CHRONOLOGY AND USE OF PLAYAS BY WATERFOWL AND WETLAND BIRDS

by

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ABSTRACT

Playa lakes are important migratory stopover and wintering areas for waterfowl and other shorebirds. The purpose of this study was to determine what species of waterfowl, shorebird and other wetland birds use playas in the Texas Panhandle and to determine the timing (chronology) of each species' use of playas. I surveyed playas biweekly during spring migration (February through May), fall migration (August through November) and winter (December through January) from February 2004 – January 2006. In 2004 playas were surveyed monthly during the summer (June through July). In 2005 playas were surveyed twice a month during all seasons. Fifty-six species of waterfowl, shorebirds and other wetland birds were identified on our survey routes. During the 2004 migration, spring peak abundance of waterfowl occurred on 27 February ($\bar{x}$ = 1,522 birds/playa) and fall peak abundance occurred on 5 November ($\bar{x}$ = 352 birds/playa). During the 2005 migration, spring peak abundance of waterfowl occurred on 11 March ($\bar{x}$ = 807 birds/playa) and fall peak abundance occurred on 11 November ($\bar{x}$ = 515 birds/playa). The 5 most abundant waterfowl observed during my surveys were northern pintail (*Anas acuta*; 32% of all waterfowl observed during surveys), American green-winged teal (*Anas crecca*; 22%), mallard (*Anas platyrhynchos*; 13%), American wigeon (*Anas americana*; 8%) and Canada goose (*Branta canadensis*; 6%). The 3 most abundant shorebird species observed during my surveys were American avocet (*Recurvirostra americana*; 32% of all shorebirds observed), Wilson's phalarope

(*Phalaropus tricolor*; 17%), and killdeer (*Charadrius vociferous*;15%). The 2 most abundant wetland bird species observed during my surveys were American coot (*Fulica americana*; 41% of all wetland birds observed) and sandhill crane (*Grus canadensis*; 31%). Five species of waterfowl (mallard, northern pintail, blue-winged teal [*Anas discors*], cinnamon teal [*Anas cyanoptera*], and northern shoveler [*Anas cylpeata*]), 3 species of shorebirds (American avocet, killdeer and black-necked stilt; *Himantopus mexicanus*), and 2 species of waterbirds (American coot and pied-billed grebe; *Podilymbus podiceps*) used playas for reproduction (young observed) during the summer of 2005. Detailed information on chronology and numbers of birds using playas in this area will provide management agencies vital information needed to make management decisions regarding these species.

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CHAPTER I

INTRODUCTION

Aristotle knew that cranes migrated seasonally from the steppe of Asia Minor to the marshes of the Nile, yet many misconceptions regarding migration by birds existed. As late as the 1600s the arrival of barnacle geese (*Branta leucopsis*) in Northern Europe was explained by them arising from goose barnacles (*Lepas australis*) that came ashore on driftwood (Gill 1994). In the early 1800s, John James Audubon conducted the first known bird-banding studies in North America. By tying strings around the legs of eastern phoebes (*Sayornis phoebe*), he learned that these birds returned each year to the same sites (Gill 1994). Although migration is energetically taxing on birds, it allows them to move from their preferred breeding areas to areas where the climate is milder and food is abundant. The study of avian migration has provided insight into the abilities of birds, identified migration routes and determined the timing of migration of many species (Gill 1994).

Migrating waterfowl and shorebirds in North America tend to use four major migratory routes. In 1948, four administrative flyways were established in the United States encompassing these migration routes, for the purpose of managing waterfowl. At this time it was believed that birds stayed within these flyways when migrating. Biologists discovered through band recovery studies that many species did not stay within these four flyways, but moved between flyways during both migration and dispersal (Gill 1994, Sibley 2001). Northern pintails (*Anas acuta*;

hereafter "pintail"), for example, migrate from the Northwest Territories of Canada and Alaska southeastward across the Pacific flyway to winter in the central flyway of Texas (Sibley 2001). Knowledge of regional migration patterns, including the timing and relative use of specific stopover sites, regions, and wintering areas is vital to management of these areas.

In addition to banding studies, weather radar has been used to track migrating waterfowl which show up as small targets on the radar screens. Because individuals can be distinguished from flocks, the intensity of migration can be quantified (Gill 1994). This information is valuable for biologists and has enabled them determine numbers of waterfowl using a particular flyway. Speeds and altitudes at which migrating waterfowl fly have also been studied with the aid of weather surveillance radar stations (Gill 1994), and when paired with weather data this information has given scientists valuable information on the energy costs of migrating waterfowl (Miller et al. 2005). Our knowledge of migration flyways, numbers of waterfowl using flyways, and their energy needs is vital to the management of flyway stopover and wintering areas.

With mounting evidence of global climate change, not only is our continued study of the mechanics of migration important, but our knowledge of the timing of these migrations is equally vital. For migratory birds, the timing of arrival on breeding and over-wintering grounds is a key determinant of reproductive success, survivorship, and fitness (Cotton 2003). There is mounting evidence that global climate change has altered the migration phenology of some migratory birds. In Oxfordshire, United Kingdom, the average arrival and departure dates of 20 migrant bird species have advanced by 8 days over the past 30 years (Cotton 2003).

The playa lakes region of the Texas Panhandle is located in the southern portion of the central flyway. This area is known as a major staging and wintering area for migrating waterfowl and shorebirds because of the abundance of playa lakes (hereafter "playas"; Anderson

and Smith 1999). The playa lakes region is located in the Southern Great Plains (SGP) and includes southeastern Colorado, southwestern Kansas, the Texas and Oklahoma Panhandles, and eastern New Mexico. Playas do extend northward into northwestern Kansas, northeastern Colorado, eastern Wyoming, and western Nebraska although not in as high a density as found farther south (Smith 2003). The playas in the southern portion of the SGP, eastern New Mexico, and the panhandles of Oklahoma and Texas are considered to be in the Southern High Plains (SHP).

Playas are best described as shallow circular depressions with erratic hydroperiods that have an average area of 6.3 ha and with most less than 2 m in depth (Smith 2003). Playas are formed by dissolutions of subsurface soils and wind erosion (Haukos and Smith 2003). In the Texas Panhandle, playa basins are lined with nearly impermeable Randall clay which differs from the more porous surrounding soils allowing runoff to collect in these basins. There is no outflow from playas and, as long as they are not used for irrigation, evaporation accounts for about 90% of the water loss and percolation accounts for the remaining 10% (Bolen et al. 1989a). If sufficient spring rains occur, playas can hold water through September and October then become dry and remain so for the next 5-7 months (Proctor 1990). There are estimated to be 25,000 to 30,000 playas on the SHP (Anderson and Smith 1999).

Playas of the SHP are estimated to annually collect 246,600 to 370,000 ha-m of water primarily from surface runoff from spring and summer thunderstorms (Bolen et al. 1989a). The amount of runoff that reaches a playa will depend on the surrounding vegetation, size and slope of the watershed, surrounding soil type and rate of precipitation (Bolen et al. 1989b). Thus, SHP playas provide a potential wetland habitat of 93,100 to 101,200 ha (Bolen et al 1989a) and serve as an important wildlife resource (Bolen 1982). With playas second in importance only to the Gulf Coast

as winter habitat for waterfowl in the central flyway (about 30% of all waterfowl wintering in Texas depend on playas; Bolen et al. 1989a) the chronology of waterfowl and wetland birds use of the playas should not be overlooked as a key management factor.

Pre-settlement vegetation surrounding playas in the SHP would be classified as a short-grass prairie, consisting mainly of buffalo grass (*Buchloe dactyloides*) and blue grama (*Bouteloua gracilis;* Bolen 1982). Other common plants included yucca (*Yucca* spp.) and prickly pear cactus *(Opuntia* spp.) and shinnery oak (*Quercus havardii*) is common in sandier soils (Smith 2003).

The SHP is now an area of intense agricultural use which includes row crop agriculture, cattle ranching, feedlots and dairies. Crops that are commonly grown here include winter wheat, corn, cotton, and sorghum (Guthery et al. 1982). Some short-grass prairie rangeland still exists and Conservation Reserve Program (CRP) grasslands are common (Smith et al. 2004).

Agricultural practices near playas have changed the composition of plant species found in and near playa basins (Haukos and Smith 2004, Conway et al. 2005). Barnyardgrass (*Echinochloa crusgalli*), smartweeds (*Periscaria* and *Polygonum* spp.), curly dock (*Rumex crispus*), and sprikerushes (*Eleocharis* spp.) are a few of the more common species associated with cropland playas (Smith et al. 2004). When the CRP program was created in 1985, planting of exotic grasses in these fields was common. Although planting of exotic grasses in CRP fields is no longer allowed, many of the exotic species continue to thrive (e.g., weeping lovegrass; (*Eragrostis curvula*), varieties of silver blue stem (*Bothriochola ischaemum)*, and kleingrass *Panicum coloratum*; Haukos and Smith 2004). The seeds of 5 of these plants including pale smartweed (*Periscaria lapathifolia*), Pennsylvania smartweed (*Periscaria pensylvanica*), barnyardgrass, curly dock and spikerushes are important foods for ducks (Haukos and Smith 1993). Dry playas are characterized by plant species commonly found in the surrounding uplands, including native prairie species (Haukos and Smith

2004).

Several species of amphibians are commonly found in or near playas. These species include the plains spadefoot (*Spea bombifrons*), New Mexico spadefoot (*Spea multiplicata*), Great Plains toad (*Bufo cognatus*), and barred tiger salamander (*Ambystoma mavortium*; Gray et al. 2004). Many species of invertebrates are also found in and near playas. These organisms can inhabit playas because of their ability to migrate or aestivate during periods of drought (Proctor 1990). Waterfowl feed on invertebrates and plant seeds. Waterbirds feed on amphibians, and shorebirds feed largely on invertebrates (Smith 2003).

In the SHP, 108 non-waterfowl species have been sighted using playas with 63 of these species using playas during fall and spring migration (Smith 2003). Playas provide habitat for ring-necked pheasants (*Phasianus colchicus*), an important game species, and during the winter months many species of raptors use playa basins for hunting (Bolen 1982). Common birds of prey include prairie falcon (*Falco mexicanus*), peregrine falcon (*Falco peregrinus),* bald eagle (*Haliaeetus leucocephalus*), golden eagle (*Aquila chrysaetos),* great-horned owl (*Bubo virginianus),* Swainson's hawk (*Buteo swainsoni),* rough-legged hawk (*Buteo lagopus*), red-tailed hawk (*Buteo jamaicensis*), ferruginous hawk (*Buteo regalis*), Cooper's hawk (*Accipiter cooperii*), and the northern harrier (*Circus cyaneus*; Smith 2003).

Common nesting species that use playas with emergent vegetation include red-winged blackbirds (*Agelaius phoeniceus*) and yellow-headed blackbirds (*Xanthocephalus xanthocephalus*; Bolen 1982). Dry playa basins offer nesting habitat for eastern (*Sturnella magna)* and western (*Sturnella neglecta*) meadowlarks, northern bobwhite (*Colinus virginianus),* Cassin's sparrow (*Aimophila cassinii)* and grasshopper sparrows (*Ammodramus savannarum*; Smith 2003).

In the central flyway the playa lakes of the SHP provide feeding and resting areas for migrating waterfowl and serve as prime wintering habitat in years of abundant rainfall (Rollo and Bolen 1969). Commonly cited estimates of the numbers of waterfowl wintering in the SHP, range from 500,000 to 2.8 million ducks and 100,000 to 750,000 geese (Smith 2003). Use of playas as stopover sites by shorebirds in the Great Plains is not well known, but playas are important to migrating shorebirds (Davis and Smith 1998, Cole et al. 2002). Both waterfowl and shorebirds that use playas, likely rely on them to replenish their energy reserves so they can continue with migration (Guthery et al. 1984). The use of playas by migrating and wintering waterbirds (defined here as members of the families Gruidae, Rallidae, Ardeidae, Threskiornithidae, Podicipedidae and Laridae) is poorly known (Guthery et al. 1984).

Past chronology studies in the SHP suggest that timing of use of playas by wintering waterfowl varies among species (Soutiere et al. 1972, Obenberger 1982). Migration of waterfowl in spring begins in mid-February and continues through May. Canada geese (*Branta canadensis*), lesser snow geese (*Chen caerulescens*; hereafter "snow geese"), pintails and mallards (*Anas platyrhynchos*) are the first to migrate (many of these having wintered here) while in late May blue-winged teal (*Anas discors*), gadwall (*Anas strepera*) and northern shovelers (*Anas clypeata*; hereafter "shoveler") will be the last to migrate north (Smith 2003). In 1980 and 1981 pintail migration peaked in November and February (Obenberger 1982).

Species of waterfowl which commonly winter in the Texas Panhandle include pintails, mallards, American green-winged teal (*Anas crecca*; herafter "green-winged teal"), and American wigeon (*Anas americana*; hereafter "wigeon"; Seyffert 2001). Other species which migrate through the region include blue-winged teal, cinnamon teal (*Anas cyanoptera*), gadwall, northern shoveler, ring-necked duck (*Aythya collaris*), canvasback (*Aythya valisinearia*), lesser scaup

(*Aythya affinis*), redhead (*Aythya americana*), ruddy duck (*Oxyurajamaicensis*), and wood duck (*Aix sponsa*; Seyffert 2001).

Many species of shorebirds use playas during migration and their numbers vary depending on the season. In the spring, the most abundant species are the American avocet (*Recurvirostra americana*), long-billed dowitcher (*Limnodromus scolopaceus*), and Wilson's phalarope (*Phalaropus tricolor*; Seyffert 2001). In the fall the most abundant species are the American avocet, long-billed dowitcher, long-billed curlew (*Numenius americanus*), stilt sandpiper (*Calidris himantopus*), and lesser yellowlegs (*Tringa flavipes*; Seyffert 2001). One species of shorebird, the killdeer (*Charadrius vociferous*), has been recorded throughout our study area in every month of the year (Seyffert 2001). Black-necked stilts (*Himantopus mexicanus*), American avocets, long-billed curlews, Wilson's phalaropes, and killdeer are known to nest in the playa lakes region (Seyffert 2001).

Although the playa lakes of the SHP are well known as migration stopover and wintering areas they also serve as the southernmost breeding area for many duck species (Ray et al. 2003). The nesting period for waterfowl in the SHP can extend from April through August (Smith 2003). A breeding duck study conducted from 1988 - 1992 in the High Plains of Texas observed 15 species of duck pairs: mallard, blue-winged teal, northern shoveler, green-winged teal, cinnamon teal, pintail, gadwall, wigeon, redhead, ruddy duck, lesser scaup, bufflehead (*Bucephala albeola*), ring-necked duck, Mexican duck (*A. p. diazi*), and canvasback (Ray et al. 2003).

Water conditions in playas may cause their use of by birds to fluctuate. An increase in agricultural use in this area and changes in crop types and farming practice since these earlier studies (Haukos and Smith 2003) were conducted may have influenced the use of the area as stop-over and wintering habitat by waterfowl and other wetland birds. Therefore, I examined the

migration chronology of waterfowl, shorebird, and waterbird use of playas in the Texas Panhandle.

CHAPTER II

METHODS

Study Area

My study was conducted in 8 Texas Panhandle counties: Randall, Deaf Smith, Oldham, Swisher, Parmer, Armstrong, Brisco and Castro. The climate of the study area is semi-arid, warm and continental (Sabin and Holliday 1995). Average daily air temperatures range from 25-28 °C in the summer to 1-3 °C in the winter (Bolen et al. 1989a). Annual precipitation varies considerably from year to year (Sabin and Holliday 1995), but averages about 45 cm with peak rains in April, May and September (Bolen et al. 1989a). Wind speeds of 80 kph are not uncommon, with average speeds ranging from 16 to 24 kph (Sabin and Holliday 1995).

Survey Routes

To determine the use of playas by waterfowl I developed 4 survey routes containing 12 to 17 playas per route (Fig. 1). I began my surveys of waterfowl in February 2004 and then included shorebird and other wetland birds' use of playas into my surveys in June of 2004. I selected playas that could be surveyed from public roads, thus landowner permission to conduct surveys was not required. When selecting playas for my routes, I chose those that were holding water at that time because data on their water holding history was not available.

The initial or north survey route encompassed 3 counties in the Texas Panhandle: Randall, Oldham, and Deaf Smith. This survey route contained 14 playas which differed in size, amount of emergent vegetation and surrounding land use. In September of 2004, two additional survey routes

were added. These 2 routes enlarged the survey area from a 3 county area to a 6 county area. The three counties added at this time were Swisher, Castro and Parmer. The west route was in Parmer County and contained 13 playas while the south route in Swisher and Castro County contained 17 playas. In August of 2005, I added a fourth or east route. The east route was in Swisher, Randall, Brisco and Armstrong counties. The addition of Armstrong and Brisco Counties brought the total number of counties surveyed to 8. The E survey route consisted of 12 playas. This 4 route, 8 county survey area contained 58 playas.

Data recorded

From February of 2004 through May of 2005 playas were surveyed once every two weeks during fall, winter and spring (August through May) and monthly during the summer (June and July). Beginning in June of 2005, playas were surveyed once every two weeks during all seasons. Whenever possible I would use binoculars (Pentax DCF SP 10X43; Pentax Corporation, Tokyo, Japan) to identify and count birds. If the playa was too far from the road to use binoculars, I used a window mounted high-power spotting scope (Nikon Field Scope with 82 mm ED angled body and 25-75 zoom eye piece; Nikon Sport Optics, El Segundo, CA). I would stay inside the vehicle while counting to minimize disturbances and flushing of birds.

Species and numbers of birds were recorded if they were on or near the playa. Birds flying over the playa were not counted unless they had flushed upon our arrival or were actively using the playa. Percent of emergent vegetation was visually estimated as 0%, >0-25%, >25-50%, >50-75% and 75-100%. In the winter the percent ice cover was visually estimated and recorded using the same scale as used for emergent vegetation. Weather events, including fog, rain or snow were also recorded. Percent cloud cover was visually estimated as 0-10%, >10-75% and >75-100%. Time, temperature, wind direction, and wind speed values were recorded

for each playa during each survey. A pocket weather meter (Kestrel 3000, Nielsen-Kellerman, USA) was used to measure wind speed and temperature. At times, conditions made surveying a playa impossible. These conditions included impassable roads, heavy fog, rain or snow, vegetation too dense, and strong wind. Dry playas were not surveyed.

I used two methods to count waterfowl on my survey routes. The method chosen depended on the number of ducks present on a playa. When numbers were low, I counted each individual duck of each species present. When numbers were too high to count individuals, I counted the number of ducks present in my field of view and then counted the number of times I filled my field of view with approximately that same number. By multiplying the number of ducks in the field of view by the number of times this was repeated, I was able to estimate of the overall number of ducks. I then scanned back across the playa and estimated the percentage of each different species of duck using the playa. I multiplied the percentage of each species by the total number of ducks to arrive at an estimate of the number of each species present.

Playa conditions (wet or dry) are recorded for 217-223 randomly selected playas during the annual mid-winter waterfowl survey conducted by Texas Parks and Wildlife Department (TPWD). The playa condition data allows TPWD biologists to calculate a wet playa index. The survey is conducted by air and takes place during the first week of January. Data included in this analysis are from 2003-2006 surveys. However, during the 2004 mid-winter waterfowl survey, only 70 of the randomly selected playas were surveyed due to lack of funding.

CHAPTER III

RESULTS

Precipitation

Precipitation totals over the past 20 years have varied from a high of 67.48 cm in 1999 to a low of 34.08 cm in 2003 with a 20 year average precipitation (1986-2005) of 50.69 cm. The year prior to my study (2003) was the 8th driest year on record since 1892 and the driest year since 1980, and 2004 was the 9th wettest year on record (Fig 2). The year 2005 was another dry year with a yearly precipitation total of 38.10 cm. (National Oceanic and Atmospheric Administration [NOAA] 2006). In January of 2003, only 33.2% of playas (72 of 217) surveyed during the annual mid-winter waterfowl survey, held water. In January 2004, 2.9% of playas (2 of 70) surveyed held water (in pits only) compared to 62.8% of playas (140 of 223) surveyed in January 2005. Conditions were once again dry in January 2006 with only 30 wet playas (13.5%) of the 223 surveyed (Fig. 2).

Chronology

Fifty-six species of waterfowl and wetland birds were identified during my surveys. Arrival dates, departure dates and length of use of playas in the panhandle varied between species. Total waterfowl abundances varied greatly by species (Table 1). Pintails were the most abundant waterfowl species observed during my surveys from February of 2004 through January of 2006 (32% of all waterfowl observed during surveys). Next in abundance were green-winged teal (22%), mallard (13%), wigeon (8%), Canada goose (6%), northern shoveler (5%), lesser snow

goose (4%), blue-winged teal (3%), redhead (3%), ruddy duck (1%), canvasback (0.8%), gadwall (0.6%), lesser scaup (0.5%), ring-necked duck (0.4%), cinnamon teal (<0.4%). Eight species were rarely observed and each accounted for less than <1% of the total observations (Table 1).

Pintails were present at the start of my surveys in February 2004 and remained in my surveys through 7 May 2004 (Fig. 3). Pintail migration in spring 2004 peaked on 27 February with an average of 1,220 pintails per playa. Pintails were not observed on playas during June and July of 2004. Pintails were first encountered during fall migration on 27 August of 2004 and remained through January 2006, when my surveys ended. Peak fall 2004 migration occurred on 19 November with an average of 323 pintails per playa. Peak migration in spring 2005 occurred on 21 February with an average of 205 pintails per playa. Peak fall 2005 migration occurred on 11 November with an average of 417 pintails per playa (Fig.3). Some pintails remained in the area through summer of 2005. I observed broods on 7 playas and on 3 of 4 routes during 18 May through 7 July 2005.

Green-winged teal were present in February 2004 at the start of my surveys and remained in the area through 27 May 2004 (Fig. 4). Green-winged teal spring 2004 migration peaked on 26 March with an average of 68 green-winged teal counted per playa. Green-winged teal were not observed in June and July of 2004. Green-winged teal were first encountered during fall 2004 migration on 27 August and remained through 30 December of 2005. Peak fall 2004 migration occurred on 5 November with an average of 160 green-winged teal per playa. Peak spring 2005 migration occurred on 25 March with an average of 423 green-winged teal per playa. Peak fall 2005 migration occurred on 6 October with an average of 144 green-winged teal per playa. No green-winged teal were observed in January 2006 (Fig 4.).

Mallards were present in February 2004 when I began my surveys and remained in my

surveys through January of 2006 (Fig. 5). Mallard migration in spring 2004 peaked on 27 February with an average of 128 mallards per playa. Peak fall 2004 migration occurred on 19 December with an average of 61 mallards per playa. Spring 2005 migration peaked on 21 February with an average of 97 mallards per playa and fall 2005 migration on 11 November with an average of 312 mallards per playa (Fig 5). Mallard broods were first observed on 12 April, 2005, and were present until 2 September 2005. Mallard broods were observed on 22 playas and on all 4 survey routes.

Wigeon were present in February 2004 when my surveys began and remained in my surveys through 7 May 2004 (Fig. 6). Wigeon migration peaked in spring 2004 on 26 March with an average of 43 wigeon per playa. Wigeon were not observed during June through August of 2004. In fall 2004 wigeon were first observed 9 September and remained through 10 May 2005. Fall 2004 migration peaked on 8 October with an average of 63 per playa. Spring 2005 migration peaked on 11 March with an average of 164 per playa. Wigeon were not observed during June through August of 2005. On 16 September 2005 wigeon were observed and remained through January 2006 when my surveys ended. Fall 2005 migration peaked on 11 November with an average of 211 per playa (Fig 6).

Canada geese were present when my surveys began in February 2004 with an average of 2 per playa (Fig. 7). Canada geese remained in the area during 26 March - 27 May 2004. Canada geese were absent during June through August 2004 and were next observed on 14 September. No Canada geese were seen in October 2004. Migrant Canada geese were first observed on 5 November of 2004 and remained over winter through 7 June 2005. Peak abundance during winter of 2004-2005 occurred on 15 January with an average of 280 per playa. No Canada geese were observed in July and September 2005 but 30 geese were observed 15 August and 32 observed 31

August 2005. Canada geese were observed once again on 28 October 2005 and were present through the end of my survey in January 2006. Peak abundance during winter of 2005-2006 occurred on 5 January with an average of 287 per playa (Fig7).

Shovelers were present when I began my surveys in February 2004 and remained through 27 May 2004 (Fig. 8). Shoveler migration in spring 2004 peaked on 12 March with an average of 23 per playa. Shovelers were not observed in June and July of 2004. Shovelers were first observed during fall migration on 27 August of 2004 and remained through December 2005. Peak abundance during fall 2004 occurred on 27 November with an average of 44 per playa. Migration peaked in spring 2005 migration on 11 March with an average of 41 per playa. In fall 2005 migration peaked on 6 October with an average of 31 per playa. No shovelers were observed in January 2006 (Fig 8). On 3 August of 2005 a brood of shovelers was observed on an east route playa.

Snow geese were present when I began my surveys in February 2004 and remained through 27 May 2004 (Fig. 9). Snow goose migration in spring 2004 peaked on 26 March with an average of 207 per playa. Snow geese were not observed during June through November 2004, but were observed on 1 December 2004 through 28 January 2005 with peak winter abundance of 120 per playa occurring on 15 January. Snow geese were absent from my surveys in February 2005 but were present on 8 March 2005. Snow goose spring migration 2005 peaked on 10 March with an average of 62 per playa with snow geese last observed on my surveys on 25 March. No snow geese were observed during April through October 2005. Snow geese were first observed on fall 2005 surveys on 11 November, which is when their 2005 migration peaked at 99 per playa. Snow geese remained until my surveys ended in January 2006. Winter 2005-2006 peak abundance occurred on 5 January with an average of 500 per playa (Fig 9).

Blue-winged teal were not observed when I began my surveys in February 2004 and remained absent until 9April (Fig. 10). In spring 2004 blue-winged teal migration peaked on 7 May with an average of 6 per playa. Blue-winged teal were absent from my surveys from June - July 2004. Blue-winged teal were once again observed on 13 August 2004 with fall migration peaking on 14 September at 141 per playa. Only 0.04 blue-winged teal per playa were observed on my surveys in December 2004 and none were observed in January through February 2005. Blue-winged teal were once again observed on my surveys on 10 March 2005 and remained in my surveys through 27 October 2005. In spring 2005 blue-winged teal migration peaked on 25April with an average of 15 per playa. Fall 2005 migration peaked on 14 September with an average of 52 per playa. No blue-winged teal were observed November 2005 through January 2006 (Fig 10). In the summer of 2005, 4 blue-winged teal broods were observed on 4 playas. These 4 playas were on 3 different survey routes (east, north, south). Three broods were observed beginning on 3 August and the fourth brood was observed on 31 September.

Redheads were present when I began my surveys in February 2004 and remained through 27 May 2004 (Fig. 11). Spring 2004 migration peaked on 27 February with an average of 7 per playa. Redheads were absent June through August 2004. Redheads were once again observed on 14 September 2004 and were present through 20 June 2005. Fall 2004 migration peaked on 5 November with an average of 43 per playa. Spring 2005 migration peaked on 21 February with an average of 47 per playa. No redheads were observed in July. Redheads were observed on 8 August 2005 and were present in my surveys through January 2006. In fall 2005 migration peaked on 11 November with an average of 28 per playa (Fig 11).

Ruddy ducks were not present when I began my surveys in February 2004 (Fig. 12). They were first observed on 12 March 2004 and were present through 23April 2004. Ruddy duck

spring 2004 migration peaked on 9 April with an average of 12 ruddy ducks per playa. No ruddy ducks were observed on my surveys during May through August 2004. Ruddy ducks were once again observed on 9 September 2004 and were present through 15 July 2005. Migration peaked in fall on 19 November with an average of 56 per playa. Migrant numbers peaked in spring 2005 on 25 March with an average of 29 per playa and were present until July. Ruddy ducks were once again observed on 6 October 2005 and were present through 23 December 2005. Peak abundance during fall 2005 occurred on 11 November 2005 and averaged 25 per playa. No ruddy ducks were observed on my surveys in January 2006 (Fig 12).

Canvasbacks were present when I began my surveys in February 2004 (Fig. 13). They were first observed on 27 February when their abundance peaked at 2 per playa. Canvasbacks were not observed again until 5 November 2004 and were present until 15 April 2005. In fall 2004 migration peaked on 19 November with an average of 19 per playa. Spring 2005 migration peaked on 21 February 2005 with an average of 6 per playa. No canvasbacks were observed May through September of 2005. Canvasbacks were once again observed on my survey routes 14 October and fall migration peaked on 11 November at 2 per playa. No canvasbacks were observed after November 11 2005 through the date my surveys ended in January 2006 (Fig 13).

Gadwall were not present when I began my surveys in February 2004 (Fig. 14). They were first observed on my routes on 12 March 2004 and were present through 27 May 2004. Gadwall spring 2004 migration peaked on 12 March with an average of 3 per playa. Gadwall were next observed on my survey routes on 14 September 2004 and were present through 14 June 2005. Fall 2004 migration peaked on 27 November with an average of 8 per playa. In spring 2005 migration peaked on 30 March with at 7 gadwall per playa. No Gadwall were observed during July 2005. Gadwall were observed on my surveys 8 August 2005 through 31 August, but

not in September 2005. Gadwall were next observed on 6 October 2005 and were present through January 2006. Fall 2005 migration peaked on 11 November at 4 gadwall per playa (Fig 14).

Lesser scaup were first observed on 27 February 2004 with an average of 7 per playa (Fig. 15). Lesser scaup were not observed again until 8 October 2004 and remained in my surveys until 15 April 2005. Fall 2004 migration peaked on 19 November with an average of 10 per playa. In winter 2004 abundance peaked on 17 December 2004 at 19 per playa. Spring 2005 migration peaked on 11 February with an average of 8 per playa. Lesser scaup were next observed on 19 October and fall 2005 migration peaked on 11 November at 1 per playa. Lesser scaup were not observed on my surveys in December 2005 and January 2006 (Fig 15).

Ring-necked ducks were not present when I began my surveys in February 2004 (Fig. 16). They were first observed on 9April 2004 with an average of 0.5 per playa. Ring-necked ducks were not observed again until 28 September 2004 and were then present through 15 April, 2005. In fall 2004 migration peaked on 8 October with an average of 13 per playa. Migration abundance during spring 2005 migration peaked on 11 February with an average of 7 per playa. Ring-necked ducks were next observed on my survey routes 11 October 2005 and were present through 23 December 2005. Abundance peaked during fall 2005 migration on 27 October 2005 at 2 per playa. No ring-necked ducks were observed on my surveys in January 2006 (Fig 16).

Cinnamon teal were not present when I began surveys in February 2004 (Fig. 17). They were first observed on my 12 March 2004 and were present through 27 May 2004. Cinnamon teal spring 2004 migration peaked on 26 March at 1 per playa. Cinnamon teal were next observed on 9 September 2004 and were present through 6 October 2005. Fall 2004 migration peaked on 27 November with an average of 2 per playa. Winter peak abundance occurred on 19 December 2004 with an average of 7 per playa. Spring 2005 migration peaked on 10 March at an average of

9 per playa. In fall 2005 migration abundance peaked on 6 October at 0.7 per playa. No cinnamon teal were observed during November through December 2005 and January 2006 (Fig 17). Three cinnamon teal broods were observed during summer 2005. These broods all occurred on the south route on three different playas. Two of the broods were observed on 7 June and the third brood was observed on 11August.

Two species of geese and 6 species of ducks were uncommon to rare visitors on my playa surveys. These included greater white-fronted geese (three occasions), Ross's geese (four occasions), buffleheads (eight occasions), and wood ducks (eight occasions). Eurasian wigeons were documented on survey routes on 11 February 2005 and 10 March 2005. Common goldeneyes were observed on a survey 11 February 2005. Hooded mergansers were observed on a survey 9 April 2004 and a common merganser was observed on a survey 8 November 2004.

Twenty-two species of shorebirds birds were identified during surveys. Arrival dates, departure dates and length of use of playas in the panhandle varied between species. Total shorebird abundances varied greatly by species (Table 2). American avocets were the most abundant shorebird species observed and occurred from February of 2004 through January of 2006 (32% of all shorebirds observed during surveys). Next in abundance were Wilson's phalaropes (17%), killdeer (15%), long-billed dowitchers (13%), lesser yellowlegs (7%), black-necked stilts (4%), long-billed curlews (3%), Baird's sandpipers (*Calidris bairdii*; 2%), stilt sandpipers (1%), least sandpipers (*Calidris minutilla*; 1%), and greater yellowlegs (*Tringa melanoleuca*; 1%). Ten species were rarely observed and each accounted for less than <1% of the total observations.

American avocets were not present when I began my surveys in February 2004 (Fig. 18). They were first observed on 26 March 2004 and until 9 November 2004. Peak 2004 spring

abundance occurred on 9 April with an average of 14 per playa. Peak summer abundance occurred on 9 July with an average of 4 per playa. Peak fall abundance occurred on 14 September 2004 with an average of 6 per playa. In 2005 spring abundance peaked on 18 May 2005 with an average of 16 per playa, summer abundance peaked on 7 June 2005 at 11 per playa, and fall abundance peaked on 30 September 2005 at 17 per playa. American avocets were not observed between the months of December and February in any year (Fig 18). In the summer of 2005 American avocet broods were observed on 4 playas. These 4 broods occurred on 2 routes (south, west). Two broods were observed on 6 June, a third brood was observed on 7 July, and a fourth brood on 13 July.

Wilson's phalaropes were not present when I began surveys in February 2004 (Fig. 19). They were observed on 7 May 2004 and were not observed again until 27 August and remained on my surveys until 22 September 2004. Spring 2004 peak abundance occurred on 7 May with an average of 8 per playa. Fall 2004 peak abundance occurred on 9 September with 12 per playa. Wilson's phalaropes were next observed on 25 April 2005 and were present until 23 September. No Wilson's phalaropes were observed during October 2005 through the end of my surveys in January 2006. Peak spring 2005 abundance occurred on 6 May with an average of 18 per playa. Summer 2005 peak abundance occurred on 30 June with 2 per playa. Fall 2005 peak abundance occurred on 26 August with an average of 25 per playa (Fig 19).

Killdeer were not counted when I began surveys in February 2004 (Fig. 20). They were first observed on 10 September 2004 and were present through 19 December 2004. Peak fall 2004 abundance occurred on 24 September with 12 per playa. No killdeer were observed during January 2004. They were next observed on 21 Feb 2005 and were present until the end of my survey in January 2006. Spring 2005 peak abundance occurred on 30 March with an average of 3

per playa. Summer 2005 peak abundance occurred on 13 July with an average of 4 per playa. Abundance peaked in fall 2005 on 31 August with an average of 6 per playa. Winter abundance peaked in 2005 on 23 December at 1 per playa (Fig 20). On 3 August 2005 a killdeer brood was observed on an east route playa.

Long-billed dowitchers were not present when I began surveys in February 2004 (Fig. 21). They were first observed on 26 March 2004. They were next observed on 7 May 2004. The first 2004 fall migrants were observed on 8 October and last were seen on 29 October. Long-billed dowitchers were again observed on 30 March 2005 and were present through 20 May 2005. Spring 2005 peak abundance occurred on 6 May 2005 with an average of 16 per playa. Long-billed dowitchers were next observed on 7 July 2005 and remained through 11 November 2005. Peak fall 2005 abundance occurred on 14 October 2005 with 21 per playa (Fig 21).

Lesser yellowlegs were not present when I began surveys in February 2004 (Fig. 22). They were first observed on a survey 26 March 2004 and not observed again until 19 November 2004. Migrating spring 2005 lesser yellowlegs were first observed on 8 March 2005 and last seen on 30 March 2005. Lesser yellowlegs were again observed on 13 July 2005 and remained through 29 November 2005. Fall 2005 peak abundance occurred on 2 September with an average of 16 per playa. Lesser yellowlegs were next observed on 5 January 2006 with an average of 2 per playa that month (Fig 22).

Black-necked stilts were not present when I began surveys in February 2004 (Fig.23). They were first observed on a survey 9 April 2004, and then next observed on 3 May 2004. No black-necked stilts were observed on survey playas during June – August 2004. Black-necked stilts were observed on 9 September 2004 through 28 September 2004 with an average of 0.9 per playa that month. The first spring 2005 black-necked stilts were observed on 6 May. Black-

necked stilts remained on survey playas throughout the summer and were last observed on 16 September 2005. Spring 2005 abundance peaked on 18 May at 1.5 per playa, summer 2005 abundance peaked on 7 June at 2 per playa, and fall 2005 abundance peaked on 26 August at 11 per playa (Fig 23). During the summer of 2005 black-necked stilt broods were observed on 2 south route playas. The first brood was observed on 7 June and the last brood on 11 August.

Long-billed curlews were not present when I began surveys in February 2004 (Fig. 24). They were first observed on 12 March 2004 and were present through 23 April 2004. Long-billed curlews were next observed on 9 July 2004 at an average of 18 per playa. Long-billed curlews were again observed on 9 September 2004 and were present through 19 November 2004. Abundance in spring 2004 peaked on 26 March with an average of 4 per playa. Fall 2004 peak abundance occurred on 8 November 2004 with an average of 1 per playa. Long-billed curlews were observed on 2005 surveys on 15 April, 15 August, 14 October, and 19 October. In October 2005 they averaged 0.3 per playa (Fig 24).

Baird's sandpipers were not present when I began surveys in February 2004 (Fig. 25). They were first observed on 6 May 2005 and remained through 11 November 2005. Spring 2005 peak abundance occurred on 6 May with an average of 1 per playa. Summer 2005 peak abundance occurred on 15 July with an average of 1 per playa. Fall 2005 abundance peaked on 14 October with an average of 1 per playa (Fig 25).

Stilt sandpipers were not present in surveys in 2004 (Fig. 26). In spring 2005 they were only observed in May and averaged 0.8 per playa. Stilt sandpipers were again observed in August 2005 and averaged 0.02 per playa. Stilt sandpipers were observed again in early October with an average of 0.5 that month (Fig 26).

Least sandpipers were not present when I began surveys in February 2004 (Fig. 27). They

were first observed on 13 July 2005 and remained through 31 August 2005. Least sandpipers were next observed on 11 October 2005 and were present through 11 November 2005. Fall 2005 peak abundance occurred on 11 November 2005 with an average of 8 per playa (Fig 26).

Greater yellowlegs were not present when I began surveys in February 2004 (Fig. 28). They were first observed on 10 September 2004 with an average of 0.2 per playa which was also their fall 2004 peak abundance. Greater yellowlegs were first observed in 2005 on 15 August which was also their peak at 1 per playa. Greater yellowlegs were not observed on any spring surveys (Fig 28).

Semipalmated sandpipers were not present when I began my surveys in February 2004 (Fig. 29). They were first observed on 6 May 2005 through 18 May 2005 with an average of 0.9 per playa that month. They were next observed on 15 August 2005. Their abundance peaked in fall 2005 on 11 November 2005 at 5 per playa (Fig 29).

Ten species of shorebirds were uncommon to rare visitors. These include upland sandpipers (five occasions), spotted sandpipers (twelve occasions), western sandpipers (six occasions), solitary sandpipers (three occasions), black-bellied plovers (three occasions), willets (four occasions), common snipe (two occasions), semipalmated plovers (one occasion), marbled godwits (two surveys), and piping plovers (one occasion).

Eleven species of waterbirds were observed during my surveys. Arrival dates, departure dates and length of use of playas in the panhandle varied between species. Total waterbird abundances varied greatly by species (Table 3). American coots were the most abundant wetland bird species observed during my surveys from February 2004 through January 2005 (41% of all wetland birds observed during surveys). Next in abundance were Sandhill cranes (31%), white-faced ibis (*Plegadis chichi*; 15%), black-crowned night-heron (*Nycticorax nycticorax*; 6%), great

blue heron (*Ardea herodias*; 2%), cattle egret (*Bubulcus ibis*; 2%), pied-billed grebe (1%), eared grebe (*Podiceps nigricollis*; 1%), black tern (*Chlidonias niger*; <1%). green heron (*Butorides virescens*; <1%), and snowy egret (*Egretta thula*; <1%).

American coots were not present when I began surveys in February 2004 (Fig. 30). They were first observed on 26 March 2004 and remained through 7 May 2004. Spring 2004 migration peaked on 9 April at an average of 8 per playa. American coots were observed on 9 September 2004 and were present through 23 December 2005. Fall 2004 abundance peaked on 8 October at 48 per playa. Spring 2005 migration peaked on 6 May with an average of 5 per playa. Peak abundance during fall 2005 occurred on 14 October at 27 per playa (Fig 30). During the summer of 2005 American coot broods were observed on 5 playas. These broods occurred on 2 routes (south, east). The first brood was observed on 13 July and the last brood was observed on 31 September.

Sandhill cranes were present when I began surveys in February 2004 (Fig. 31). They were first observed on 27 February 2004 when they averaged 6 per playa. Sandhill cranes were next observed on 22 October 2004 and were present through 19 November 2004. Fall 2004 abundance peaked on 19 November at 19 per playa. Sandhill cranes were observed on 11 November 2005 and were present through 5 January 2006. Winter 2005-2006 peak abundance occurred on 5 January 2006 with an average of 143 per playa (Fig 31).

White-faced ibis were not present when I began surveys in February 2004 (Fig. 32). They were first observed on 23 April 2004 and remained through 22 October 2004. Spring 2004 abundance peaked on 27 May with an average of 2 per playa. Fall 2004 peak abundance occurred on 14 September with an average of 9 per playa. White-faced ibis were next observed on 15 April 2005 and remained through 14 October 2005. Abundance in spring 2005 peaked on 6 May at 5

per playa. Fall 2005 abundance peaked on 31 August at 10 per playa. Summer peak abundance occurred in August of both 2004 and 2005 (Fig 32).

Black-crowned night-herons were not present when I began surveys in February 2004 (Fig. 33). They were first observed on 7 May 2004 through 27 May 2004 with an average of 6 per playa that month. Black-crowned night-herons were observed on one survey 13 August 2004 with an average of 0.1 per playa. They were next observed on 15 April 2005 and remained through 11 October 2005. Peak abundance in spring 2005 occurred on 10 May at 5 per playa and the fall 2005 peak occurred on 15 August 2005 with 4 per playa (Fig 33).

Great blue herons were not present when I began surveys in February 2004 (Fig. 34). They were first observed on one survey 9April 2004 and had sporadic appearances on survey playas during the remainder of the survey. Great blue heron abundance peaked during the study during fall 2005, when they averaged 3 per playa on 15 August (Fig 34).

Cattle egrets were not present when I began surveys in February 2004 (Fig. 35). They were first observed on 14 September 2004 and were present through 13 October 2004. Fall 2004 peak abundance occurred on 14 September with an average of 3 per playa. Cattle egrets were observed on 15 April 2005 and remained through 23 September 2005. Spring 2005 peak abundance occurred on 6 May 2005 with an average of 0.9 per playa. In summer 2005 abundance peaked on 27 July at 2 per playa. Peak abundance during fall 2005 occurred on 11 August and averaged 0.6 per playa (Fig 35).

Pied-billed grebes were not present when I began surveys in February 2004 (Fig 36). They were first observed on 13 August 2004 and were present through 19 December 2004. Fall 2004 peak abundance occurred on 13 October with an average of 0.4 per playa. Pied-billed grebes were observed on 18 February 2005 and remained through 30 March 2005. They were next

observed on 27 July 2005 and were present through 23 December 2005. Abundance peaked in fall 2005 on 3 August at 1 per playa (Fig 36). During the summer of 2005 a pied-billed grebe brood was observed on an east route playa. This brood was first observed on 3 August 2005.

Eared grebes were not present when I began surveys in February 2004 (Fig.37). They were first observed on 9 September 2004 and were present through 27 November 2004. Fall 2004 peak abundance occurred on 9 September with an average of 0.9 per playa. In 2005, eared grebes were observed on 14 April 2005 and remained through 27 July. Peak abundance for summer 2005 occurred on 30 June with 0.2 per playa. Eared grebes were observed again on 2 September 2005 and were present through 28 October 2005. Abundance peaked in fall 2005 on 28 October with an average of 0.9 per playa (Fig 37).

Three species of waterbirds were uncommon to rare visitors. These include black terns (6 surveys), green herons (two surveys) and snowy egrets (one survey).

CHAPTER IV

DISCUSSION

Precipitation

Playas receive most of their water from precipitation runoff (Haukos and Smith 2003, Conway et al. 2005). The years 2003 through 2005 exemplify the conditions which contribute to the erratic hydroperiods by which playas are characterized (Smith 2003). During this time, the Texas Panhandle experienced one of the driest years on record (2003) as well as one of the wettest (2004). When I began my surveys in February 2004 most of the playas in my study area were dry and remained so until early fall 2004. TPWD's wet-playa index obtained during the January 2004 mid-winter waterfowl surveys indicated only 2.9% of playas held water, however, heavy rains in the spring and fall of that year increased the wet playa index to 62.8% by January of 2005. Total waterfowl, shorebirds and other wetland birds were lower during the first year of my study, a possible response to the dry conditions. However, the average number of birds per playa was similar in 2004 and 2005. Since numbers of birds per playa did not appear to increase with lower numbers of playas I hypothesize that fewer birds used the area as a staging and wintering area.

The High Plains of Texas is one of the southernmost breeding areas for many North American ducks (Ray et al. 2003) and at least 4 species of shorebirds nest in the playa lakes region (Conway et al. 2005). The most noticeable effect of the variation in precipitation during my study occurred during the summer of 2005, when 5 species of waterfowl, 3 species of shorebirds and 2 species of waterbirds were observed with broods on survey playas. In contrast, no broods

were observed during the summer of 2004. Although this area is not responsible for the production of large numbers of waterfowl broods, additional research is needed to determine the contributions of playas as nesting habitat in this area (Ray et al 2003). This is particularly true considering the fact that some species observed breeding in the playa lakes region are also suffering long-term continental declines (e.g., pintails; Miller and Duncan 1999, Conway et al. 2005).

Chronology

Existing chronology data for waterfowl, shorebirds and waterbirds in the Texas Panhandle is based primarily on research collected 20 or more years ago at Muleshoe National Wildlife Refuge (MNWR) and Buffalo Lake Wildlife Refuge (BLNWR; Soutiere et al. 1972). Data from MNWR were collected from saline lakes and associated freshwater springs and data from BLNWR involved a 2,000 acre reservoir (Soutiere et al. 1972). Both these areas differ from the majority of shallow playas of the Texas Panhandle. Most other migration chronology information is derived from the observations of bird watchers and hunters (Seyffert 2001). Therefore, current chronology data from playa lakes is lacking and the importance of conducting chronology research of this area and habitat cannot be overstated.

Ten species of waterfowl were present when I began my surveys in February 2004. For 5 of these species their abundances peaked during February 2004. These include pintails, mallards, redheads, canvasbacks and lesser scaup. In February 2005 abundances again peaked for pintails, mallards, redheads and lesser scaup. Previous work has suggested pintails, mallards, green-winged teal and wigeon all reach their peak numbers in February (Bolen et al. 1989a, Smith 2003). Although my data support a February peak for pintails and mallards, both green-winged teal and wigeon peaked in March of 2004 and 2005.

The mallard is the only dabbling duck (*Anas* spp.) that reached its peak abundance during

the winter, instead of during migration. This agrees with observations from Seyffert (2001) suggesting that mid-winter is the season of the mallard's greatest abundance. In 2004 mallard numbers reached their peak on my study playas in December and in 2005 they peaked in mid-November.

Green-winged teal fall migration peaked in November 2004 and in October 2005. Comparisons of the initial rise in fall numbers that I recorded for green-winged teal to arrival dates of previous studies suggest teal in my study area may have arrived somewhat later. Seyffert (2001) suggest teal arrive in the Texas Panhandle begin arriving during the first week of October (Seyffert 2001). The November 2004 peak for this species may be worth further investigation to determine if this late migration peak of green-winged teal could possibly put more hunting pressure on blue-winged teal during the early teal hunting season.

In 2004, fall migration peak of wigeon occurred on 8 October. In 2005, fall migration peak for this species occurred on 11 November, which is slightly over 4 weeks later than the first year. Seyffert's (2001) reports of early or mid-October dates are consistent with the results of my survey in 2004. During a study of the winter periods 1959-60 to 1967-68 main flight arrivals of wigeon at MNWR occurred in October while the main flight arrival at BLNWR occurred in November (Soutiere et al. 1972). Both these National Wildlife Refuges are in or near my survey routes and these data are consistent with observations from my surveys.

In 2004 and 2005 lesser scaup and canvasbacks were absent from my surveys by April. Seyffert (2001) reports that canvasbacks are gone by the third week of April and lesser scaup are gone by early May with the heaviest movements occurring in late March and early April. I observed peak use of playas by redhead's occurring in February of 2004 and 2005. Previous reports indicate spring migration peaks occurred during the first two weeks of March (Seyffert

2001). My observation of fall migration peaks in November for canvasbacks and redheads coincides with past observations. My observation of similar peaks for lesser scaup and ruddy ducks were later than past observations of mid to late October for lesser scaup and October for ruddy ducks with them having largely disappeared by late November (Seyffert 2001).

Shovelers, cinnamon teal and gadwall reached spring peak migration numbers in March of 2004 and 2005. My findings of shoveler peaks occurring in mid-March are consistent with reports of peak migration occurring during mid-March through mid-April (Seyffert 2001). Fall peak migration periods for shovelers of early October through early November (Seyffert 2001) are consistent with my observations in 2004 and 2005.

The cinnamon teal has been poorly studied in the Panhandle and an assessment of normal numbers during migration is lacking (Seyffert 2001). Of interest with this under-studied species was their presence in my study during the winter of 2004 and 2005 with a peak in December 2004 of 117 birds or an average of 2 per playa (average range on individual playas of 0-4). This differs from accounts that listed only 10 winter sightings including birds seen in the month of February (Seyffert 2001). Lack of information on this species is a possible result of observers not taking the time or making the effort to separate teal species in a mixed flock when arriving at aggregate numbers. Identification is particularly difficult during fall migration when these ducks are in transition plumage. This may be one reason observers have not reported significant numbers of cinnamon teal (Seyffert 2001).

Mid to late March peak use of playas by gadwall occurs earlier than previous reports of peaks occurring in mid-April to early May (Seyffert 2001). Gadwall fall migration peak occurred in November of 2004 and 2005. This timing is consistent with reports of mid-October or late-November peak abundance (Seyffert 2001).

Peak spring abundance of blue-winged teal occurred in early May 2004 and in late April of 2005. Peak spring migration of this species has been reported to occur in mid-April followed by a rapid decline in abundance (Seyffert 2001). The earliest returning fall migrant during my study years of 2004 and 2005 was the blue-winged teal with peak migration occurring both years in September which is consistent with previous reports (Seyffert 2001). Ruddy duck and ring-necked duck spring migration peaked in early April of 2004. In 2005, peak use of playas by ruddy ducks and ring-necked ducks occurred in late march and February respectively, which, unlike the previous year's peak in early April, is consistent with reports of peaks occurring in late February and early March (Seyffert 2001). The earliest returning fall diver during my study years of 2004 and 2005 was the ring-necked duck with peaks occurring both years in October, consistent with previous accounts of early October to late November peak migration (Seyffert 2001).

Canada and snow geese were present on my survey routes in large numbers in January of 2005 and 2006. Both species are common winter residents with most Canada geese having departed by the first week of March (Seyffert 2001). Snow geese however, exhibited a mid to late-March spring peak abundance which is slightly later than previous accounts of peaks in mid-February (Seyffert 2001). However this could be because most records of geese are from traditional roosting areas, which are largely permanent bodies of water, and not playas.

No snow geese were observed on my playa surveys in the fall of 2004. Seyffert (2001) reports snow geese first sightings in the fall occur around 14-24 November which is consistent with my observations of peak fall abundance occurring in mid-November of 2005. Canada geese began to appear on my survey routes in November of 2004 and in October of 2005, dates that are consistent with previous accounts (Seyffert 2001). In November of 2005 Canada and snow geese were present in equal numbers with an average of 31 per playa. This observation may be worth

further study to determine whether the exploding snow goose population (Seyffert 2001) could be impacting Canada geese, our most abundant winter resident goose species.

The remaining six species of ducks and 2 species of geese were uncommon visitors so chronology patterns for them could not be established.

In June of 2004, I expanded the scope of my research to include chronology of shorebirds and wetland birds when observations during waterfowl surveys indicated significant playa use by these birds. June was too late to capture arrival times of spring migration for these species of shorebirds and wetland birds, however this time frame did allow for observations of summer residents and fall migrants. Notations of observations of shorebirds and wetland birds taken prior to my formal inclusion of them in my study did allow me to confirm the presence of several species in early spring of 2004.

American avocets, Wilson's phalaropes, and black-necked stilts were present in my surveys during spring, summer and fall of 2004 and 2005. Their peak abundances and arrival and departure dates remained consistent as well during those two years. All three species were present spring through fall of 2005 but only American avocets remained during the dry summer of 2004. Seyffert (2001) reports American avocets and black-necked stilts to be abundant breeders, which is consistent with my observations of broods of both species during the summer of 2005.

Long-billed dowitchers and greater yellow-legs were most abundant in the spring and fall of 2005 when conditions were wetter than in 2004. Lesser yellowlegs, which were among the top 5 most abundant shorebird species, were not abundant in my surveys until the wet fall of 2005. These observations are consistent with shorebird occurrence being transient and dependent upon suitable wetland habitat availability (Conway et al. 2005).

Long-billed curlews were present in my surveys in greater numbers during spring and

summer of 2004 than in those same seasons in 2005, unlike all other shorebirds. Seyffert (2001) reports long-billed curlews to be a common to fairly common breeder in the northwest section of the Texas Panhandle. Perhaps their presence in greater abundances in my more centrally located study area of the Texas Panhandle in the dry summer of 2004 was a response to drought conditions throughout the entire Texas Panhandle.

Killdeer, one of the most abundant shorebirds during my surveys, were not present until the fall of 2004. Except for the absence of killdeer in the spring and summer of 2004, these abundances and chronology are consistent with past observations (Seyffert 2001). Killdeer, unlike most other shorebirds, are known to use diverse habitats such as pastureland, prairie dog towns, river sandbars and golf courses (Seyffert 2001). I hypothesize that this species' absence from my playa surveys was a response to the drought conditions of the spring and summer of 2004 and although they were not observed during my playa surveys they likely could have been observed in other habitats in my study area.

The 4 most common sandpipers observed on my survey routes, Baird's sandpiper, stilt sandpiper, least sandpiper and semipalmated sandpipers, were absent from my survey's in 2004. This is likely due to the lack of wet playas in the summer and early fall of 2004. In 2005, my observations of 3 of these sandpiper's chronology were consistent with reports of spring arrivals leaving by late June and early returning migrants in late July or early August (Seyffert 2001). Baird's sandpiper however remained present during April of 2005 through November 2005.

The spring 2005 April arrival dates for Baird's, and semipalmated sandpipers are later than previous accounts. Least sandpipers were not observed on my surveys until June of 2005 which were likely southbound birds (Seyffert 2001).

Sandhill cranes were present when I began my surveys in February 2004 but disappeared

by March of that year, consistent with earlier observations of the chronology of this species (Seyffert 2001). Interestingly, cranes were the second most abundant wetland bird counted on my surveys, but were only seen on 7 of the 58 playas. Thus, when observed on my surveys, cranes were found in very large groups. They were not present on my surveys routes in the spring of 2005. Fall migration peaks varied during the years of 2004 and 2005. In 2004 they only appeared briefly in November, as opposed to fall 2005 when they began to appear in October with numbers building to a high in January 2006 when my surveys ended. This later chronology pattern more closely fits prior observations (Seyffert 2001).

American coots and great blue herons were present throughout most of my surveys in 2004 and 2005. In 2004 the spring migration peak for American coots occurred in April which is consistent with previous accounts (Seyffert 2001); however in 2005 their numbers did not peak until May. Fall peak migration occurred in October of both years, an observation consistent with previous findings as does the fact that their numbers were greater in the fall than in the spring (Seyffert 2001). American coots were 1 of 2 wetland bird species I observed with broods which is consistent with previous reports (Seyffert 2001 and Smith 2003).

In the first year of my study, numbers of great blue herons were fairly evenly distributed for fall and spring; however in 2005 their numbers were far greater in the fall than in the spring of that year. The later observation is similar to previous reports from this area (Seyffert 2001).

Cattle egrets were first observed in the Texas Panhandle in September of 1966 (Seyffert 2001) and were first observed on my survey routes in the fall of 2004 with numbers peaking in September. In 2005 they were observed in the spring (March) and remained in my surveys until October. My observations of this species arrival in March differs from previous observations of April 1st as the early arrival date (Seyffert 2001).

The mid-May to early September presence of white-faced ibis and the April through late September presence of black-crowned night-herons that I observed on my 2004 and 2005 surveys are consistent with previous observations (Seyffert 2001). Neither eared nor pied-billed grebes were observed during the spring of 2004. They both were observed that fall with my observations of a September-October peak migration for eared grebes and an August peak for pied-billed grebes consistent with previous accounts. I did not observe any eared grebe broods in 2005, data consistent with previous reports of the southern limits of their breeding grounds being well north of the Texas Panhandle (Seyffert 2001). However, in 2005 I did observe broods of pied-billed grebes in my survey area, an observation not uncommon for this area (Seyffert 2001, Smith 2003). Three species of wetland birds were uncommon visitors so chronology patterns for them could not be established.

Comparisons between my chronology data and that taken previously by other researchers, did not reveal any major shifts in either arrival or departure times. Very minor shifts of either earlier or later arrivals and departures of individual species in my data set could possibly be explained by conditions such as dry or frozen playas occurring at that time. In the two years of my study I found very little variance in seasonal arrival, departure and peak abundance dates on a per species basis from one year to the next. Among groups of waterfowl, (e.g., dabblers and divers), their seasonal arrival, departure and peak abundance dates were similar when compared as a group. This held true for shorebirds as well, but waterbirds when compared as a group showed greater variance in seasonal arrival, departure and peak abundance dates than what I saw in the other three groups.

My study of the chronology and use of playas by waterfowl and wetland birds furthers our

understanding of this important wetland habitat. Waterfowl, shorebird and wetland bird chronology data is vital for habitat planning purposes, establishing population objectives, proper implementation of seasonal management strategies, and for setting hunting season dates. With increasing agricultural development in my study area, further research of the chronology and use of playas by waterfowl, shorebirds and waterbirds will hopefully increase the awareness of both the scientific and public community of the value of playa habitats. Indeed, studies are needed that evaluate the impact of landscape factors on seasonal use of playas by waterfowl and other birds.

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Table 1. Number observed (abundance), percent of total individuals (%), and number of playas used by waterfowl on 58 survey playas in the Texas Panhandle during February 2004 through January 2006. Asterisk indicates the species used playas for breeding.

Species	Common Name	Abundance	%	Playas Used
*Anas acuta**	Northern pintail	81,331	32	57
Anas crecca	Green-winged teal	57,587	22	55
*Anas platyrhynchos**	Mallard	33,104	13	58
Anas americana	American wigeon	21,234	8	52
Branta canadensis	Canada goose	15,380	6	23
*Anas clypeata**	Northern shoveler	13,069	5	56
Chen caerulescens	Snow goose (lesser)	11,031	4	16
*Anas discors**	Blue-winged teal	7,859	3	53
Aythya americana	Redhead	6,662	3	36
Oxyura jamaicensis	Ruddy duck	3,689	1	29
Aythya valisineria	Canvasback	2,046	<1	21
Anas strepera	Gadwall	1,600	<1	42
Aythya affinis	Lesser scaup	1,184	<1	27
Aythya collaris	Ring-necked duck	1,010	<1	20
*Anas cyanoptera**	Cinnamon teal	736	<1	31
Chen rossii	Ross's goose	41	<1	3
Bucephala albeola	Bufflehead	16	<1	6
Aix sponsa	Wood duck	11	<1	6
Anser albifrons	Greater white-fronted goose	10	<1	2
Lophodytes cucullatus	Hooded merganser	4	<1	1
Bucephala clangula	Common goldeneye	3	<1	1
Anas penelope	Eurasian wigeon	2	2	2
Mergus merganser	Common merganser	1	<1	1

Table 2. Number observed (abundance), percent of total (%), and number of playas used by shorebirds on 58 survey playas in the Texas Panhandle from February 2004 through January 2006. Asterisk indicates the species used playas for breeding.

Family	Species	Common name	Abundance	%	Playas Used
Charadriidae	*Pluvialis squatarola*	Black-bellied plover	17	<1	5
	Charadrius melodus	Piping plover	3	<1	1
	Charadrius semiplamatus	Semipalmated plover	4	<1	1
Recurvirostridae	*Recurvirostra americana**	American avocet	2,230	32	48
	*Himantopus mexicanus**	Black-necked stilt	301	4	19
Scolopacidae	*Phalaropus tricolor*	Wilson's phalarope	1,217	17	33
	Limnodromus scolopaceus	Long-billed dowitcher	914	13	26
	Tringa flavipes	Lesser yellowlegs	458	7	28
	Numenius americanus	Long-billed curlew	212	3	13
	Calidris bairdii	Baird's sandpiper	145	2	13
	Calidris himantopus	Stilt sandpiper	100	1	8
	Calidris minutilla	Least sandpiper	80	1	6

Table 2. Continued.

Family	Species	Common name	Abundance	%	Playas Used
Scolopacidae	*Tringa melanoleuca*	Greater yellowlegs	76	1	15
	Calidris pusilla	Semipalmated sandpiper	61	<1	5
	Bartramia longicauda	Upland sandpiper	38	<1	7
	Actitis macularia	Spotted sandpiper	37	<1	14
	Calidris mauri	Western sandpiper	33	<1	5
	Tringa solitaria	Solitary sandpiper	22	<1	5
	Catoptrophorus semipalmatus	Willet	13	<1	6
	Gallinago gallinago	Common snipe	6	<1	2
	Limosa fedoa	Marbled godwit	4	<1	2

Table 3. Number observed (abundance), percent of total individuals (%), and number of playas used by wetland birds on 58 survey playas in the Texas Panhandle from February 2004 through January 2006. Asterisk indicates species used playas for breeding.

Family	Species	Common name	Abundance	%	Playas Used
Podicipedidae	*Podilymbus podiceps**	Pied-billed grebe	69	1	21
	Podiceps nigricollis	Eared grebe	53	1	13
Ardeidae	*Nycticorax nycticorax*	Black-crowned night-heron	320	6	23
	Ardea herodias	Great blue heron	109	2	31
	Bubulcus ibis	Cattle egret	106	2	11
	Butorides virescens	Green heron	2	<1	2
	Egretta thula	Snowy egret	1	<1	1
Threskiornithidae	*Plegadis chihi*	White-faced ibis	809	15	32
Rallidae	*Fulica americana**	American coot	2,186	41	41
Gruidae	*Grus canadensis*	Sandhill crane	1,632	31	7
Laridae	*Chlidonias niger*	Black tern	29	<1	8

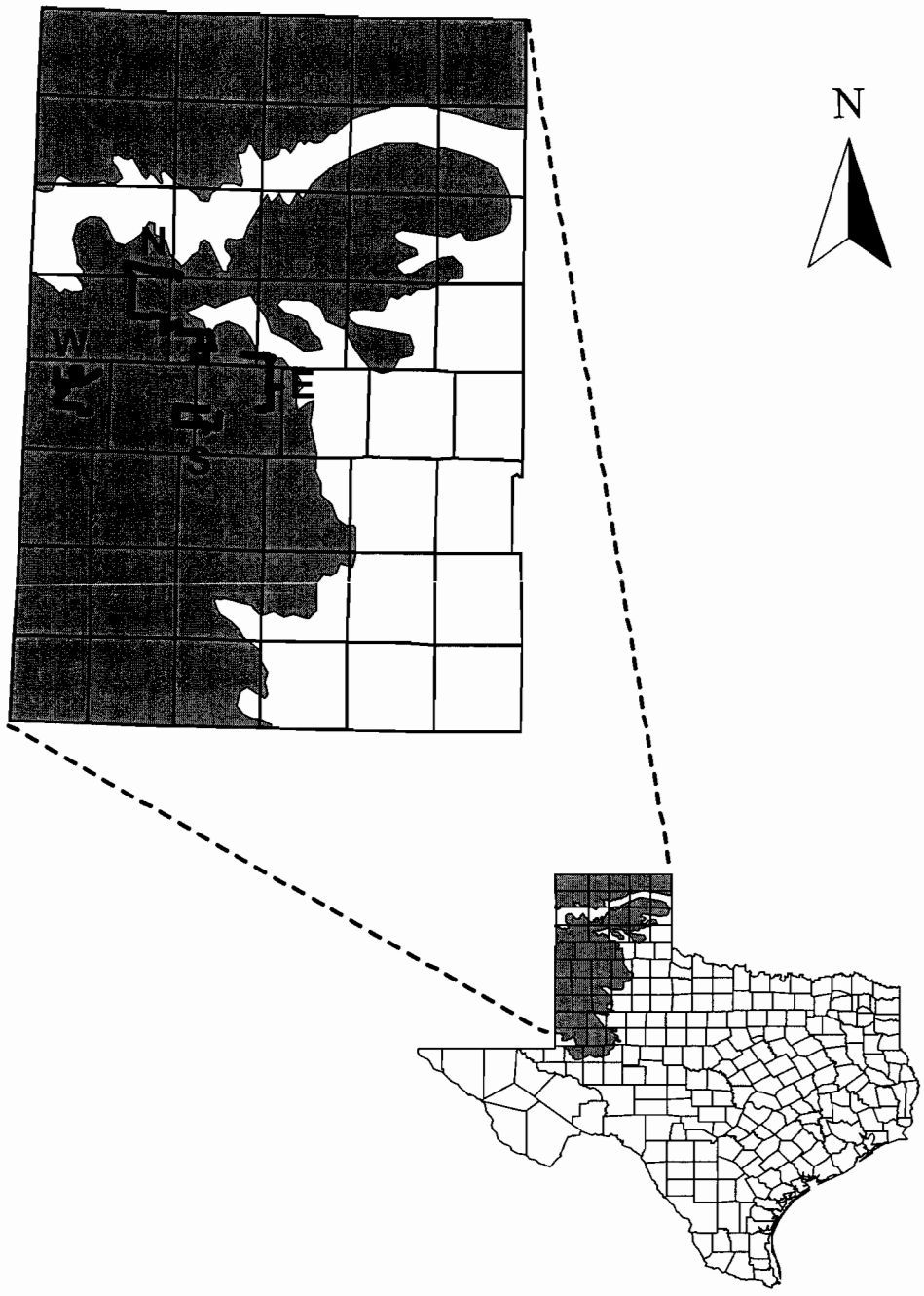

Figure 1. Location of North (N), East (E), South (S), and West (W) playa survey routes in the Southern High Plains ecoregion (shaded grey) of Texas.

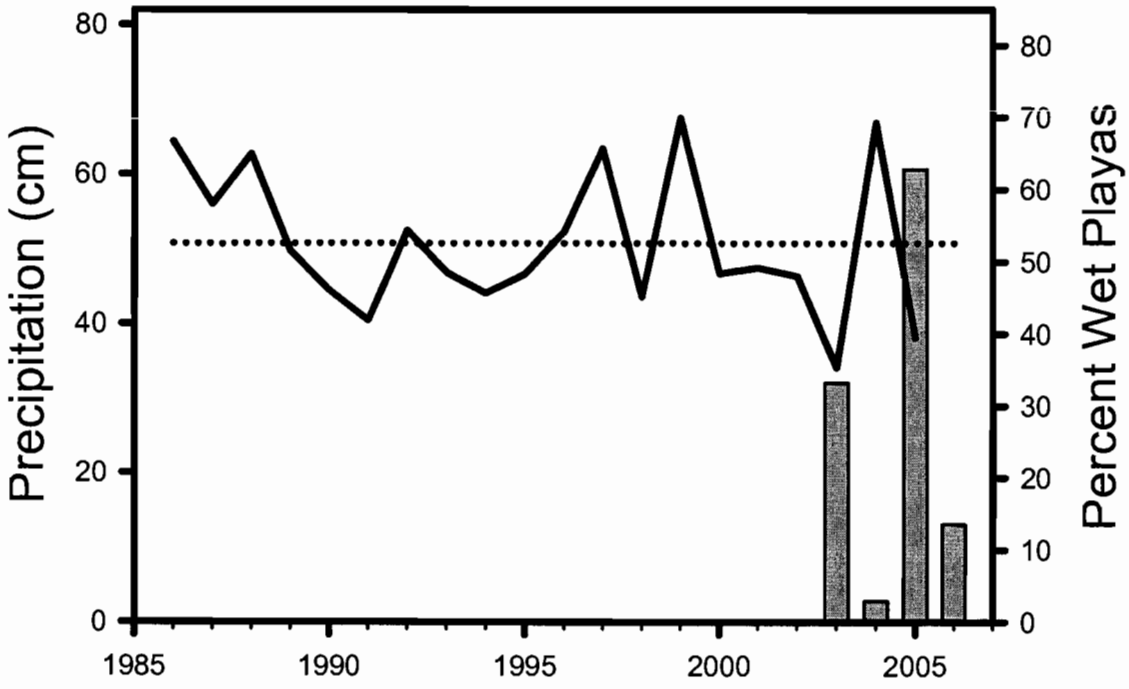

Figure 2. Total amount precipitation (solid line), mean annual precipitation from 1985-2005 (dotted line), for Amarillo, Texas, and percent of playas containing water (bars) during annual mid-winter waterfowl survey conducted by Texas Parks and Wildlife Department, January 2003-2006, in the Texas Panhandle.

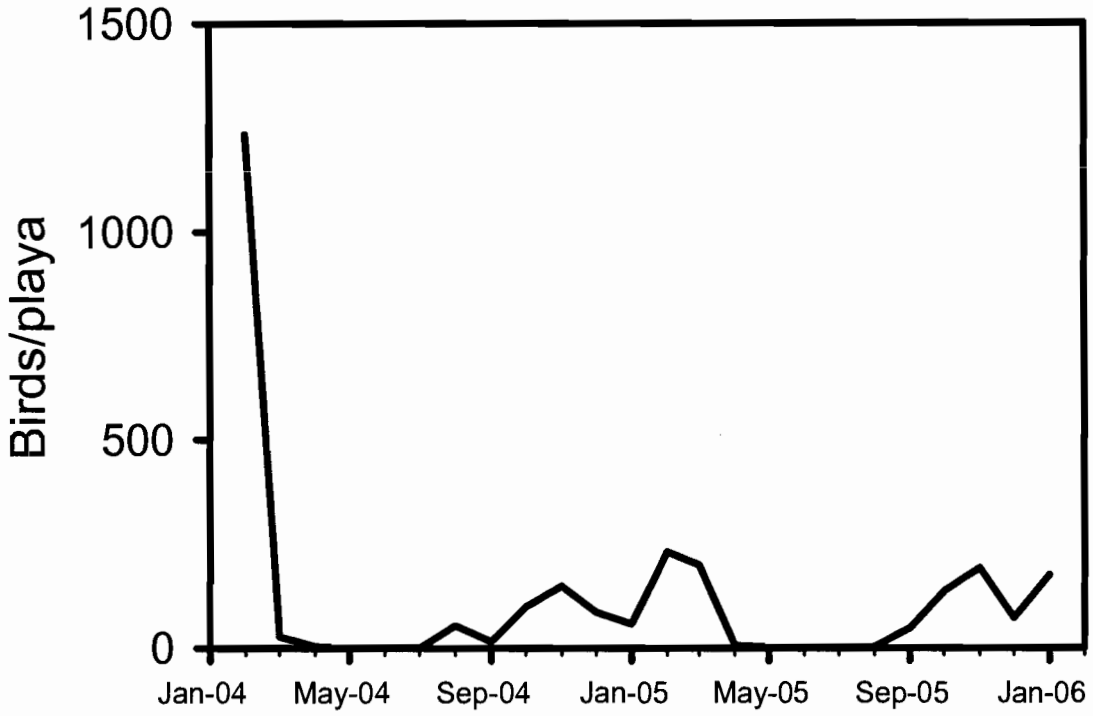

Figure 3. Number of northern pintails (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

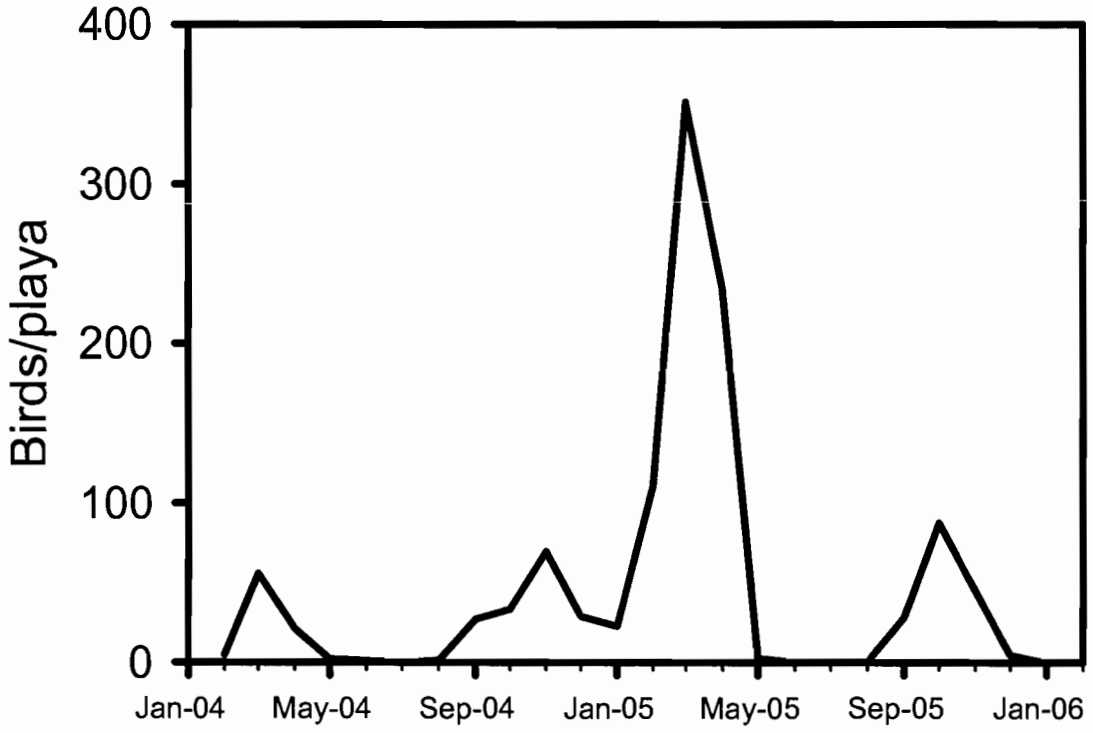

Figure 4. Number of American green-winged teal (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

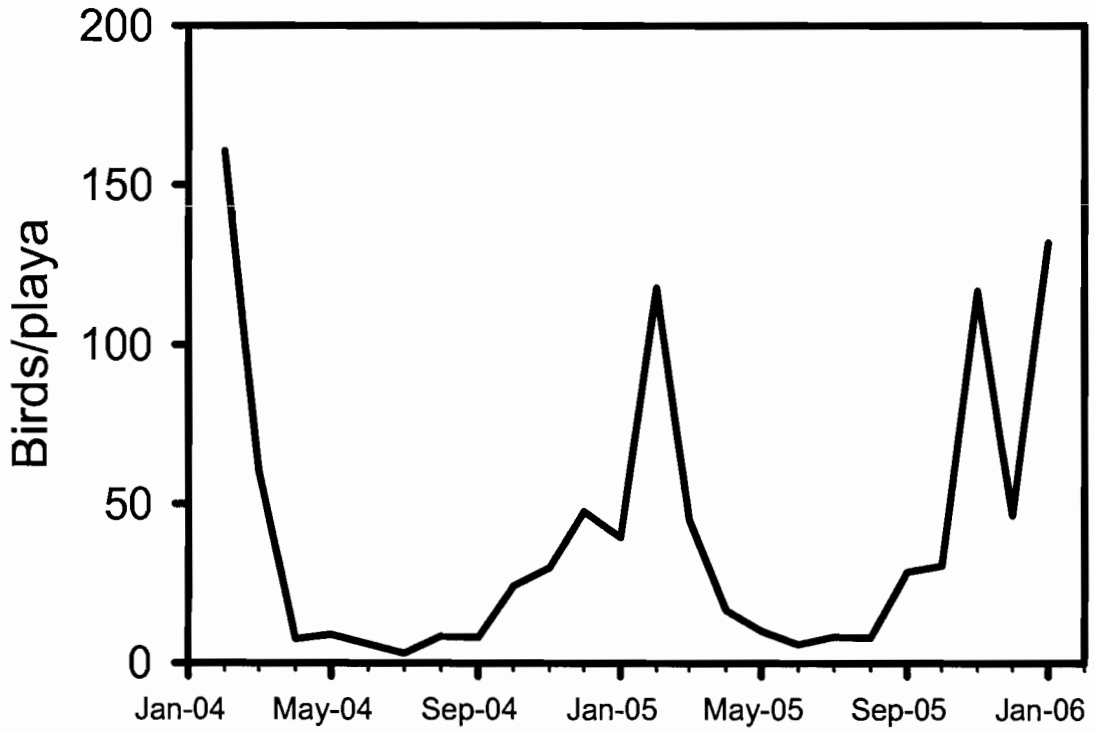

Figure 5. Number of mallards (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

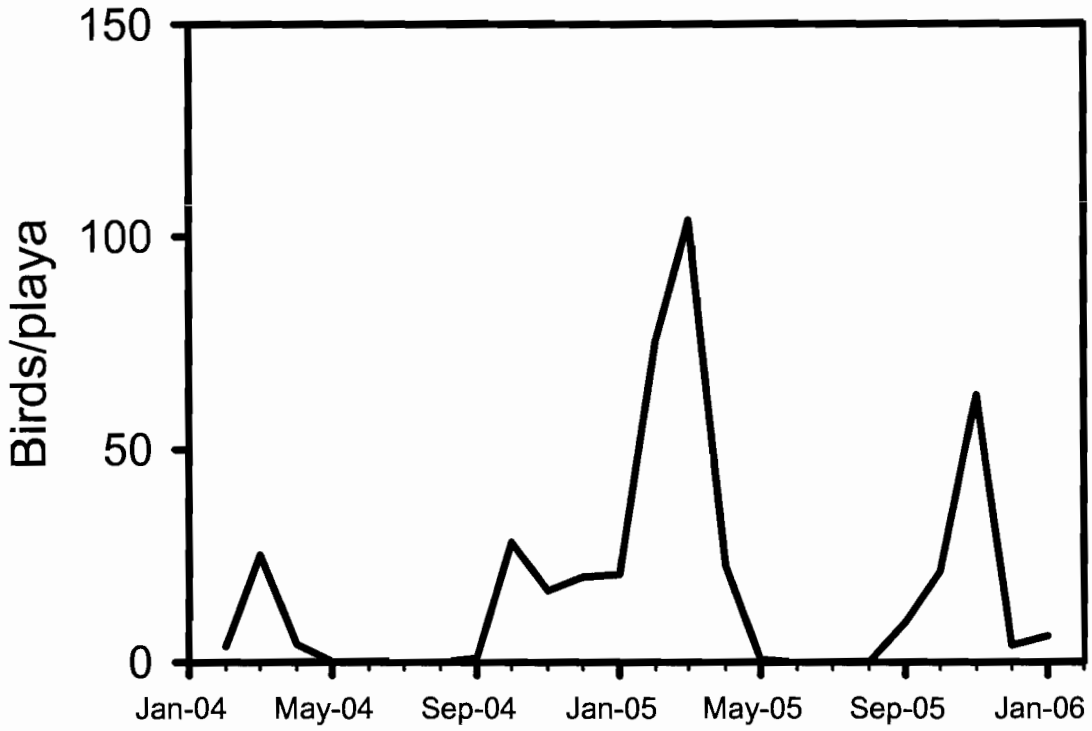

Figure 6. Number of American wigeon (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

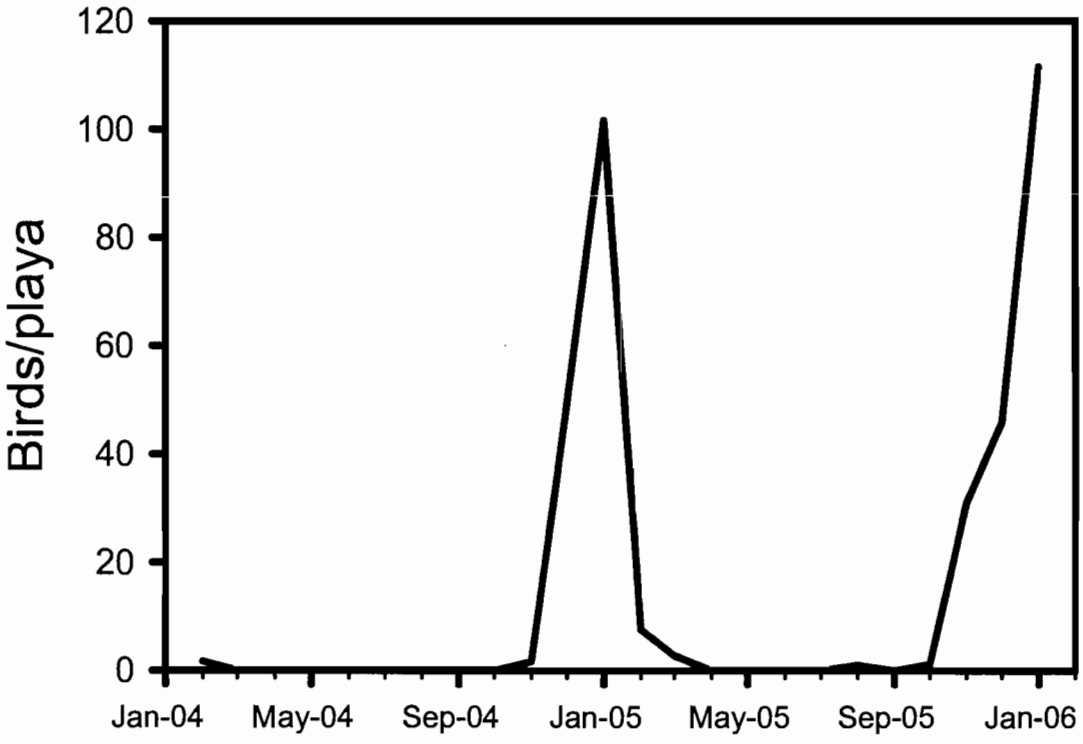

Figure 7. Number of Canada geese (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

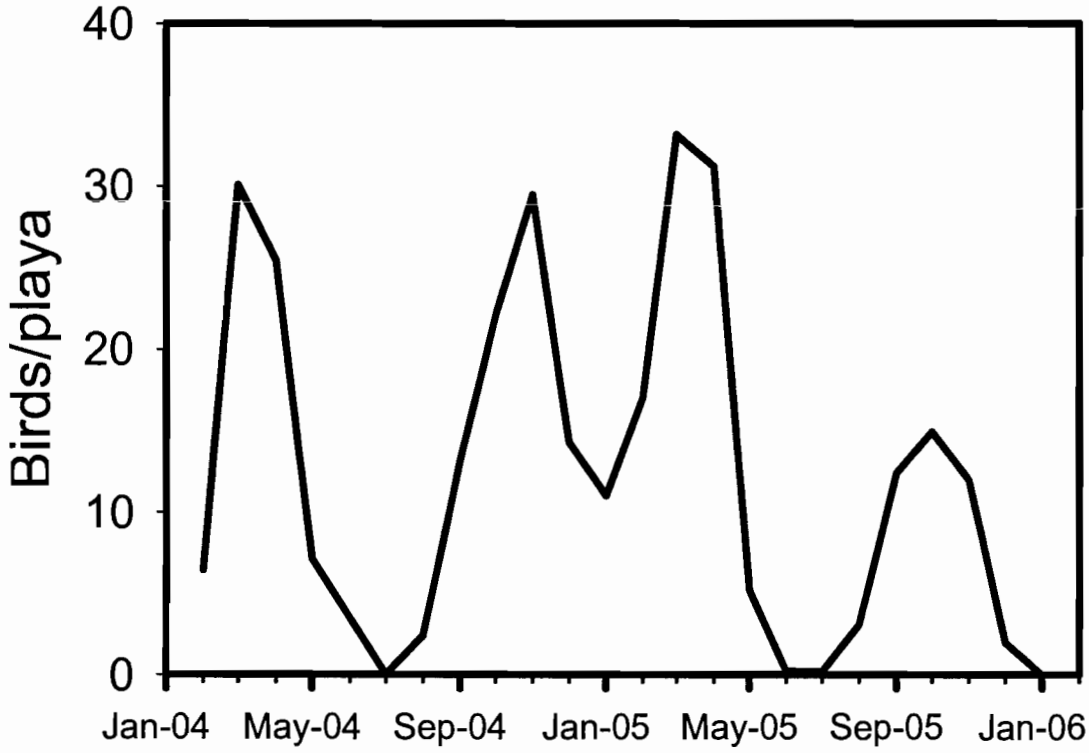

Figure 8. Number of northern shovelers (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

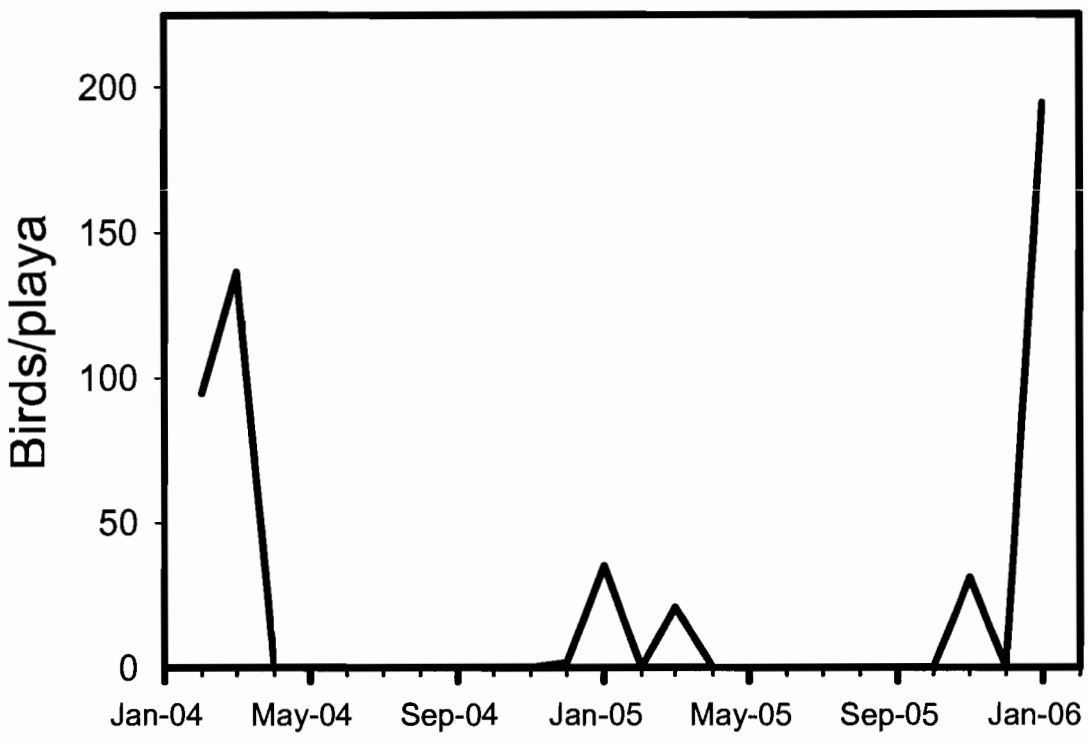

Figure 9. Number of lesser snow geese (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

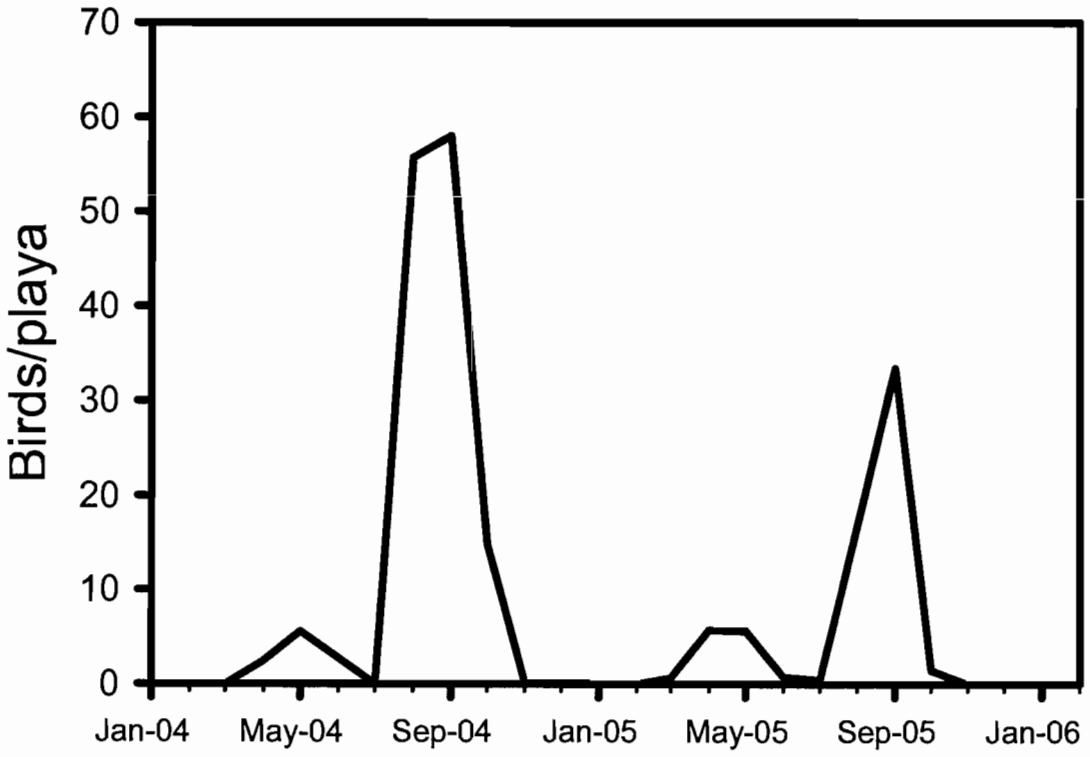

Figure 10. Number of blue-winged teal (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

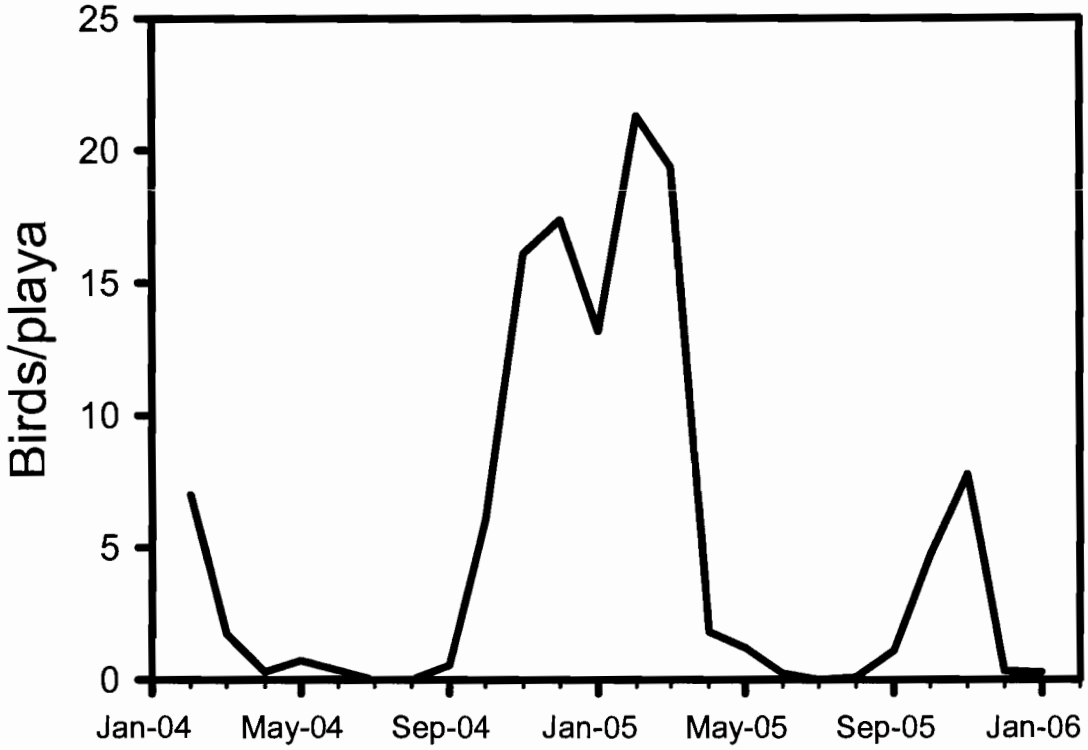

Figure 11. Number of redheads (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

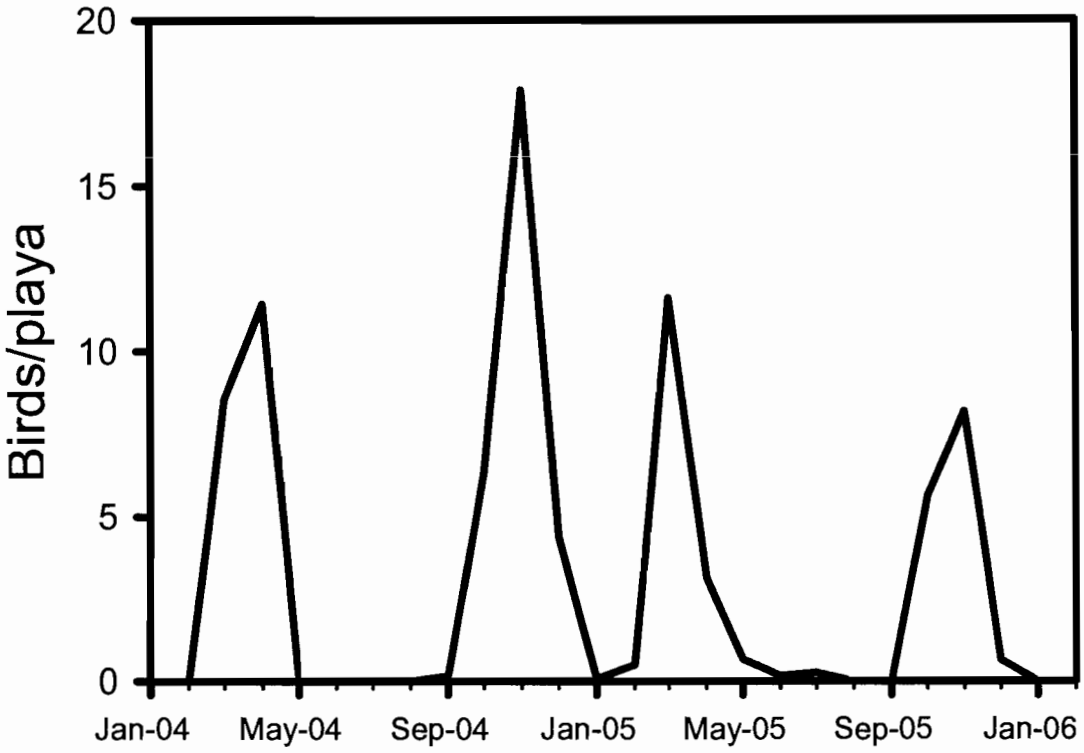

Figure 12. Number of ruddy ducks (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

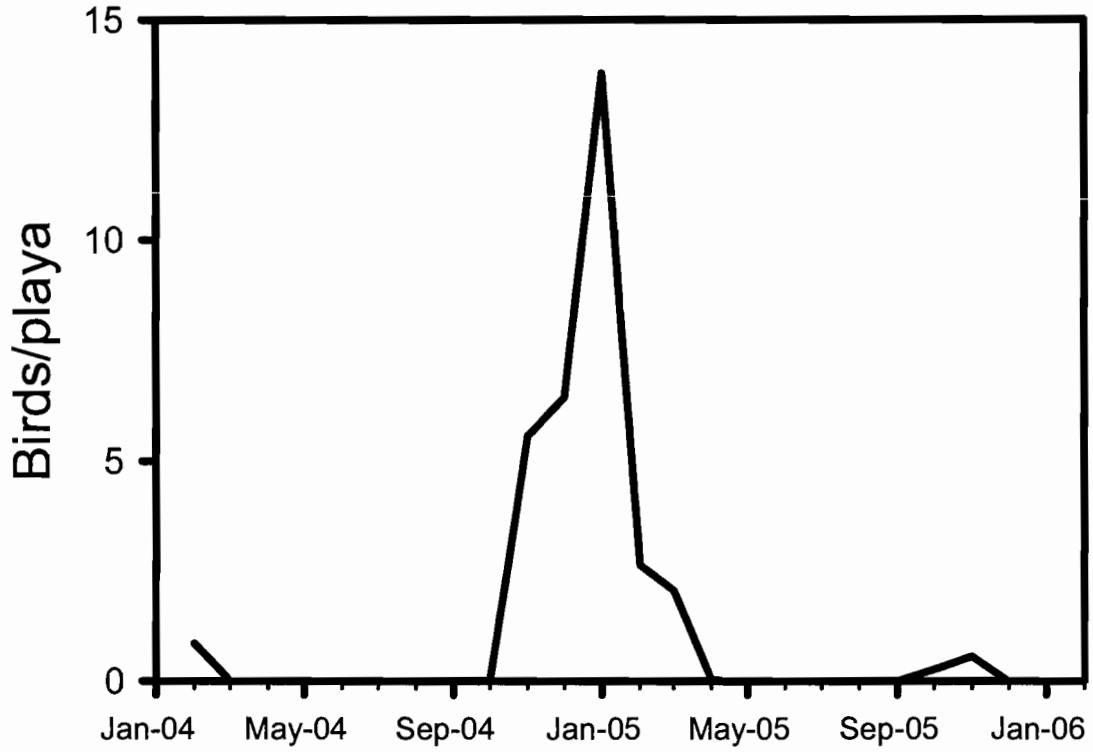

Figure 13. Number of canvasbacks (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

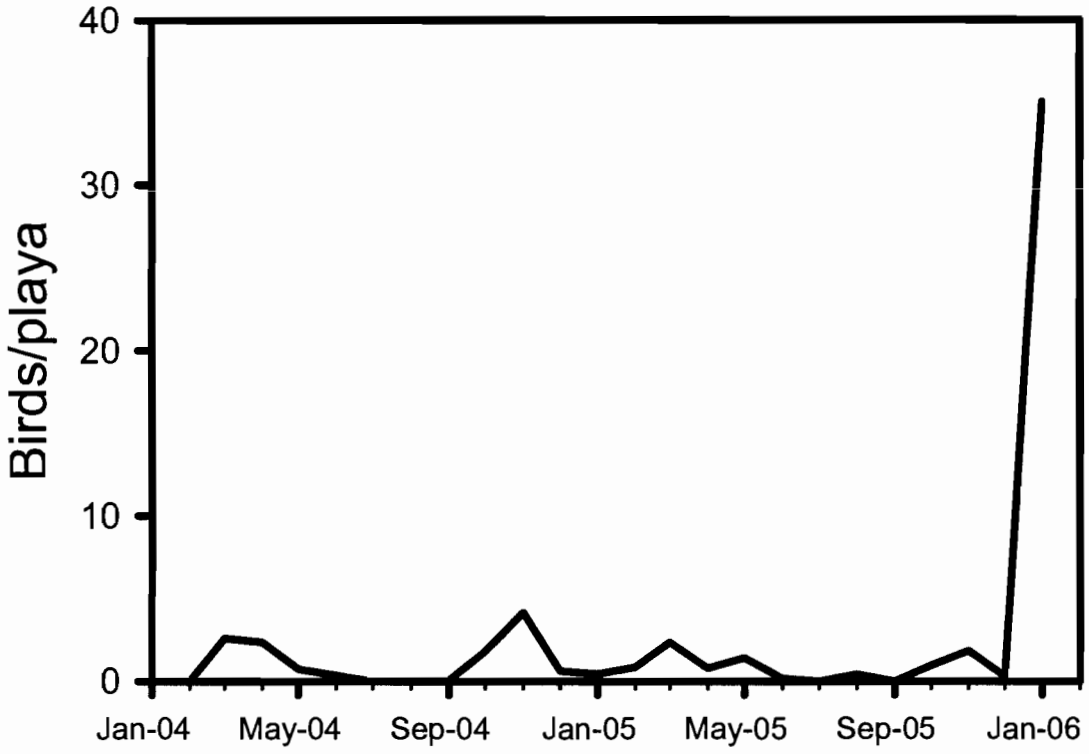

Figure 14. Number of gadwall (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

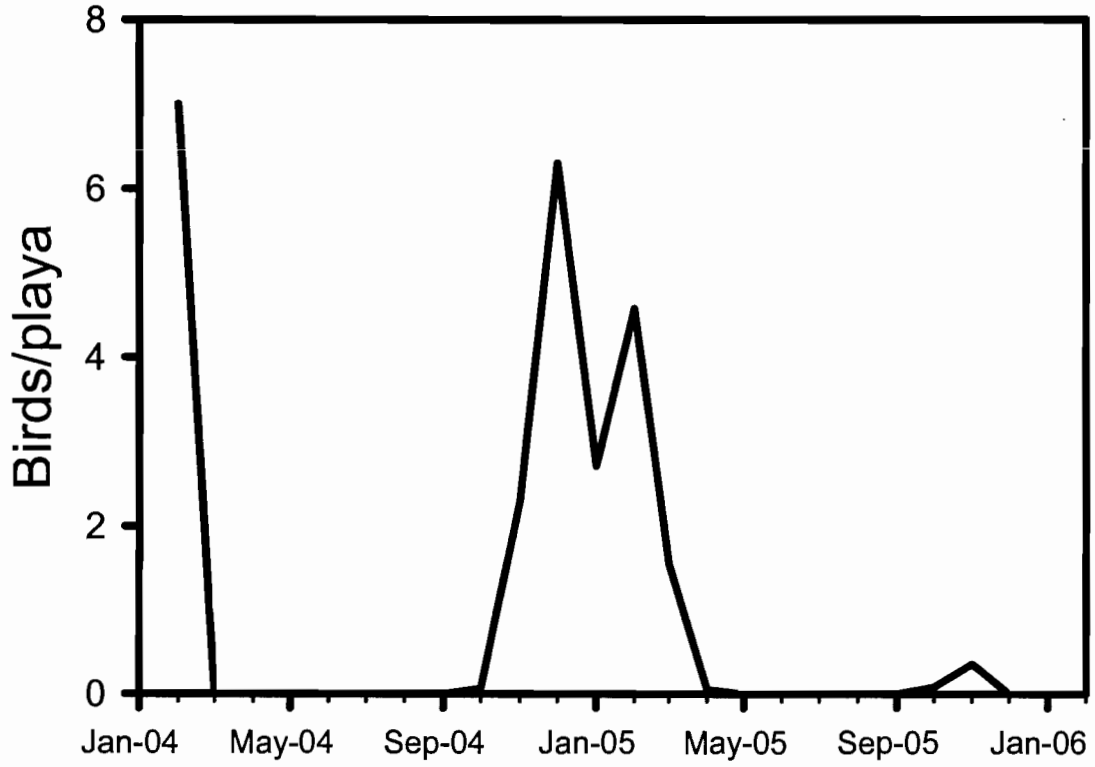

Figure 15. Number of lesser scaup (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

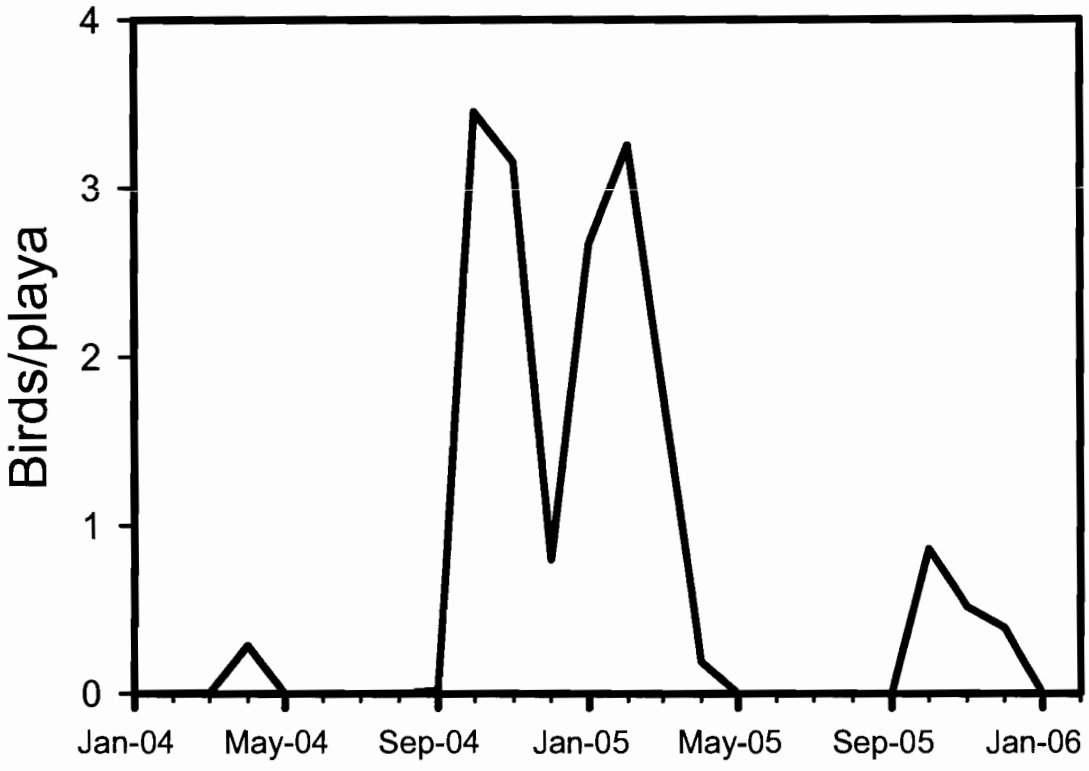

Figure 16. Number of ring-necked ducks (birds/playa) on all 4survey routes in the Panhandle from February 2004 - January 2006.

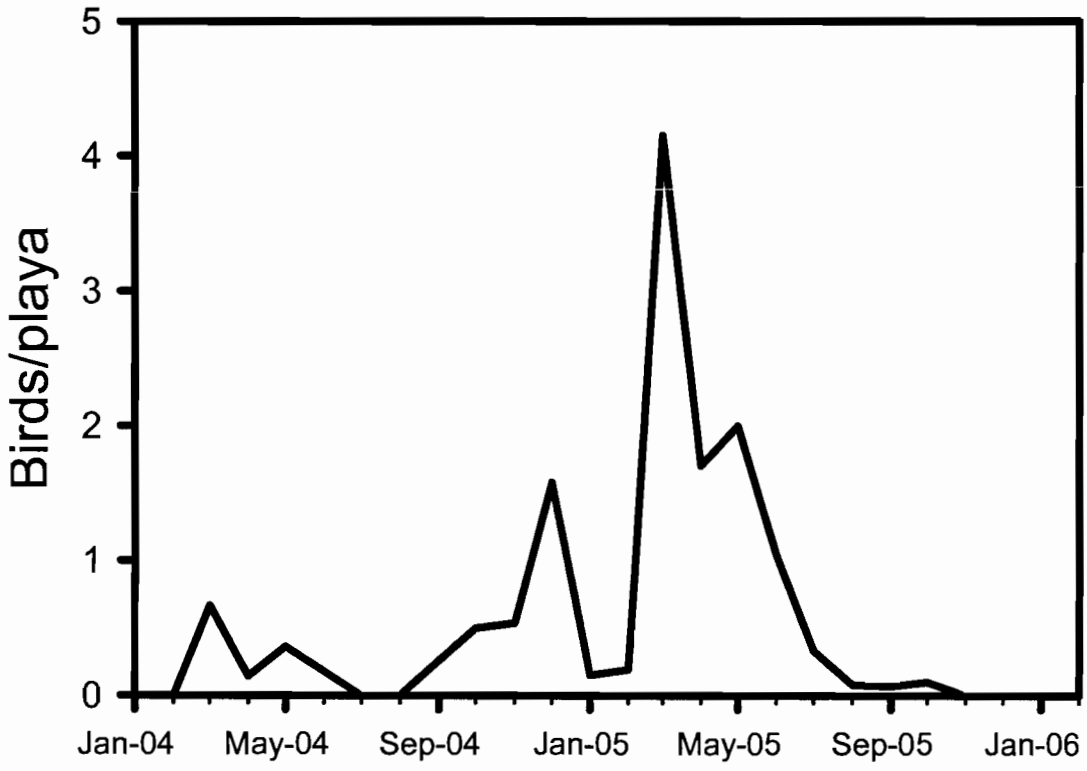

Figure 17. Number of cinnamon teal (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

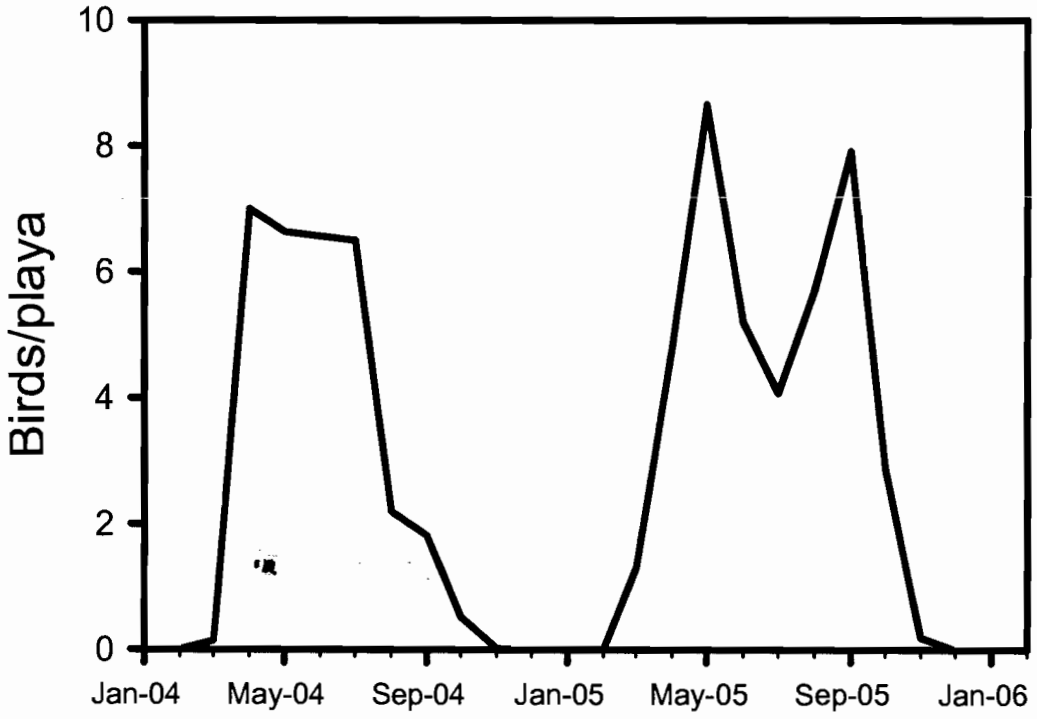

Figure 18. Number of American avocets (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

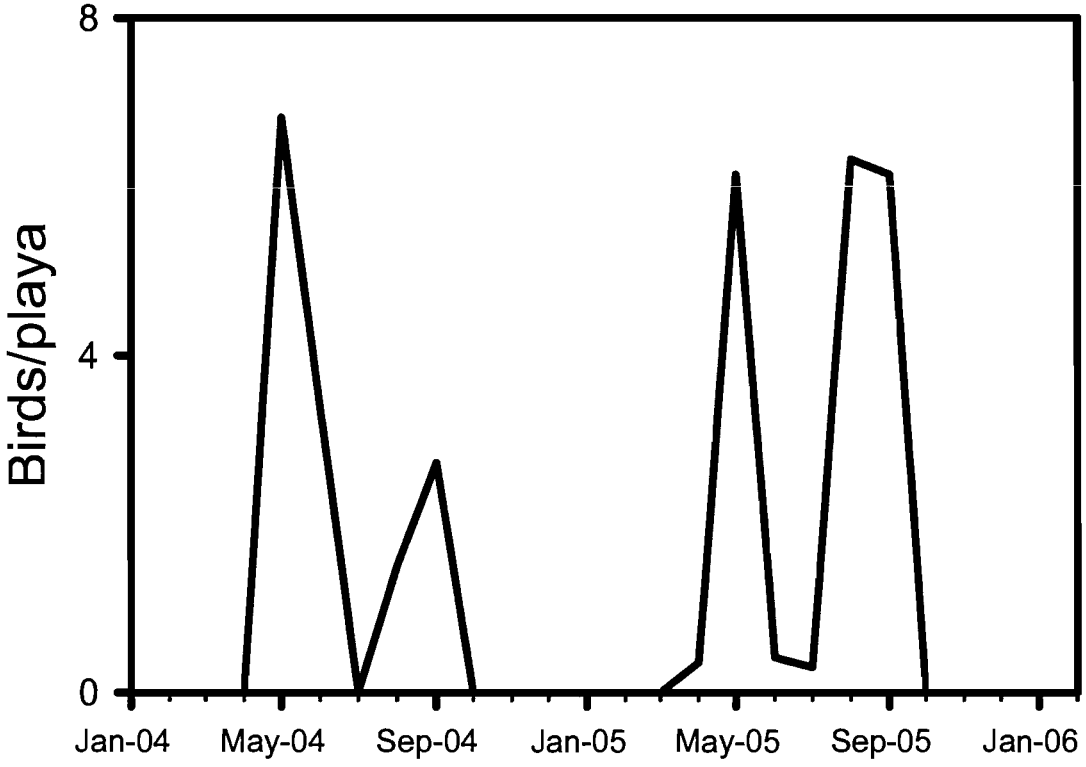

Figure 19. Number of Wilson's phalaropes (birds/playa) on all 4 survey routes in Texas Panhandle from February 2004 - January 2006.

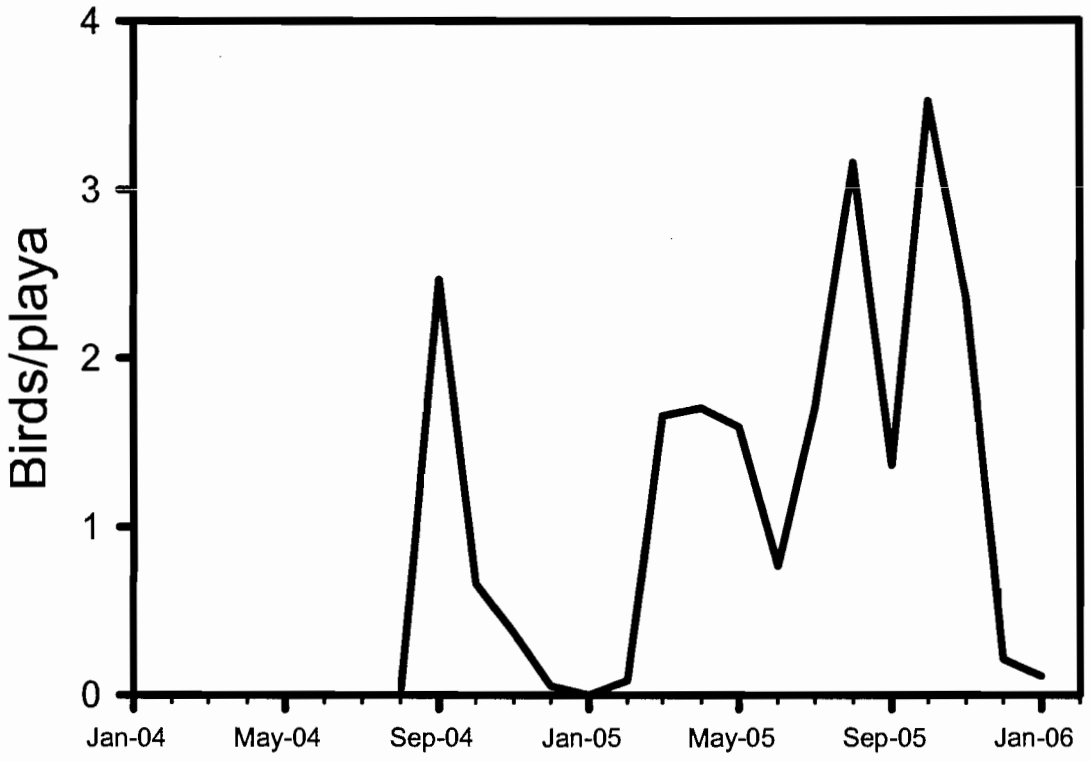

Figure 20. Number of killdeer (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

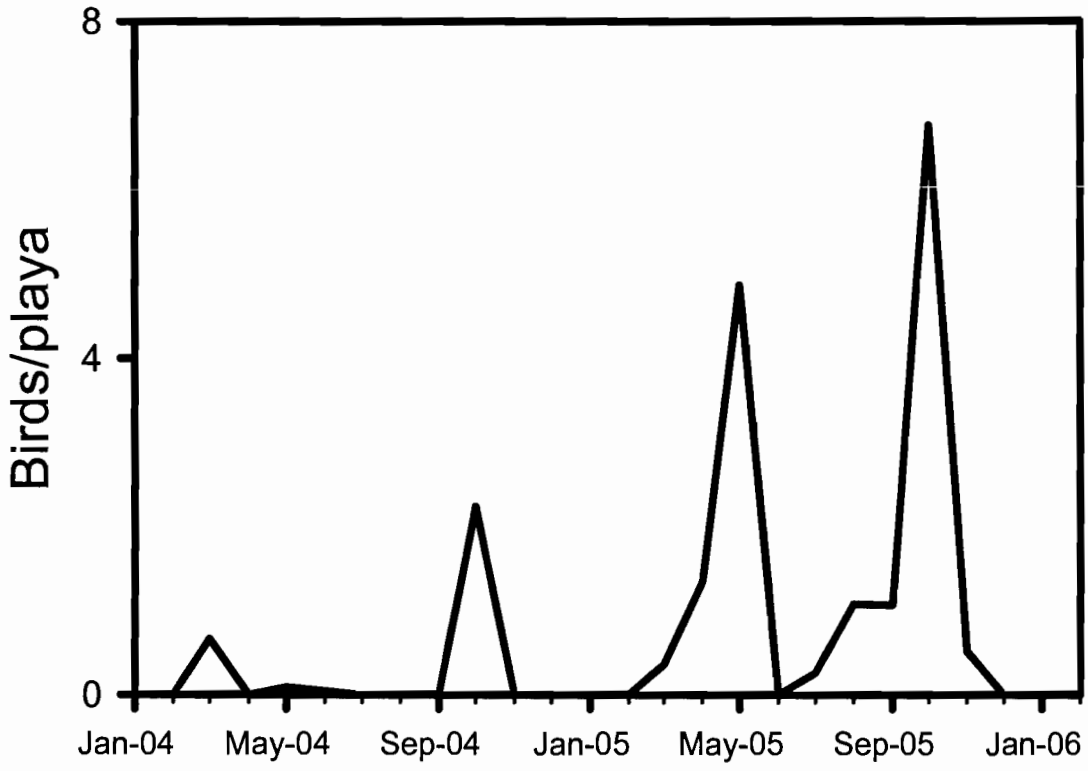

Figure 21. Number of long-billed dowitchers (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

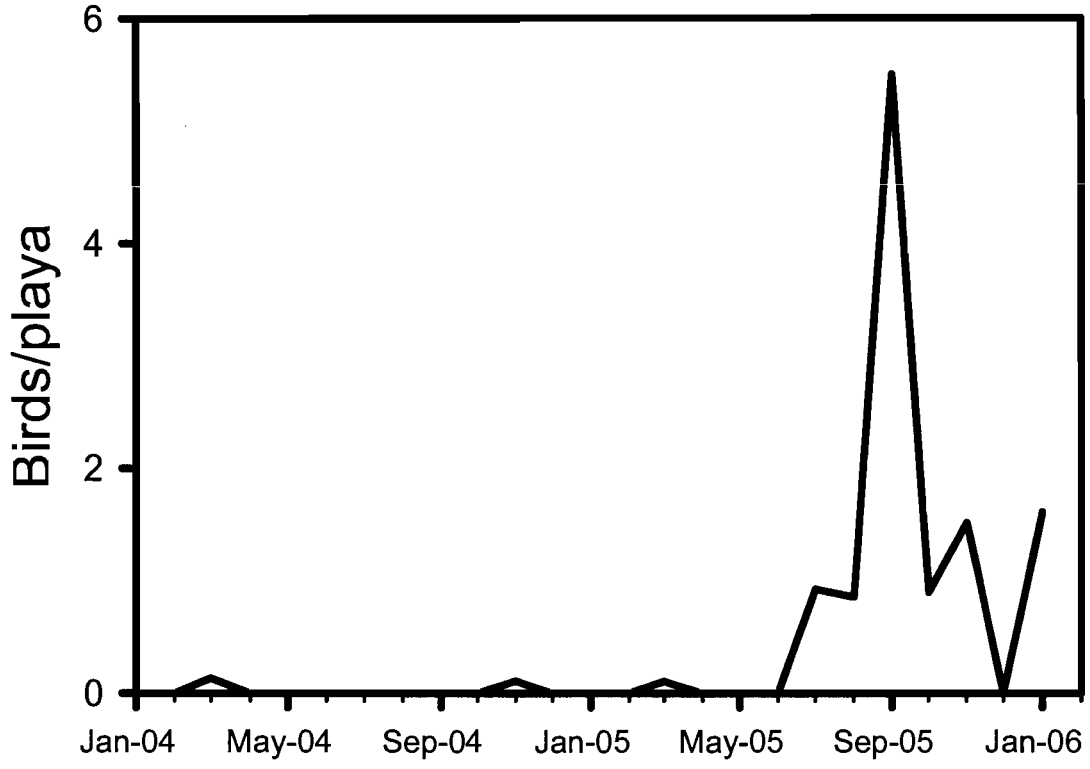

Figure 22. Number of lesser yellowlegs (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

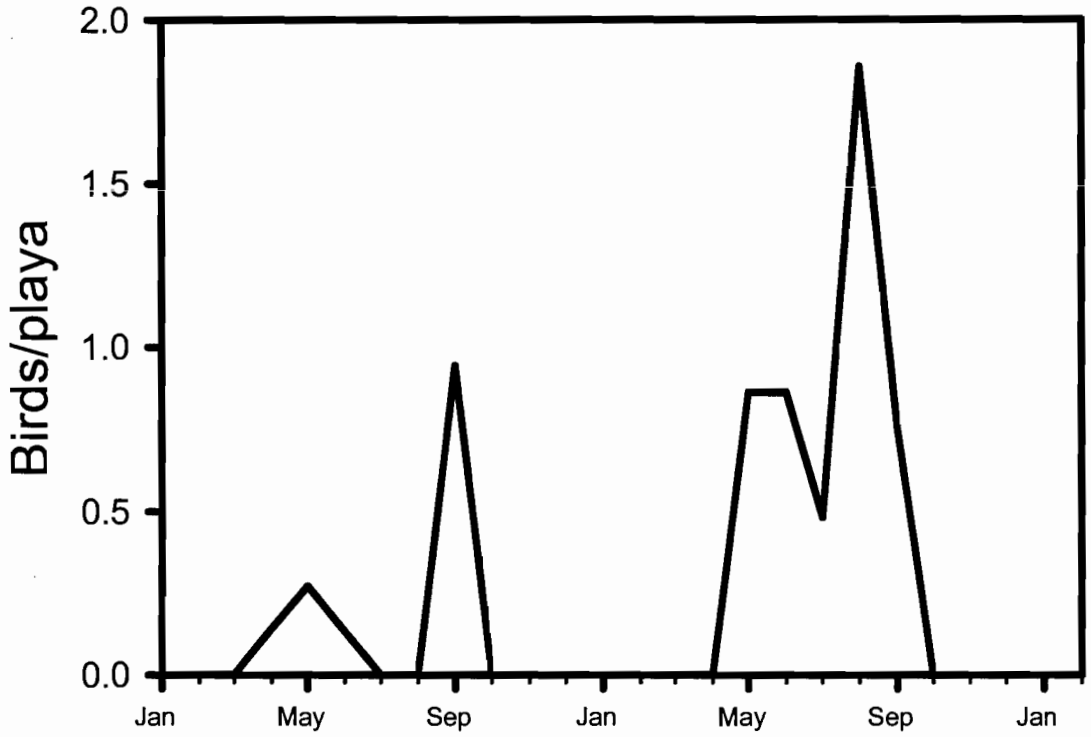

Figure 23. Number of black-necked stilts (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

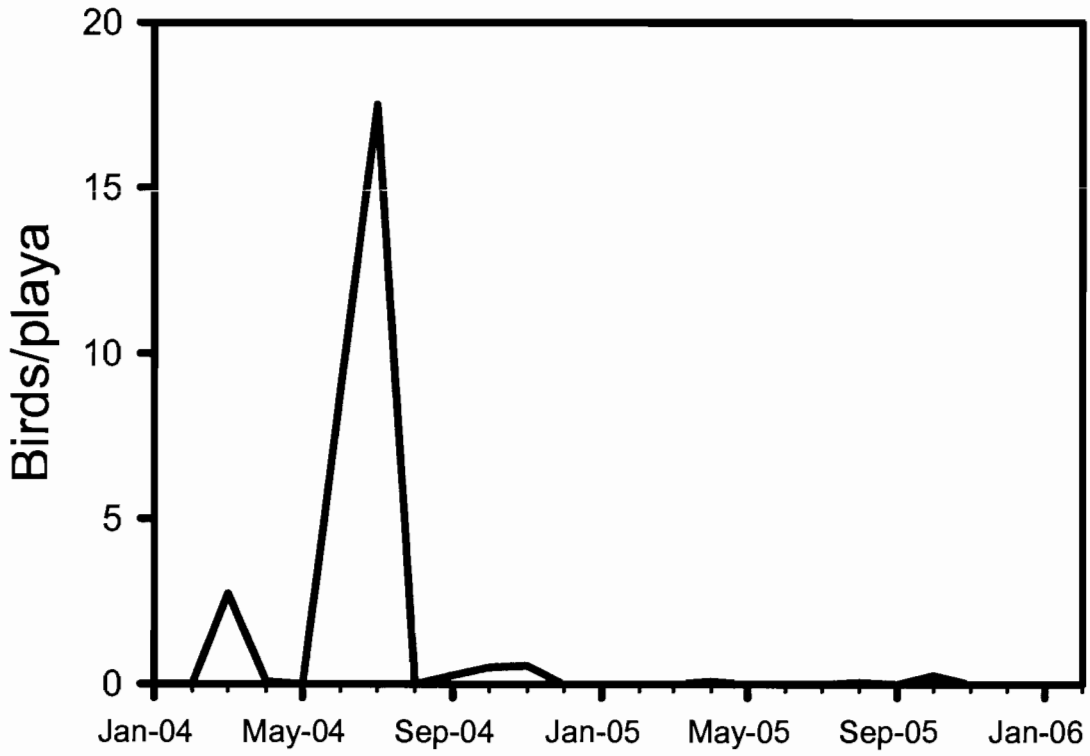

Figure 24. Number of long-billed curlews (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

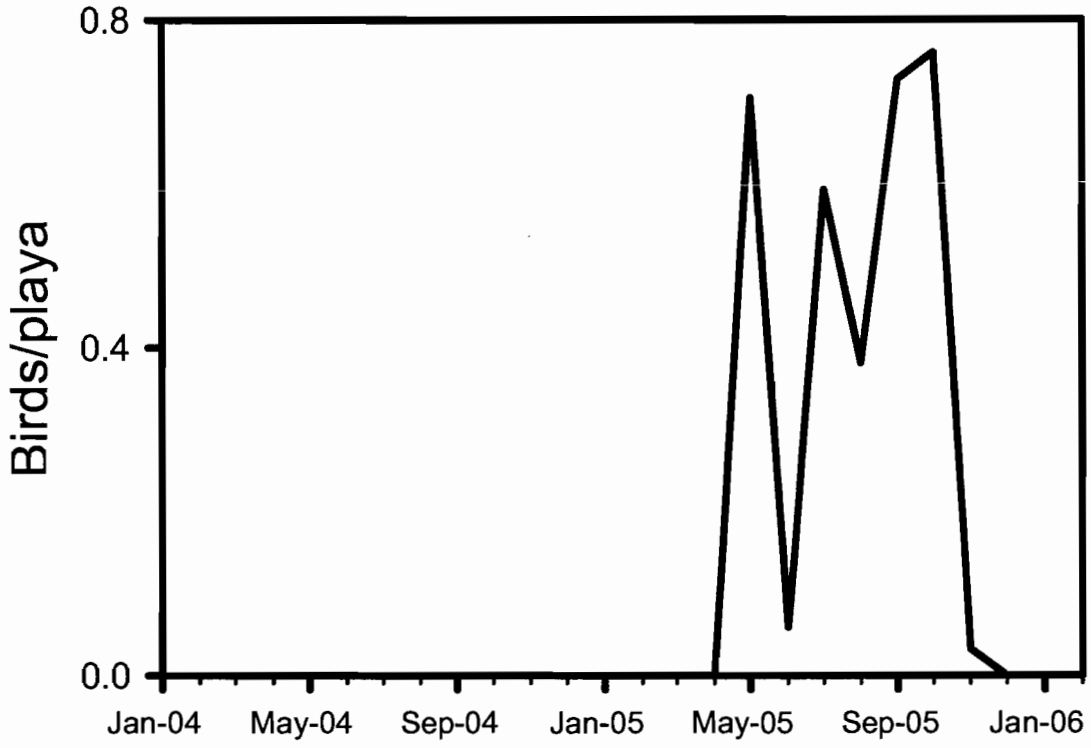

Figure 25. Number of Baird's sandpipers (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

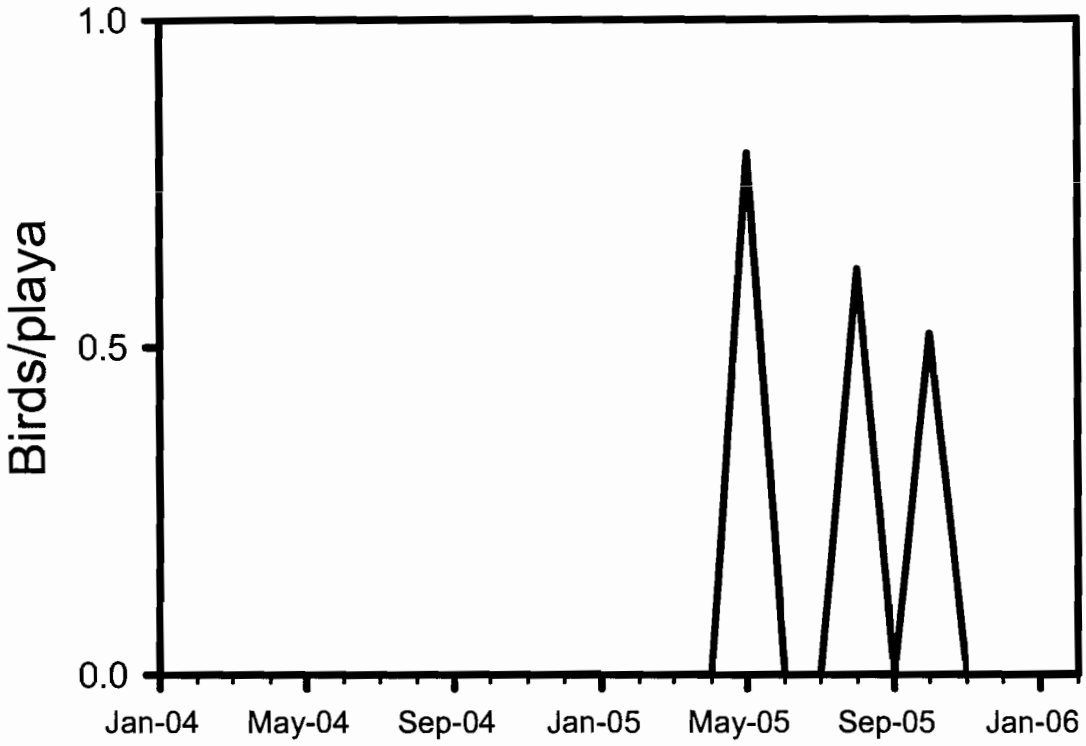

Figure 26. Number of stilt sandpipers (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

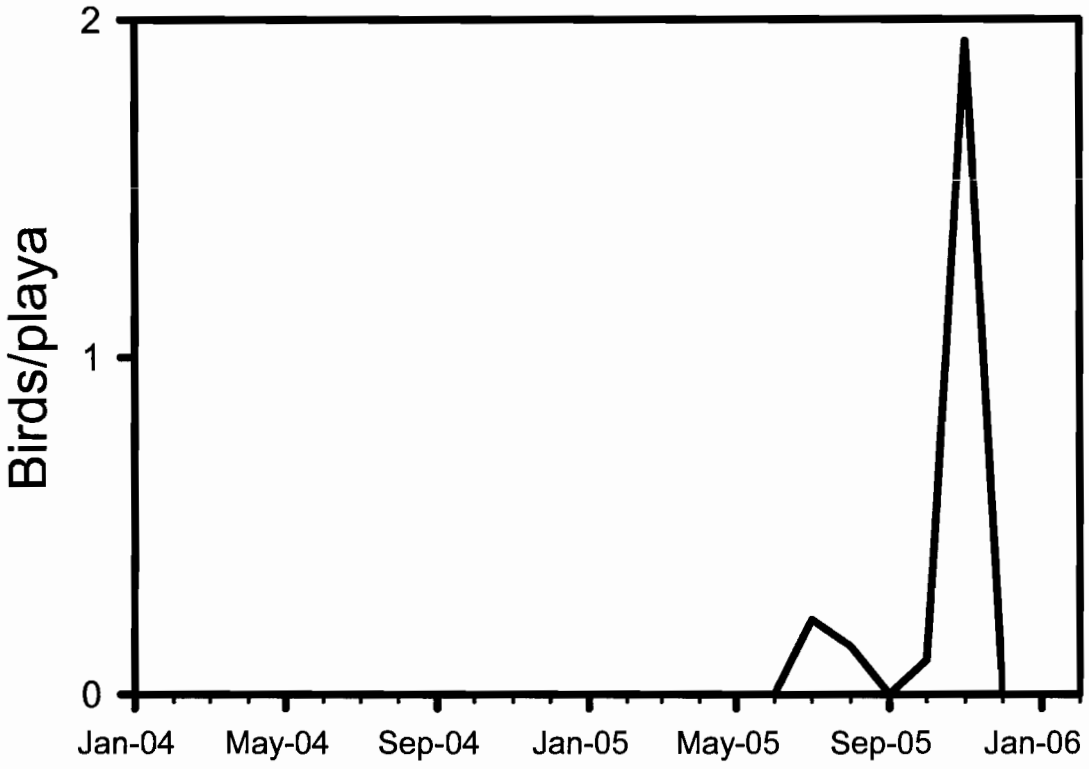

Figure 27. Number of least sandpipers (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

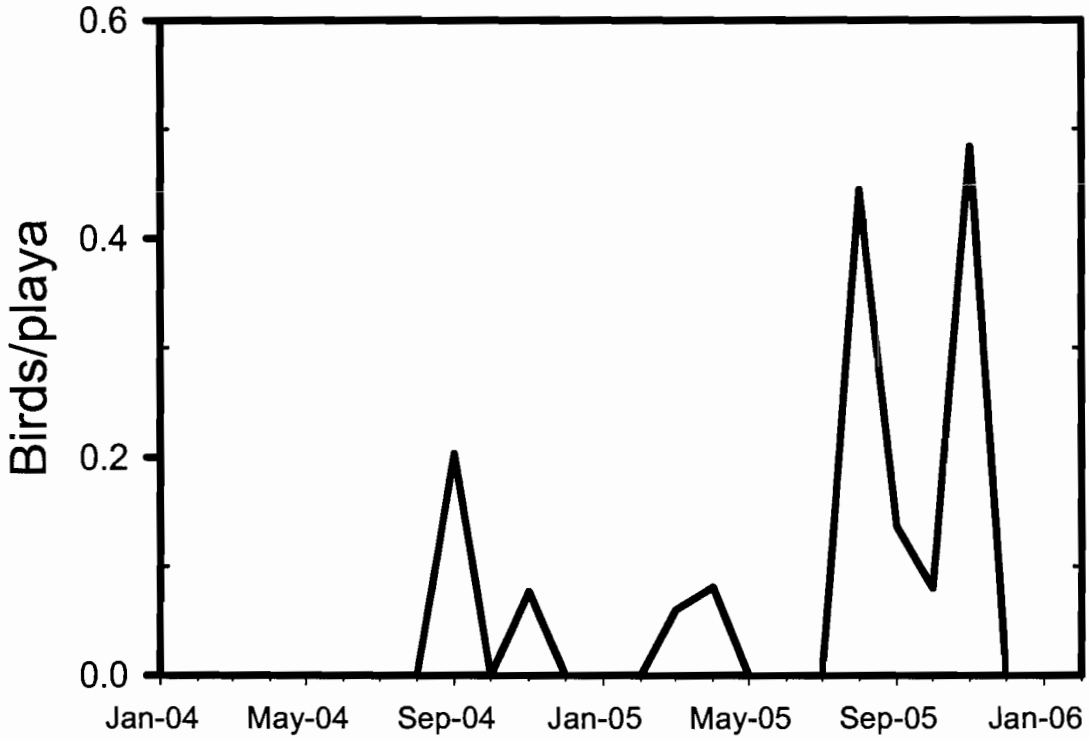

Figure 28. Number of greater yellowlegs (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

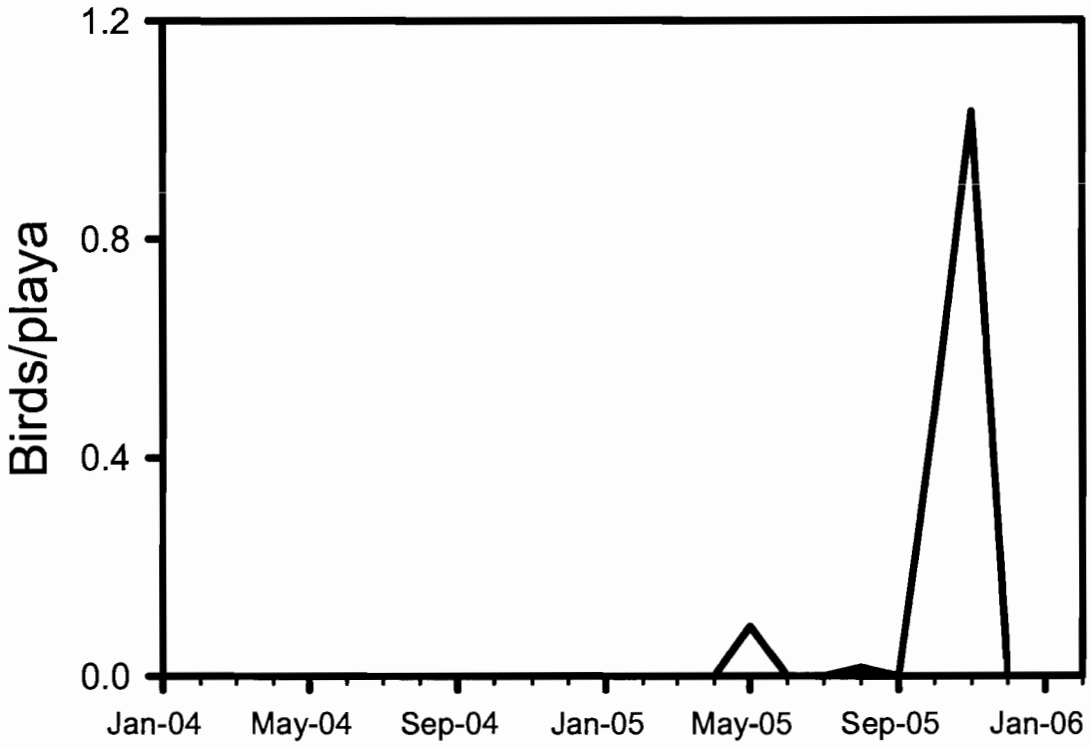

Figure 29. Number of semipalmated sandpipers (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

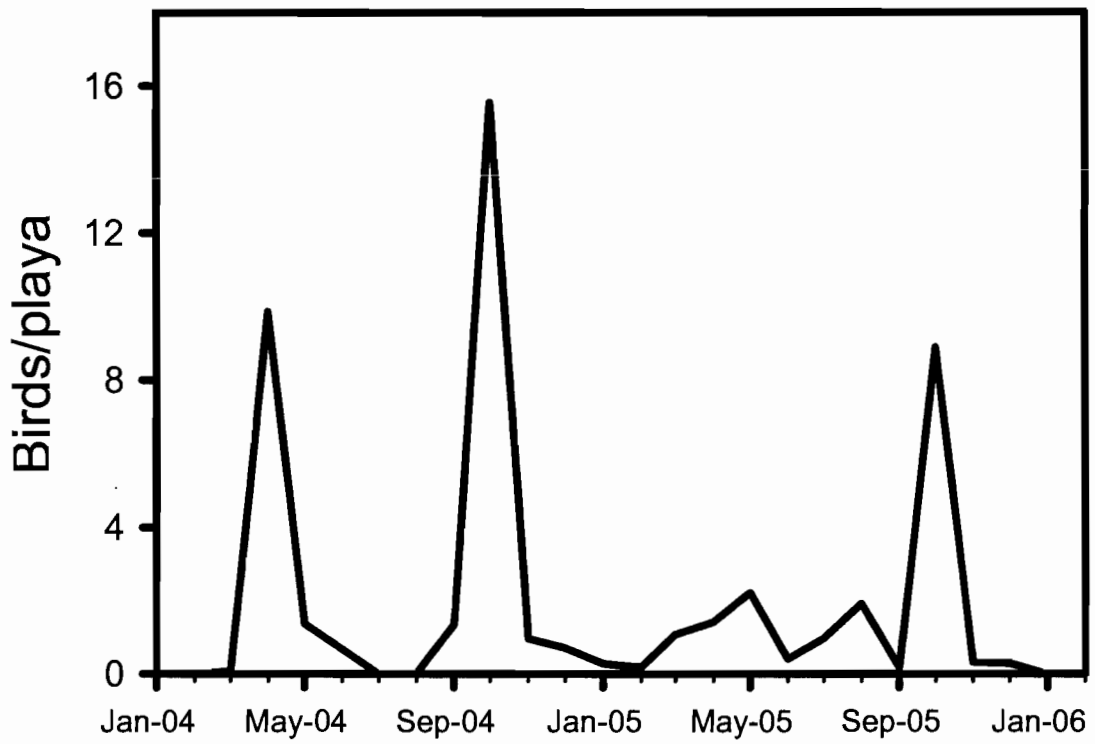

Figure 30. Number of American coots (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

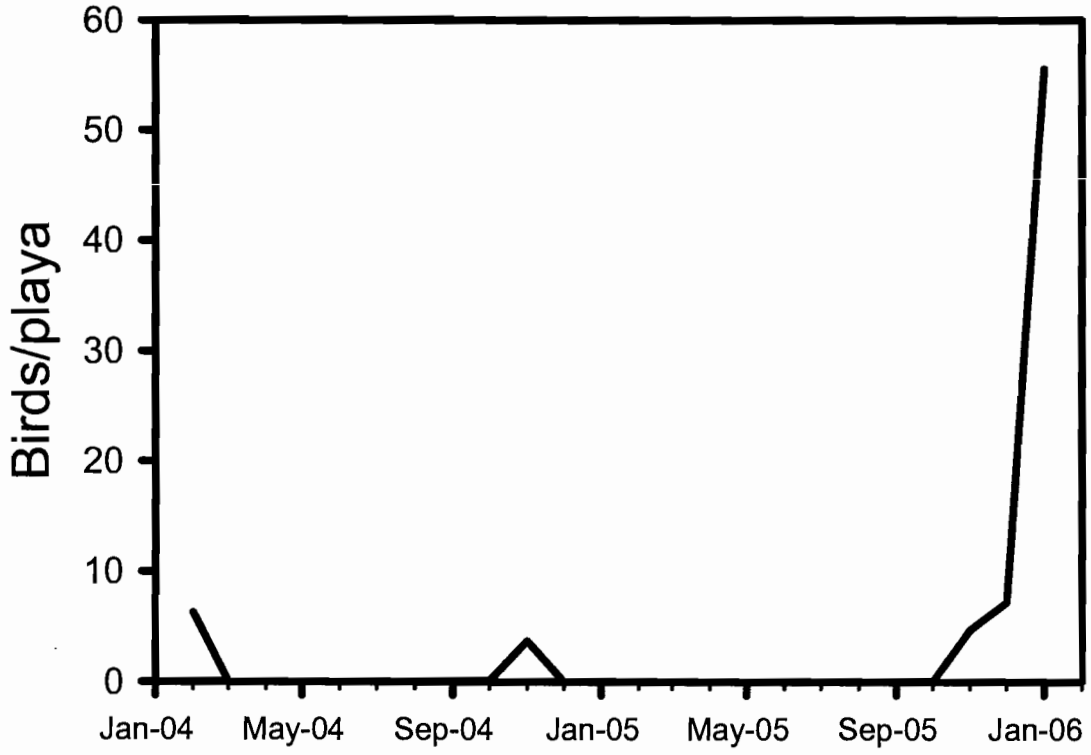

Figure 31. Number of sandhill cranes (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

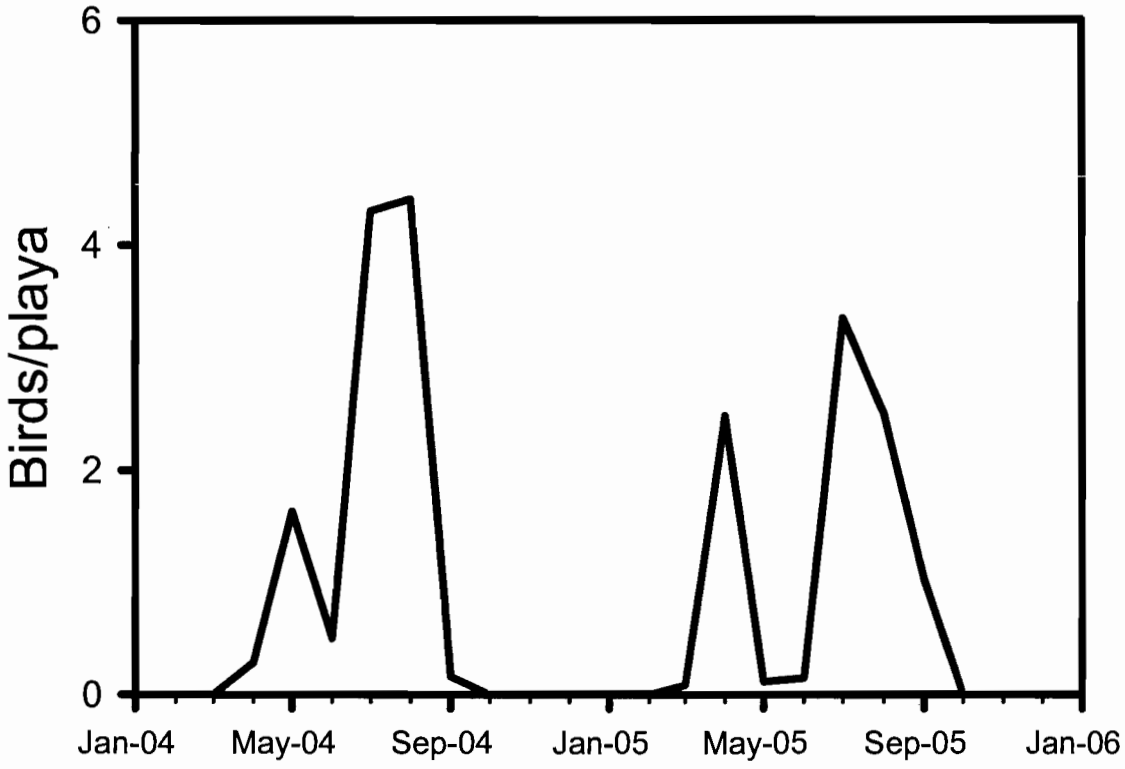

Figure 32. Number of white-faced ibis (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

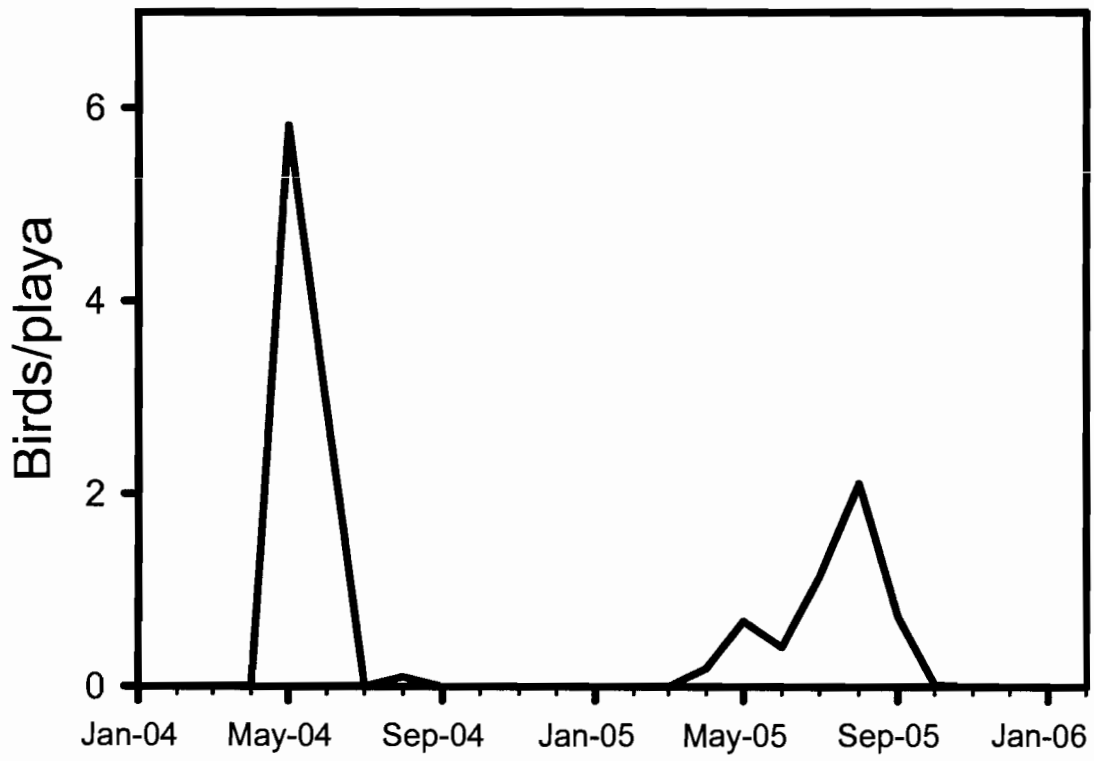

Figure 33. Number of black-crowned night-herons (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

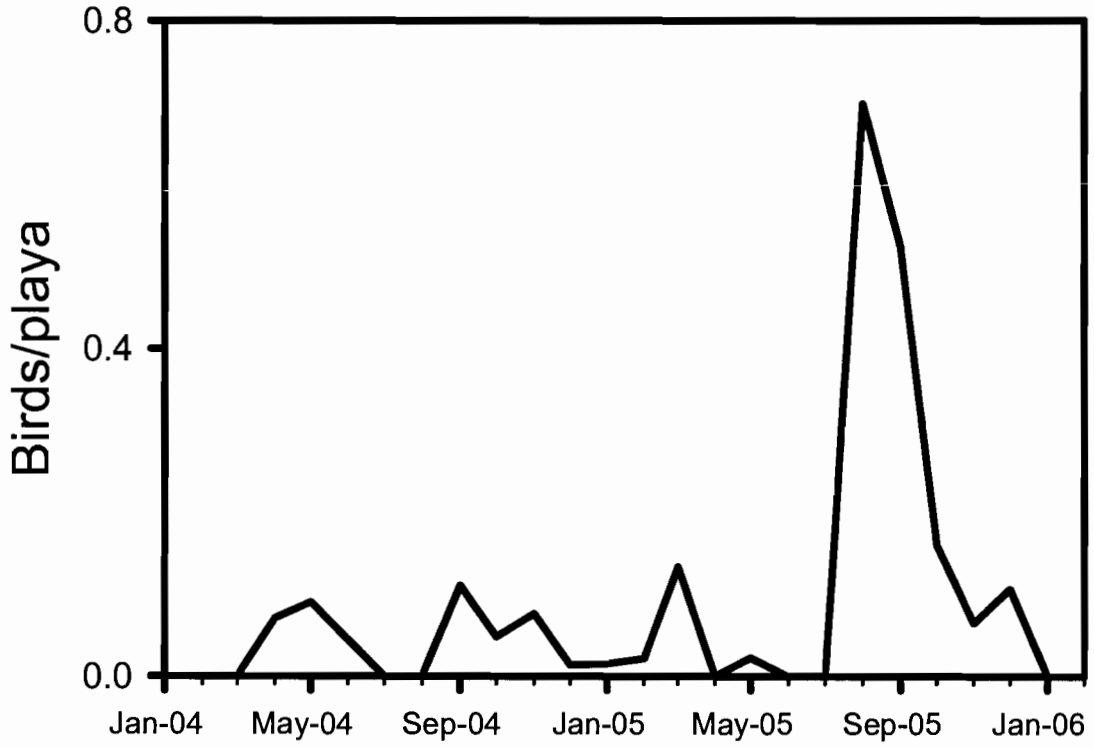

Figure 34. Number of great blue herons (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

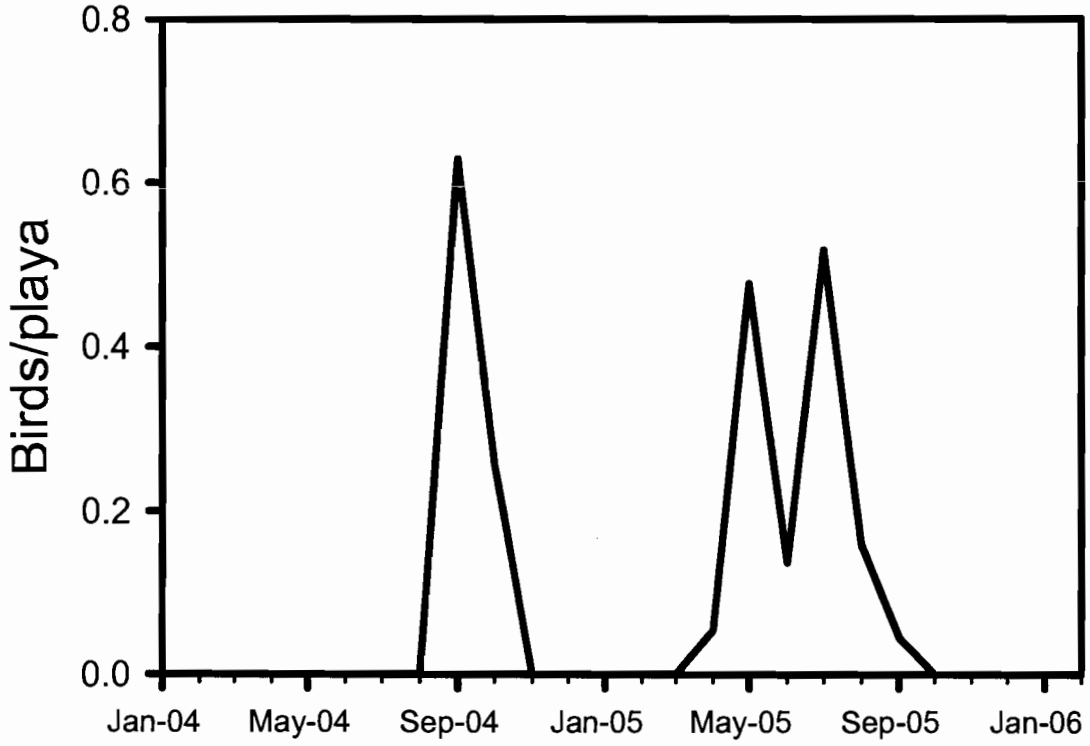

Figure 35. Number of cattle egrets (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

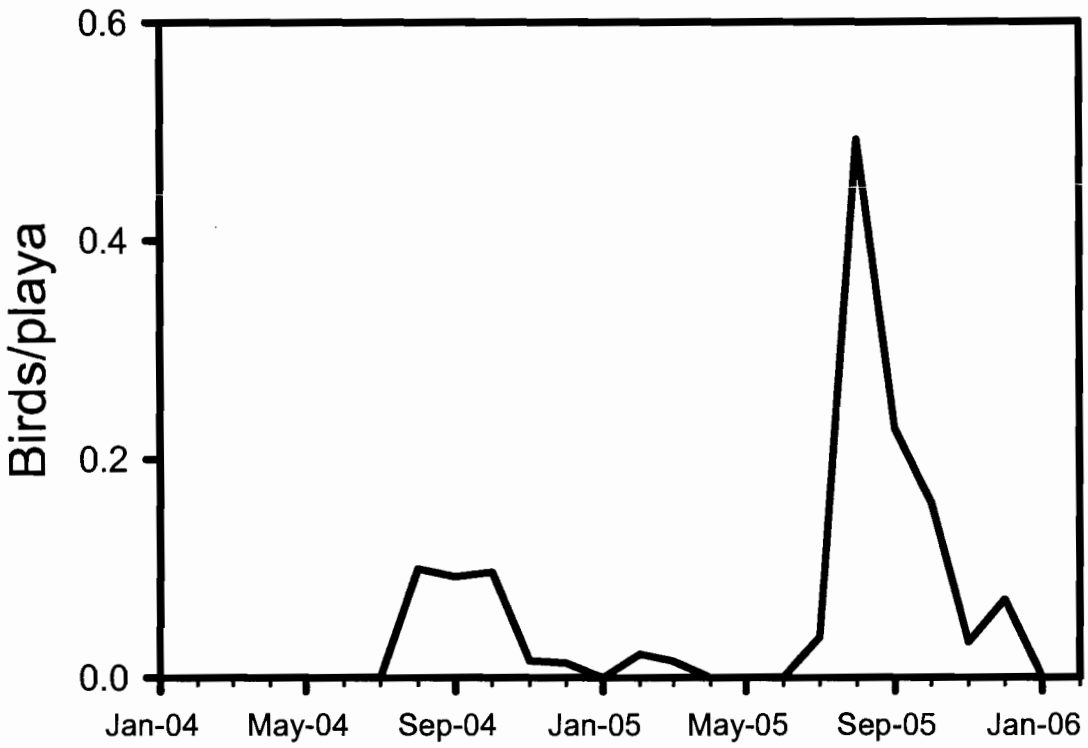

Figure 36. Number of pied-billed grebes (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.

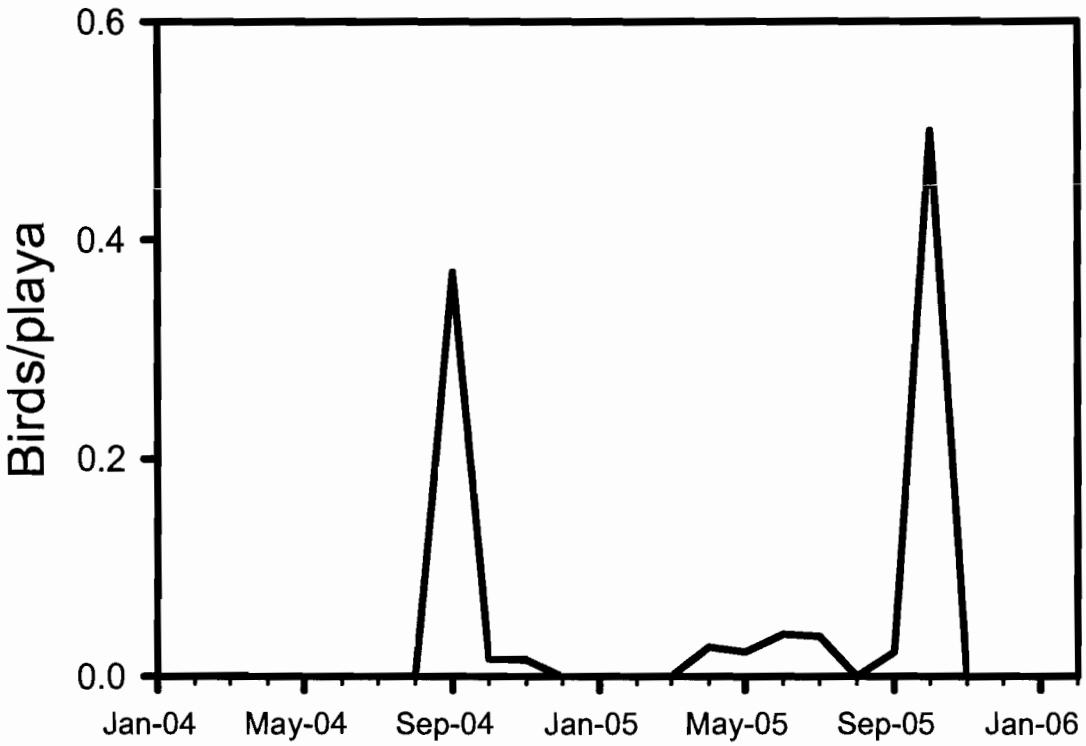

Figure 37. Number of eared grebes (birds/playa) on all 4 survey routes in the Texas Panhandle from February 2004 - January 2006.