitate nest location (Dugger and Dugger 2002).

Long-billed Curlew nests are shallow depressions in the ground. Nest-lining material is variable and includes small pebbles, bark, livestock droppings, grass, rabbit and Canada goose droppings, small stems, twigs, seeds, and cheatgrass leaves (Allen 1980, Jenni et al. 1981, Campbell et al. 1990). Nest size is also variable, but 59 nest scrapes in southeastern Washington averaged 4.6 cm in depth and 20.1 cm in diameter (Allen 1980).

Fecundity and Survivorship

Age at first reproduction is two to three years for females and three to four years for males, and they presumably breed every year after they reach breeding age (Redmond and Jenni 1986). Long-billed Curlews have one brood of two to five eggs (average four) per year. There is no evidence that Long-billed Curlews renest if their first nest is destroyed (Allen 1980, Paton and Dalton 1994).

The average life span of Long-billed Curlews is 8-10 years (six to seven years of breeding) (Redmond and Jenni 1986), but maximum lifespan is unknown. The annual survival of breeding adults during a three year period in Idaho was 89% ± 0.10 SD, 64% ± 0.10 SD, and 0.84% ± 0.16 SD respectively, but this is likely an underestimate (Redmond and Jenni 1986).

Annual and Lifetime Reproductive Success

The following are nest success percentages from various areas; 69.0% (n = 40 nests) and 65.0% (n = 61) in Oregon (Pampush and Anthony 1993); 39.7% (n = 119) in Idaho (Redmond and Jenni 1986); 33.6% (n = 21) in Wyoming (Cochrane and Anderson 1987). The lowest documented nest success was 20% in Utah (n = 10), even though the method used to estimate apparent nest success generally overestimates success compared to other methods used (Paton and Dalton 1994).

The percent of eggs hatched from successful nests in Idaho was 91.3% (n = 254 eggs) for one year, and 88.4%-94.1% for a range of three years (Redmond and Jenni 1986). Survival of radio-marked chicks from hatching to fledging in Idaho was 39% (20 of 51 chicks, n = three years), but this was highly variable among years – 75% (9 of 12), 15% (2 of 13), and 35% (9 of 26) (Redmond and Jenni 1986).

Population Demographics

Limiting Factors

Little is understood regarding Long-billed Curlew population regulation. The most limiting factor of Long-billed Curlew populations over the long term is probably the quantity and quality of breeding habitat (Dugger and Dugger 2002). Internal variation in clutch size is presumably related to decreased food availability (Redmond and Jenni 1986), but it's unclear if the shortfall occurred on the breeding grounds or migration grounds. It seems adult survival is more important

than annual productivity, however, very little is known regarding factors that may affect adult survival.

Metapopulation Dynamics

This author is not aware of any studies investigating the possible metapopulation dynamics of Long-billed Curlew populations, so there is no information on what geographic or temporal parameters might define such a system.

Genetic Concerns

It does not appear from any of the literature that any genetic concerns exist at this time in regards to current populations of Long-billed Curlews.

Food Habits

Food items

The Long-billed Curlew is an invertivore, and is predominantly carnivorous (Dugger and Dugger 2002). Their diet consists primarily of small invertebrates such as grasshoppers, beetles, caterpillars, earthworms, spiders, and wild fruits such as berries (Bicak 1977, King 1978, Cochrane 1983, Boland 1988, Redmond 1989, L.W. Leeman 2000). During migration they feed on crayfishes, crabs, snails, and toads (Redmond 1989). Curlews wintering in estuarine habitats feed on crustaceans (mud crab), mollusks (ghost and mud shrimp), bivalves, marine worms and fish (Stenzel et al. 1976, Boland 1988, Leeman et al. 2001). Rainfall appears to facilitate foraging as the water table rises and earthworms are likely forced to the surface (Leeman et al. 2001).

Foraging Strategy

Long-billed Curlews are opportunistic foragers, especially on their breeding grounds (Dugger and Dugger 2002). They often forage outside of their breeding territories (Dugger and Dugger 2002). They forage singly, in pairs, and in groups of as many as 15 birds (Dugger and Dugger

2002). Groups appear to be used most often in habitats with high grasshopper density (King 1978, Jenni et al. 1981), suggesting that groups may forage "cooperatively". The Long-billed Curlew uses its long, decurved bill to pick food from the ground or water, or by probing with its bill in the sand or mud, in or near shallow water (Dugger and Dugger 2002). These birds have been observed hawking for insects (Cannings et al. 1987), and flipping over cow-dung piles to probe underneath (King 1978). They may obtain insect larvae by probing into loose soil (Allen 1980).

Probing is the major foraging method used by the Long-billed Curlew on wintering grounds, however, pecking is the major foraging method used on breeding grounds (Dugger and Dugger 2002). Therefore, it is thought that the specialized bill of the Long-billed Curlew may have evolved to facilitate probing for earthworms and other burrow-dwelling organisms found on wintering grounds (Dugger and Dugger 2002). The Long-billed Curlew probes deeper than other species of wintering shorebirds, and it is believed this is because a higher percentage of decapods are located in deeper sediments (10-15 cm) (Boland 1988).

The daily energetic requirements for male and female Long-billed Curlews were estimated to be 171 and 179 kcal/day, respectively (L.W. Leeman 2000). Based on these energetic requirements, male and female Long-billed Curlews would need to forage 13.8 and 15.6 hours/day respectively in pastures, or 10.5 and 12.2 hours/day in intertidal habitat in order to meet these needs (T.S. Leeman 2000, Leeman et al. 2001).

Foraging Variation

There does not seem to be any variation in diet between male and female Long-billed Curlews (Dugger and Dugger 2002). The dominant prey items for curlew chicks in Idaho were grasshoppers and carabid beetles (Redmond and Jenni 1985). Other young have been documented eating grasshoppers, carabid beetles, and other terrestrial insects (Redmond and Jenni 1985).

Long-billed Curlews tend to forage during the day. Pastures are not used for foraging at night; individuals usually arrive 15-20 minutes after sunrise and depart shortly after sunset (Dugger and Dugger 2002). In winter range at Humboldt Bay, California, density in wet-pasture habitat was greater earlier in the day and was correlated with previous two to three day rainfall totals (T.S. Leeman 2000).

On breeding grounds, Long-billed Curlews appear to be opportunistic foragers, supplementing a diet of invertebrates like grasshoppers and beetles with small vertebrates such as bird eggs and nestlings (Timken 1969, Sadler and Maher 1976, Goater and Bush 1986). During migration they feed on crayfishes, crabs, snails, and toads (Redmond 1989). Curlews wintering in estuarine habitats feed on crustaceans (mud crab), mollusks (ghost and mud shrimp), bivalves, marine worms and fish (Stenzel et al. 1976, Boland 1988, Leeman et al. 2001).

Earthworms seem to be an important food item in wet coastal pastures (T.S. Leeman 2000). Large shrimp or crab are the most common prey items in Long-billed Curlew diets, but variation among individuals and across seasons may occur (Boland 1988, Leeman et al. 2001). Analysis of three wintering territories in California indicated that crabs were always the most common prey item, but composition of other taxa varied seasonally, (i.e. fish and shrimp more common in summer, worms more common in winter) (Leeman et al. 2001). In a study conducted by Stenzel et al. (1976), diet did not change appreciably in composition between July and October, and November and February. Seasonal variation in diet, likely exists in relation to breeding and nonbreeding seasons and associated variations in geography.

Community Ecology

Predation

Long-billed Curlews are preyed upon by coyotes (*Canis latrans*), Swainson's Hawks (*Buteo swainsoni*), Ferruginous Hawks (*B. regalis*), corvids, and humans (Silloway 1900, Allen 1980). The primary mammalian predators of Long-billed Curlews are coyotes, red fox (*Vulpes vulpes*), feral dogs (*Canis familiaris*), and badgers (*Taxidea taxis*) (Redmond and Jenni 1986). Avian predators primarily include Black-billed Magpies and corvids (Redmond and Jenni 1986, Pampush and Anthony 1993). Unsuccessful attempts have been made by Prairie Falcons (*Falco mexicanus*) (Redmond and Jenni 1986). Some other potential nest predators include feral cats (*Felis catus*), striped skunks (*Mephitis mephitis*), and raccoons (*Procyon lotor*) (Dugger and Dugger 2002). Long-billed Curlew nests can also be destroyed by trampling from livestock.

Chicks, from the time of hatching up to one year of age, are mainly depredated by various raptors (Redmond and Jenni 1986). Unknown mammals have been responsible for some chick mortality, and one chick was eaten by a long-tailed weasel (*Mustela frenata*) (Jenni et al. 1981). Long-billed Curlew nests have been depredated by a variety of mammalian and avian predators, as well as a gopher snake (*Pituophis* spp.) (Dugger and Dugger 2002).

Interspecific interactions

Long-billed Curlews are extremely territorial, especially during the breeding season, and they defend their nesting territory from the prelaying of eggs, through the hatching of chicks (Allen 1980, Jenni et al. 1981). They generally only defend their territories against other conspecifics (Dugger and Dugger 2002). Various threat displays are used to evict intruders and include supplanting and crouch-run with an aerial pursuit (Allen 1980, Jenni et al. 1981). These confrontations are not usually violent.

Parasites and Disease

Little is known regarding diseases found in this species of curlew. Aspergillosis was documented killing 15% (2 of 13) of prefledglings during one breeding season in Idaho (Redmond and Jenni 1986). Known parasites that may infest Long-billed Curlews include three species of lice, and two ectoparasites, including chiggers and a species of louse (Wilson 1937, Loomis 1966, and Malcomson 1960). Nine species of helminth endoparasites have been documented in Long-billed Curlews, but compared to similar taxa, this is neither a species rich, or large number (Goater and Bush 1988). The anterior portion of the small intestine seems to be frequently populated by host-specialist trematodes (*Dictymetra numenii, D. nymphae*), and it is thought it comes from two-striped grasshoppers, a common component in Long-billed Curlew diets (Dugger and Dugger 2002). From the literature, it does not appear that disease and parasites pose a significant problem to the livelihood of Long-billed Curlews. See Dugger and Dugger (2002; Diseases and Body Parasites) for a complete description of all parasites and a listing of the specific species.

Symbiotic and Mutualistic Interactions

Long-billed Curlews are often seen with Reddish Egrets (*Egretta rufescens*), Great Egrets (*Ardea alba*), and White Ibis (*Eudocimus albus*) but the direct association between these species is not known (Dugger and Dugger 2002).

Conservation

Conservation Status

Federal Endangered Species Act

The Long-billed Curlew was proposed for listing as a threatened species in 1982, pending further information on its status (U.S. Fish and Wildlife Service 1982). Currently there is no special status or protection for this species.

Bureau of Land Management

The Wyoming BLM developed their sensitive species list in 2001, and the Long-billed Curlew was assigned to that list. The BLM developed the list to "ensure that any actions on public lands consider the overall welfare of these sensitive species and do not contribute to their decline." The BLM's sensitive species management will include: determining the distribution and current habitat needs of each species; incorporating sensitive species in land use and activity plans; developing conservation strategies; ensuring that sensitive species are considered in NEPA analysis; and prioritizing what conservation work is needed (BLM Wyoming 2001).

Forest Service

Region 2 of the U.S. Forest Service includes the Long-billed Curlew on its sensitive species list. Sensitive species are defined by the Forest Service as "those animal species identified by the Regional Forester for which population viability is a concern as evidenced by: (a) significant current or predicted downward trends in population numbers or density, and/or (b) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution" (USDA Forest Service 1994). The Region 2 area in Wyoming includes the Bighorn, Black Hills, Medicine Bow, and Shoshone National forests and Thunder Basin National Grassland.

State Wildlife Agencies

The Wyoming Game & Fish Department classifies the Long-billed Curlew as having a Native Species Status of NSS3. This was given because Long-billed Curlew habitat is restricted or vulnerable in the state (with no recent or significant loss), and populations are declining or restricted in numbers (although extirpation is not imminent) (Oakleaf et al. 2002). Although no regulatory authority is attached to NSS rankings, the Wyoming Game and Fish Department

recommends that management agencies potentially affecting curlews should consider the above ranking and all available information on the species.

Heritage Ranks and WYNDD's Wyoming Significance Rank

The Wyoming Natural Diversity Database, as part of the nation-wide network of Natural Heritage programs, has a more detailed ranking system than other organizations. The Long-billed Curlew has been assigned a rank of G5/S3B,SZN by the Wyoming Natural Diversity Database. The G-rank (global rank) is a 5-level rank that refers to the range-wide security of native North American species. A rank of G1 indicates the highest degree of endangerment and G5 indicates the lowest. A rank of G5 for the Long-billed Curlew specifically indicates that it is demonstrably secure in much of its range, although it may be rare in certain areas, especially at the periphery of its range. The SB-rank (state breeding rank) refers to the security of breeding populations of a migratory species within the state of Wyoming. The Long-billed Curlew was given a ranking of S3B because it is considered rare, or found locally in a restricted range in Wyoming, and is generally known from 21-100 occurrences in the state. This ranking is due to the curlew's rarity within the state, its specialized breeding habitat, its low population size within the state, its specialized foraging habitat, and threats posed to the species (see Biological Conservation Factors below). The SN-rank (state non-breeding rank) refers to the security of populations that reside in the state of Wyoming during the non-breeding seasons. Since Long-billed Curlews migrate out of Wyoming during the non-breeding season, they are not of practical conservation concern in Wyoming during that period. They therefore get a rank of SZN, indicating that there are zero definable, manageable non-breeding occurrences.

On a three-level categorical scale (low, medium, high) the Wyoming significance rank for the Long-billed Curlew is Medium. This ranking is based on a decision ranking tree developed by the

Wyoming Natural Diversity Database (Keinath and Beauvais 2003a), and it is designed to consider how Wyoming contributes to the range-wide persistence of a species. The Long-billed Curlew is considered a native species to Wyoming, and it is a resident because it has been reliably encountered in Wyoming at multiple locations during the last 10 years. However, Wyoming encompasses a relatively low percentage of the Long-billed Curlew's continental and year-round range. Finally, the Wyoming population of the curlew is probably less secure than other populations elsewhere within the species' range, due to limited habitat within the state and the low number of breeders.

Biological Conservation Factors

Abundance

Rangewide, the Long-billed Curlew is fairly common, except on the east coast from Virginia south, where it is considered rare in the fall and winter (Field Guide to the Birds of North America 1999). No comprehensive population surveys have been conducted, however, some estimates have been made. Brown et al. (2000) estimated the total Long-billed Curlew population to be 20,000 individuals (thought to be accurate to $\pm$ 50%). De Smet (1992) estimated the Canadian population of the Long-billed Curlew at 4,900-7,800 individuals, and Morrison et al. (1993) estimated the wintering population in Mexico to be 6,500 individuals. Cannings (1999) estimated 250 breeding pairs in British Columbia, with the greatest numbers occurring in the Chilocotin-Cariboo region (Campbell et al. 1990). Breeding Bird Survey (BBS) data for the United States averaged 1.45 individuals per route (n = 202 routes; Peterjohn and Sauer 1999), with the highest relative abundances of Long-billed Curlews occurring on the glaciated Missouri Plateau (3.9 individuals per route).

Densities vary considerably at different sites within the breeding range. In Idaho, breeding density was found to be 5.94-6.42 males/km^2 (n = 2 yr; Redmond et al. 1981). Breeding densities were lower in Utah, at 0.59-2.36 pair/km^2 at 2 locations over the course of three years (Paton and Dalton 1994). Densities in British Columbia were 2.08-2.13 pair/km^2 (Ohanjanian 1987) and 0.46-0.80 pair/km^2 (Hooper and Pitt 1996).

Abundances on wintering grounds are also somewhat in question. Winter surveys of shallow-water wetlands in California's Central Valley averaged 4,786 (n = 3 yr; Shuford et al. 1998), but this may have been an underestimate due to birds flushing from the plane. Brown et al. (2000) counted 7,500 Long-billed Curlews wintering in the Imperial Valley of California. Peak winter counts at fiive locations on the west coast of Baja California were 3,000 individuals (Page et al. 1997).

Although once common in the state, the Long-billed Curlew is now considered uncommon in Wyoming, and infrequent throughout the eastern short grass prairies (WYNDD 2003). Quantitative estimates of abundance within Wyoming are lacking, but the Wyoming Game and Fish Department lists the Long-billed Curlew as an "uncommon, summer resident". There are locally dense populations in the state, in northern Sublette county and near the Bear and upper Ham's Fork Rivers, but beyond these areas distribution is very sparse and patchy, with only a few pairs of curlews seen annually in many counties statewide (Cochrane and Anderson 1987). Breeding locations are thinly scattered across the state in suitable habitat and there are only eight to ten documented current breeding locations within the state (WYNDD 2003). The density estimate at the best Long-billed Curlew population in the state, near Merna, was found to be 15.58 curlews per 100 hectares ($\pm$ 3.04) in 1981 (Cochrane and Oakleaf 1982). Although official population counts in Wyoming have not been done, it is very unlikely that there are more than

1,000 individuals in the state in any given season. Numbers of breeding individuals are likewise fairly low. Based on this information, WYNDD categorizes the abundance of Long-billed Curlews within Wyoming as rare (Abundance Rank = B; Keinath and Beauvais 2003b). The confidence in this rank is High.

Trends

Abundance Trends

Early accounts by naturalists indicate there were significant declines in population sizes of Long-billed Curlews throughout their historic range during the last half of the 1800's (Grinnell et al. 1918, Bent 1929). Qualitative accounts of population declines have continued into the 1990's (Ryser 1985, SDOU 1991). The Long-billed Curlew was once abundant throughout prairie regions of the U.S., but habitat loss and uncontrolled hunting in the 1920's and 1930's decimated populations. Breeding curlews disappeared from large portions of their range during these decades (Andrews and Righter 1992, Stewart 1975). Cessation of hunting and recovery of scattered grasslands after 1940 helped to thwart extinction and allow populations to start increasing by 1950 (Yocum 1956). The Long-billed Curlew's breeding range has continued to contract in some areas such as the Texas panhandle and South Dakota (Oberholser 1974, SDOU 1978). They are probably extirpated in southern Manitoba and southeastern Saskatchewan (De Smet 1992). Population declines in the western U.S. seem to be local and not widespread (De Smet 1992). They are apparently declining in Utah (Paton and Dalton 1994), and they have been extirpated from the eastern U.S. due to loss of suitable wintering habitat along the Atlantic coast (New Brunswick to South Carolina) (WYNDD 2003).

Quantitative data on population trends from the Breeding Bird Survey show a non-significant declining trend from 1966-1996 (-1.4% per year, 95% CI = 3.5 to 0.8; Peterjohn and Sauer 1999). However, this trend is not uniform across the breeding range, and it seems that populations in the

Great Plains are declining, while populations west of the Rocky Mountains (except Utah) seem to be slightly increasing. Analyses also suggest that populations continue to decline in eastern portions of the breeding range, but at a slower rate of decline than was experiences during the 1800's.

Long-billed Curlew breeding populations have decreased in Wyoming since 1940 (Cochrane and Oakleaf 1982). Populations in Wyoming are suspected to be stable to declining due to habitat loss (WYNDD 2003). Long-billed Curlews bred "abundantly" or "commonly" in suitable habitat over most of Wyoming from 1900 to 1937, even while they were declining elsewhere (Knight 1902, McCreary 1937). Now only populations near Merna, Wyoming can be classified as abundant or common, while the other remaining populations in the state are considered uncommon (Oakleaf et al. 1992). Drastic population declines have been observed in specific locations in Wyoming, but data is lacking regarding quantitative information on the extent and causes of these declines, including historical population fluctuations and habitat relationships (Cochrane and Oakleaf 1982). The numbers of curlews detected on BBS routes in Wyoming have fluctuated, therefore making it difficult to determine trends (WGFD 2002).

Although exact population numbers and trends are not known at this time, current surveys seem to indicate that Long-billed Curlew populations in the state are slightly decreasing. Therefore, WYNDD categorizes the abundance trends of Long-billed Curlews within Wyoming as moderately declining (Trends Abundance Rank = B; Keinath and Beauvais 2003b). The confidence in this rank is Moderate.

Population Extent and Connectivity Trends

Historically, the Long-billed Curlew bred over a much larger area than it does today. This included grasslands in southern Michigan, Iowa, northern Illinois, western Minnesota, southern

Wisconsin, coastal Texas, and areas of Arizona (Roberts 1919, Wickersham 1902, Wayne 1910, Fargo 1934, Thompson 1890, Renaud 1980, Dugger and Dugger 2002) Even within the current breeding range, populations of Long-billed Curlews have become more isolated and restricted, especially in parts of Canada, Kansas, and the Dakota's (Dugger and Dugger 2002). Within the current breeding range of the Long-billed Curlew, distribution is patchy (Dugger and Dugger 2002).

The Long-billed Curlew's breeding range has continued to contract in some areas such as the Texas panhandle and South Dakota (Oberholser 1974, SDOU 1978). Long-billed Curlews have probably been extirpated in southern Manitoba and southeastern Saskatchewan (De Smet 1992), however, recent populations have appeared in southeastern British Columbia, indicating an expansion of the breeding range (Cannings 1999). Some places in the western U.S. have seen increases in breeding numbers in response to invasion by cheatgrass and development of agricultural crops such as hay meadows, alfalfa, and some cereal grains (Idaho, Jenni et al. 1981; Oregon, Pampush and Anthony 1993; Wyoming, Cochrane and Anderson 1987). However, other areas in the west, such as Utah, have experienced population declines (Paton and Dalton 1994). Populations along the Atlantic coast in the eastern U.S. have been extirpated from New Brunswick south to North Carolina, and numbers even further south (South Carolina to Florida) have been reduced due to loss of suitable wintering habitat (WYNDD 2003). Wintering range has also expanded farther north in California into the Sacramento Valley and the southern end of the Imperial Valley (Root 1988).

In Wyoming, Long-billed Curlews used to be found across much of Wyoming and were thought to be common. Today their distribution is very sparse and patchy, with only a few pairs of curlews seen annually in many counties statewide (Cochrane and Anderson 1987). Breeding

locations are thinly scattered across the state in suitable habitat. Now only populations near Merna, Wyoming can be classified as abundant or common, while the remaining populations in the state are considered uncommon (Luce et al. 1997). In the early 1900's populations of nesting Long-billed Curlews were common near the Buffalo-Sheridan area, Fort Washakie, and along the Sweetwater River in eastern Fremont county (Cochrane and Oakleaf 1982). Today, only an occasional nesting pair can be found in these locations. Curlews have been common in northern Sublette county since homesteading began over 100 years ago, but numbers have decreased in the last 40 years, from flocks numbering in the hundreds to flocks of fewer than 10 individuals (Cochrane and Oakleaf 1982). They were once found on the Medicine Bow River in the Laramie Mountains (Cochrane and Oakleaf 1982), and over greater portions of eastern Wyoming in Platte, Converse, Crook and Weston counties (Oberholser 1918). Today, sightings of curlews in eastern Wyoming have been greatly reduced, perhaps as a result of habitat loss due to agricultural practices, but little is known about the extent or causes of these declines. Populations near Sheridan and Casper have recently been extirpated by housing developments.

Trends in Available Habitat

Much of the available breeding habitat for Long-billed Curlews has been lost over the past 150 years, and habitat loss continues to be the greatest threat facing Long-billed Curlew populations today. Grasslands and prairies have been greatly reduced over the years due to agricultural practices, conversion to croplands, and population growth. In Canada, 76-99% of native grasslands are gone (Pitt and Hooper 1994). Roadways also alter available habitat and result in habitat fragmentation. Habitat loss on wintering grounds is also a concern; however, it is less understood at this time. In California's Central Valley, 90% of the wetlands have been drained and grassland habitats have been lost to urban growth and converted to crops or vineyards (Dugger and Dugger 2002).

Habitat trends in Wyoming are difficult to assess, due to a lack of information. Long-billed Curlew habitat is declining in several areas of Wyoming due to fragmentation from development and agricultural practices. Some habitat in the Greater Yellowstone area has been lost due to agricultural development (Redmond 1989). Housing developments near Sheridan and Casper have also resulted in lost curlew habitat. The Wyoming Gap Analysis Project (Merrill et al. 1996) estimates that additional curlew habitat exists in the state near existing locations in the Green River Basin and on the grasslands in the east side of the state in Crook, Campbell, Weston, Niobrara, and Converse counties. Although there may be additional habitat in the eastern portion of the state, there are very few curlew records from this area and the reason for this is not clear. Habitat trends within Wyoming may be declining at this time, but there is no evidence to substantiate this theory.

Range Context

The Long-billed Curlew breeds in the western interior of North America, in the northern U.S. and southern Canada. It winters along the coasts of the U.S. and much of Mexico. Distribution is widespread but patchy in some areas of the breeding range. Most of their current range is contiguous.

Wyoming forms a large part of the core breeding range of the Long-billed Curlew, however, Wyoming probably does not support a large percentage of the total Long-billed Curlew population. The species occurs statewide in all counties except Big Horn and Washakie (WYNDD 2003), however, distribution is patchy and sparse. Too little is known regarding population numbers in Wyoming to determine how much of the current range in the state is actually occupied. WYNDD categorizes the range context of the Long-billed Curlew within

Wyoming as medium (Range Context Rank = B; Keinath and Beauvais 2003b). The confidence in this rank is **Moderate**.

Extrinsic Threats and Reasons for Decline

Anthropogenic Impacts

Habitat degradation is the single greatest threat to the Long-billed Curlew. Loss of grassland breeding habitat to agriculture and development has been extensive over the years. Long term global warming trends may shrink potential breeding distribution as climate change influences habitat. Older plantings of exotic crested wheatgrass (*Agropyron cristatum*), and infestation of knapweeds (*Centaurea* spp.) can severely degrade nesting habitat. Conversely, cheatgrass, one of the most invasive exotics in the western U.S., seems to provide better nesting habitat than natural bunchgrass due to its sparse growth (Allen 1980, Pampush and Anthony 1993). Habitat loss on wintering grounds is also a problem as many wetland areas have been drained and grasslands have been lost to urban growth.

The Long-billed Curlew was once hunted and trapped in many areas of their range. Today they are not legally hunted, but a three year study conducted in Idaho suggested that some level of illegal harvest continues to occur (Jenni et al. 1981).

Long-billed Curlews are somewhat tolerant of human disturbance if it results in only minor habitat degradation, but human disturbance can be a substantial problem during brood-rearing (Jenni et al. 1981). Excessive vehicle traffic and recreational use of breeding habitats can result in nest abandonment or disruption in parental brooding. Livestock grazing during the breeding season can result in the destruction of nests and eggs, however, only very heavy grazing would constitute a significant source of nest loss (Redmond and Jenni 1986).

Pesticides and other toxins may be a problem for Long-billed Curlews, but very little is known regarding this topic. Seven eggs collected in Oregon had high levels of DDE residues, but what effect they had on the chicks is unknown. Mortality and sublethal effects of organochlorines, including egg shell thinning and emaciation, were observed in Long-billed Curlews (Blus et al. 1985). There is no evidence at this time that insecticide spraying on curlew breeding grounds directly affects adults, however, it may indirectly affect them by reducing arthropod abundances (Dugger and Dugger 2002). At present, organochlorine residue exposure is of greatest concern throughout the wintering range of Long-billed Curlews.

In Wyoming, particularly in the breeding area along the Beaver Creeks (near Merna) and the New Fork River (Pinedale), farmers utilize a controversial practice called "dragging". This involves pulling long logs and metal rods across the native grassland in the belief that it will improve native grass seed dispersal and inhibit Artemisia growth. This destroys curlew nests if done anytime from March 15 to May 30. Housing developments that have recently been built in critical curlew habitat near Casper and Sheridan have resulted in habitat loss.

Stochastic Factors

Based on the available literature, it does not appear that stochastic factors pose a detrimental effect on Long-billed Curlew populations. There were no mortalities reported in the literature due to exposure, but information is sparse regarding this topic (Dugger and Dugger 2002).

Natural Predation

Although some raptors may prey upon adult Long-billed Curlews, this does not seem to be a problem that would contribute to the overall well being of the species. Chicks are preyed upon to a greater degree than adults by some raptors and mammals, and nests are also predated by various species. Predation on eggs and chicks may be a potential threat to the long-term existence of Long-billed Curlew populations in areas where population numbers are already low.

WYNDD Extrinsic Threat Rank

WYNDD categorizes the Long-billed Curlew within Wyoming as being moderately threatened by extrinsic threats (Extrinsic Threat Rank = B; Keinath and Beauvais 2003b). The confidence in this rank is High.

Intrinsic Vulnerability

Habitat Specificity

Long-billed Curlews have high habitat specificity for their breeding, wintering, and foraging habitats. Refer to the "Habitat Requirements" section presented earlier in the assessment for detailed habitat information. Several microhabitats are used within these broader habitat requirements as well. The high habitat specificity of Long-billed Curlews coupled with decreasing available habitat could pose a threat to existing Long-billed Curlew populations.

Territoriality and Area Requirements

Territory size has been documented ranging from six to eight hectares in southeastern Washington, to 14 hectares in Idaho, with a buffer of unoccupied habitat 300-500 meters wide around the edge of the territory in Idaho (Allen 1980, Jenni et al. 1981). Not all individuals establish territories on migration or wintering grounds, but studies in California have shown that winter territories there, are similar in size to breeding territories (Mathis 2000). A lack of suitable territory for Long-billed Curlews could pose a problem for Long-billed Curlew populations.

Susceptibility to Disease

Little is known regarding diseases found in this species of curlew. Aspergillosis was documented killing 15% (2 of 13) of prefledglings during one breeding season in Idaho (Redmond and Jenni 1986). It is not known what affect disease may play on the overall stability of Long-billed Curlew populations.

Dispersal Capability and Site Fidelity

Very little is known regarding dispersal capabilities of Long-billed Curlews and their site fidelity. It is known that males show higher site fidelity than females, who may not return if exposed to excessive disturbance or nest loss (Redmond and Jenni 1982), and that when sexes do return, it may not be to the same nesting territory (Redmond and Jenni 1982).

Reproductive Capacity

Age at first reproduction is two to three years for females and three to four years for males, and they presumably breed every year after they reach breeding age (Redmond and Jenni 1986). Long-billed Curlews have one brood of two to five eggs (average four) per year. There is no evidence that Long-billed Curlews renest if their first nest is destroyed (Allen 1980, Paton and Dalton 1994).

Long-billed Curlews are long lived and have high annual adult survival rates (Redmond and Jenni 186). Therefore, fluctuations in annual productivity are probably less important than factors influencing adult survival. However, as it may take many years to reach reproductive age, this species is prone to population declines which, if once started, are hard to reverse.

Sensitivity to Disturbance

Long-billed Curlews are sensitive to disturbance, especially during the nesting phase. It can result in nest abandonment or disruption during brooding, so care should be taken to minimize any disturbances if possible.

WYNDD Intrinsic Vulnerability Rank

WYNDD categorizes the intrinsic vulnerability of the Long-billed Curlew within Wyoming as being moderate (Trend Rank = B; Keinath and Beauvais 2003b) due to their habitat specificity, sensitivity to disturbance, and low fecundity rates. The confidence in this rank is High.

Protected Areas

Range-wide, there has been no official assessment of the actual proportion of Long-billed Curlew populations that occur on protected land, where "protected" refers to land that is free from multiple uses that can significantly alter critical habitat for curlews (e.g., wildlife refuges, national parks, wilderness areas).

In Wyoming, much of the Long-billed Curlew's range is found on various public lands. Out of a total of 223 records, only 60 of these are found on private lands. There are several occurrences in various protected areas across the state, including Grand Teton National Park, Big Goose Creek conservation easement, the Medicine Bow and Bridger-Teton National Forests, Pathfinder Reservoir, Thunder Basin National Grasslands, and Cokeville Meadows National Wildlife Refuge (WYNDD 2003). The region of highest breeding curlew density in the state, from Merna to Pinedale, includes a high percentage of private land. It is important to keep track of Long-billed Curlews that nest in private areas, and to pursue cooperative agreements which will ensure critical habitat on private lands is preserved.

Population Viability Analyses (PVAs)

The authors are not aware of any formal population viability analyses studies that have been conducted for the Long-billed Curlew.

Conservation Action

Existing or Future Conservation Plans

There are no specific Long-billed Curlew conservation plans at the state or national level known to the author at the time of this reports completion.

Conservation Elements

Inventory and Monitoring

Much of the monitoring that has been done in Wyoming has been conducted by the Wyoming Game and Fish Department and has occurred in the western portion of the state, in Teton, Lincoln, and Sublette counties. The Wyoming Game and Fish Department began monitoring long-billed curlews in areas of Wyoming in 1981 and have continued to survey areas most years since. The main study areas have been near Merna on Horse Creek, the New Fork River between Pinedale and Cora, near Cody at Chapman Bench, and in Grand Teton National Park and around Jackson. The number of curlews being detected on the Game and Fish routes and on BBS routes in Wyoming has fluctuated greatly over the years, making it difficult to determine trends. The areas surveyed by the Game and Fish are those that have the best curlew habitat and that usually appear to have the largest populations in the state. Monitoring should also be conducted in other areas of the state where high numbers of incidental sightings of curlews have been documented, such as Uinta County. It has been speculated that Long-billed Curlew populations may have suffered significant declines in the state, in the past few years, but this may also be the result of varying inventory and monitoring practices.

In Wyoming, the annual surveys that have been conducted at specific areas by the Wyoming Game and Fish Department need to be continued for some time in order to ascertain curlew population trends in the state. These surveys should remain standardized using the method developed by Cochrane and Oakleaf (1982). Continued effort is also needed on BBS routes as well. If trends in curlew populations are to be determined on the curlew survey routes conducted in western Wyoming, a standard curlew survey technique should be implemented (WGFD 2002). Andrea Cerovski, Wyoming Game and Fish Department biologist, recommends conducting many

more surveys along each route for a larger sample size, and analyzing the data using statistical methods (WGFD 2002).

There are no current management efforts directed specifically at Long-billed Curlews on their breeding or wintering grounds. Efforts are usually focused on grassland and wetland habitat in general and encompass improvements for several species of waterbirds. There is some anecdotal evidence that suggests the Long-billed Curlew can re-establish a breeding area on agricultural grounds that have been restored to grasslands (Yocum 1956). On wintering grounds flooding of postharvest rice fields has been proposed as wetland habitat for wintering waterbirds in general; however it is not known if this will benefit wintering Long-billed Curlew populations since their densities in rice fields is not related to water depth.

The accuracy of aerial surveys is suspect because the airplanes that are used cause the birds to flush before they can all be counted. Simultaneous aerial and ground counts should be done to estimate a visibility index and provide more accurate counts. Since Long-billed Curlews are sensitive to disturbance while nesting, care should be taken by researchers to minimize disturbances as much as possible.

Habitat Preservation and Restoration

Adequate short-growth grassland nesting habitat may be the single most important factor in sustaining Long-billed Curlew populations, as the continued loss of grassland habitat remains one of the greatest threats to this species future (USDA Natural Resources Conservation Service 2000). For this reason habitat preservation and restoration is an important factor in preserving Long-billed Curlew populations. The following is a table of management options for increasing habitat quality or availability for Long-billed Curlews (Table taken from USDA Natural Resources Conservation Service 2000).

Habitat Component	Management Options for Increasing Habitat Quality or Availability
Food	• Create and maintain vegetative diversity within grasslands, meadows, and prairies by conducting rotational burning, mowing, and grazing when and where appropriate. • Protect coastal wetlands, marshes, lakes and ponds from siltation and non-point source pollution by fencing livestock and providing bank stabilization through aquatic and bank vegetation plantings. • Reduce herbicide use on grasslands, especially near water, where application results in reduction of invertebrates (either terrestrial, marine, or freshwater) or berries used for food. • Avoid widespread pesticide applications aimed at controlling grasshopper outbreaks, and assess the potential risks of such applications to Long-billed Curlew food supplies within inhabited areas.
Nesting and brood-rearing cover	• Conduct prescribed burning on a three to five year rotational basis in late fall after nesting activities are completed. • Conduct haying in a timely manner so as to provide a short vegetation for the spring curlew nesting season (April-May). • Reduce herbicide use when application results in loss of nesting, loafing, brood-rearing, or winter cover.
Winter cover	• Protect coastal wetlands, marshes, lakes and ponds from siltation and non-point source pollution via fencing of livestock.
Interspersion and minimum habitat size	• Combine above prescriptions to increase interspersion of habitat components and amount of suitable Long-billed Curlew habitat.

Habitat preservation should consist of preventing conversion of upland prairie to cropland. Breeding habitat should also be protected from detrimental human activities, such as vehicular use, researcher disturbance, and shooting (Dechant et al. 2001).

There are no current management efforts directed specifically at Long-billed Curlews on their breeding or wintering grounds. Efforts are usually focused on grassland and wetland habitat in general and encompass improvements for several species of waterbirds. There is some anecdotal evidence that suggests the Long-billed Curlew will re-establish a breeding area on agricultural

grounds that have been restored to grasslands (Yocum 1956). On wintering grounds flooding of postharvest rice fields has been proposed as wetland habitat for wintering waterbirds in general; however it is not known if this will benefit wintering Long-billed Curlew populations or not since their density in rice fields is not related to water depth.

Grazing usually has a positive effect on breeding densities because it produces the short grass and open ground preferred for predator detection and chick mobility (King 1978, Pampush 1980, Cochrane and Anderson 1987). In the Riske Creek area of British Columbia, the highest breeding densities were on sites where spring grazing levels averaged 1.4 AU/ha (Animal Units / hectare; Hooper and Pitt 1996). In habitats with dense stands of perennial bunchgrass, sheep are better at trampling residual vegetation and creating appropriate breeding habitat than cattle (Jenni et al. 1981). Year-round grazing appears to be too intensive and is not appropriate for creating good breeding habitat. The best grazing rotation system includes grazing through the early spring, so that vegetation height and density are decreased during the prelaying and egg laying periods (Jenni et al. 1981). Fire suppression can have a negative effect on breeding habitat by allowing forest encroachment and growth of tall grasses and shrubs (Cannings 1999). Densities were very high in a burned field in Idaho the following spring, however, postburn plant succession can be rapid, so grazing or mowing should also be used in order to maintain the burned areas (Jenni et al. 1981).

Captive Propagation and Reintroduction

Propagation and reintroduction are not currently necessary for sustaining Long-billed Curlew populations. Based on a total population estimate of 20,000, conservation goals call for increasing population size by 30%, to 28,500 (Brown et al. 2000). Within the current breeding distribution, only the Great Basin appears to be supporting a stable population.

Information Needs

Range-wide Needs

Large gaps remain in our understanding of this species' biology because the Long-billed Curlew is often "underemphasized" in studies of shorebirds (Dugger and Dugger 2002). Although current population information suggests that the species is declining in portions of its range, accurate population surveys are not available. Development of techniques for conducting rangewide breeding surveys should be a research priority, along with efforts to estimate the number of birds that winter in interior Mexico (Dugger and Dugger 2002). More research is needed regarding the wintering ecology of the Long-billed Curlew, along with efforts to determine the accuracy of winter coastal surveys. Similarly, brood rearing habitat requirements requires further study. Researchers need to investigate the affect of human disturbance on Long-billed Curlew breeding grounds, and taxonomic work needs to be done to resolve the subspecies validity of the Long-billed Curlew. Lastly, more data is needed on annual and seasonal survival rates for chicks, subadults, and adults that will quantify sources of mortality in order to facilitate population modeling (Dugger and Dugger 2002).

Wyoming Needs

Much of the information needs for Wyoming are the same as those listed above. Specifically, detailed distribution, habitat use, and population information are needed for Wyoming. Other needs include surveys for all areas of suitable habitat within the state in order to know what kind of breeding populations the state can support. Monitoring of existing populations in a statistically valid and replicable fashion is very important, so trend estimates can be reliably referenced. It would also be valuable to try to identify new breeding locations in the state. This could be accomplished by conducting surveys at locations where curlews have been observed in the past,

but not documented to be breeding. In addition, key use areas in Wyoming need to be identified and a management/protection plan then needs to be developed.

Tables and Figures

Table 1: Long-billed Curlew survey results in Wyoming from 1981-2000, given in the total number of curlews seen only. (Data adapted from WGFD 2002).

Year	Horse Creek Route	New Fork Route	Chapman Bench Route	GTNP Hayfields	Surveyor
1981	40*	---	---	---	Cochrane
1982	48*	8**	---	---	Cochrane
1987	11	13	---	---	WGFD
1991	15	1	---	---	WGFD
1992	37	5	21	---	WGFD
1993	56	3	9	4	WGFD
1994	37	6	6	---	WGFD
1995	50	9	0	5	WGFD
1996	---	---	---	---	WGFD
1997	15	34	---	5	WGFD
1998	13	---	2	4	WGFD
1999	8	1	1	2	WGFD
2000	93	10	15	Not surveyed	WGFD

* Based on the number of curlews/km given by Cochrane (1983), since 1981 totals were not provided.

** Based on the 7 surveys conducted from 17-31 May 1982 and the pooled total of 56 curlews observed (range = 4 to 12).

*** Based on the 9 surveys conducted from 8-30 May 1982 and the pooled total of 420 curlews observed (range = 39 to 57).

Data from Cochrane (1983) and various Wyoming Game and Fish Department Nongame Completion Reports (1988, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000).

Figure 1: Photo of a Long-billed Curlew; (Photo by Will Rountree © 2001).

Long-billed Curlew *Numenius americanus* Bolivar Peninsula, TX 12-1-2001 Will Rountree

Figure 2: Rangewide distribution map for the Long-billed Curlew. Pink-breeding range; blue-winter range; dashed lines represent historical distributions which are based upon textual descriptions from the following sources (Roberts 1919, Wickersham 1902, Wayne 1910, Fargo 1934, Thompson 1890, Renaud 1980, Bent 1929, Dugger and Dugger 2002).

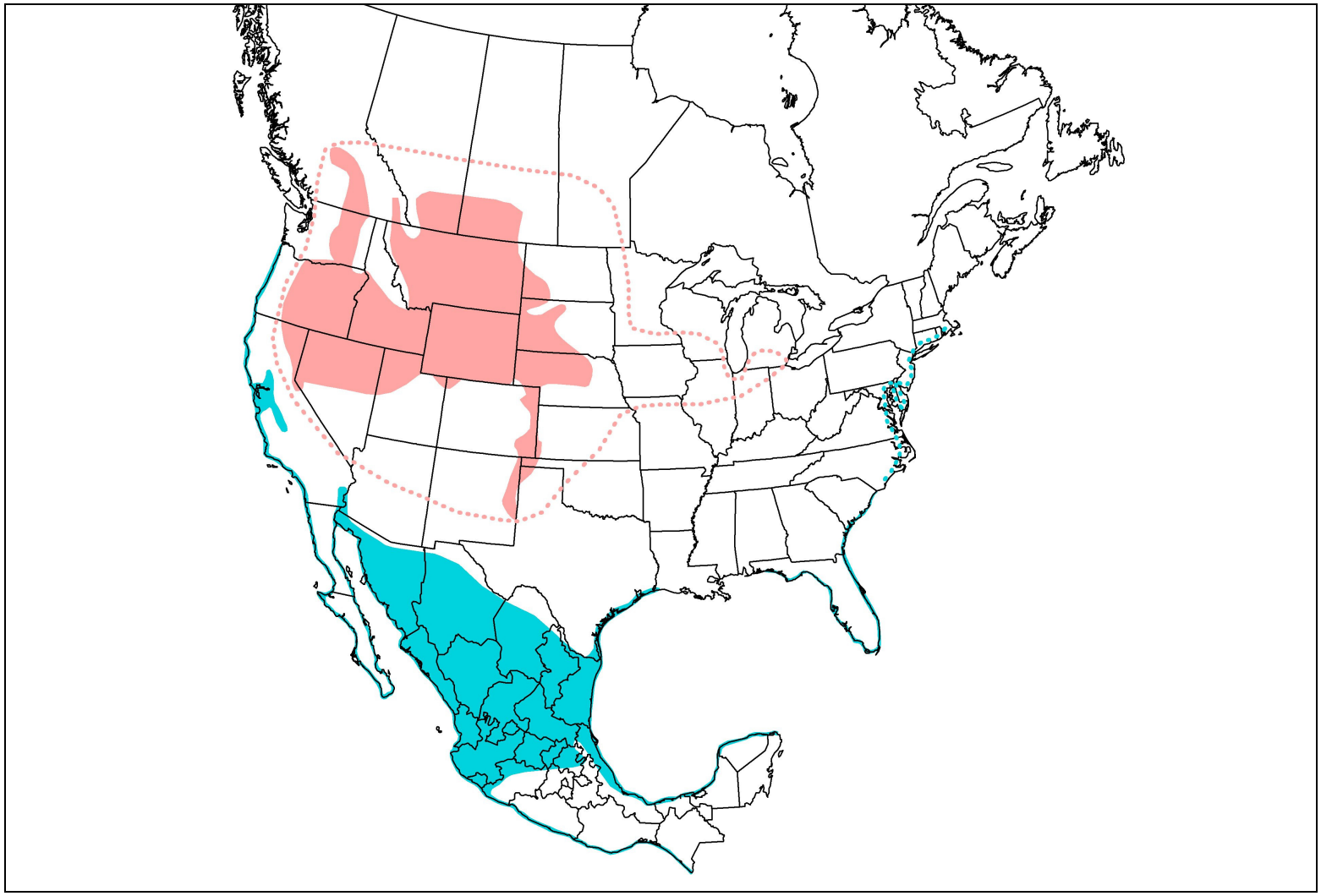
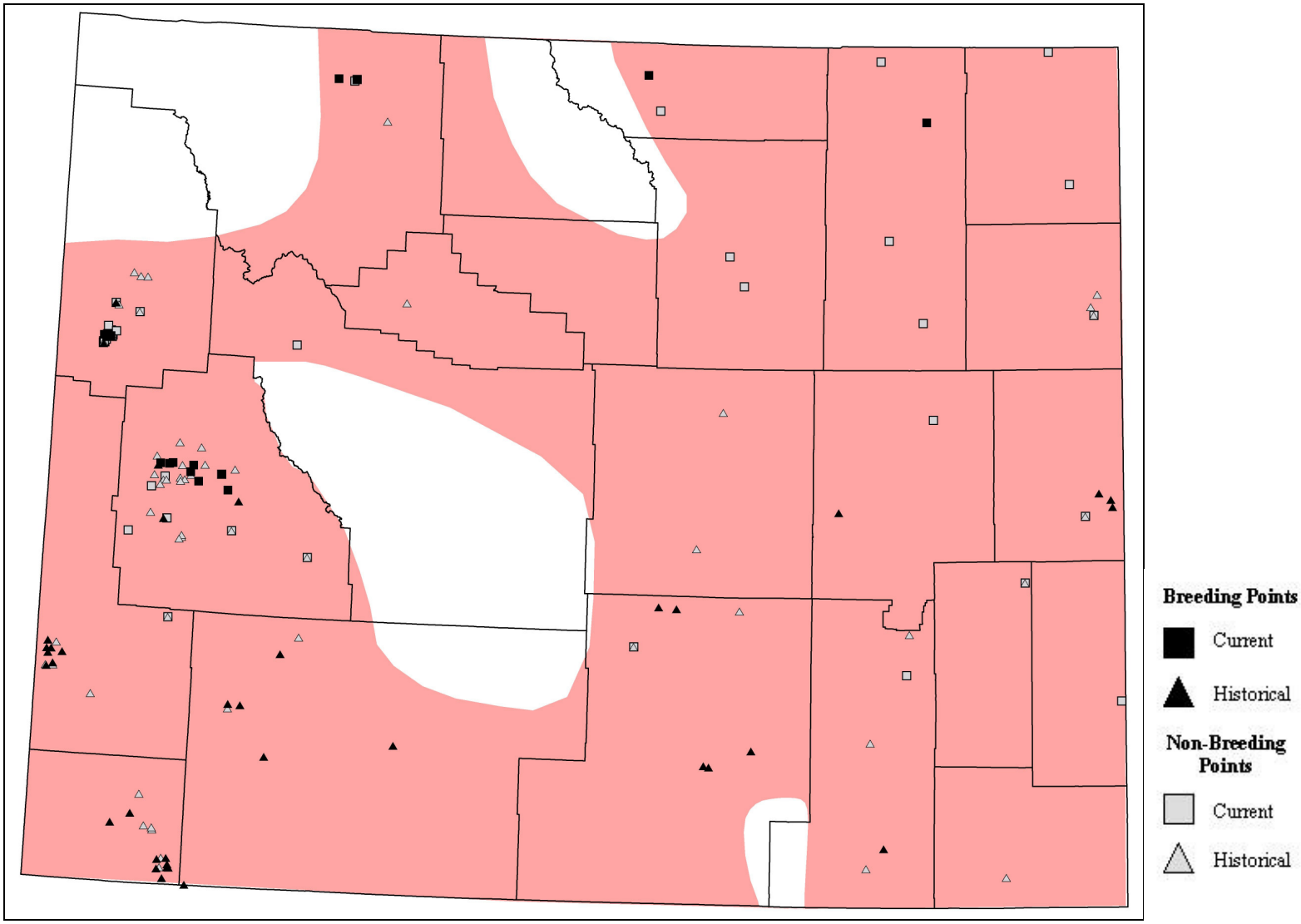


Figure 3: Reported Wyoming Long-billed Curlew occurrences and potential range.



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