ARIZONA COORDINATED BIRD MONITORING PROGRAM PROGRESS REPORT: 2006-2012

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ARIZONA COORDINATED BIRD MONITORING PROGRAM
PROGRESS REPORT: 2006-2012

Troy E. Corman and Edwin A. Juarez
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INTRODUCTION

Arizona's avifauna is particularly rich due to factors such as geography, proximity to tropical influences, and a variety of ecosystems. The number of native or established-introduced bird species documented in Arizona is 555, with over 300 breeding at least occasionally in the state (Corman and Wise-Gervais 2005). Many of these species have a significant portion of their distribution (seasonal or entire) in Arizona, therefore the state has a responsibility in their conservation.

Nationally, the North American Breeding Bird Survey (BBS) and Christmas Bird Count (CBC) have indicated downward trends for many species (NABCI 2009). Expansion of human development has reduced the quantity and quality of bird habitat through fragmentation, alteration, or loss. Widespread drought and drought-induced wildfires, forest insect outbreaks, and the spread of various invasive plant and animal species have had similar negative effects on Arizona's birds and their habitats (NABCI 2014).

The Arizona Bird Conservation Initiative (ABCI) was formed to conserve, monitor, and enhance bird populations and their habitats with the goal of "keeping common birds common." Coordinated by the Arizona Game and Fish Department (Department), ABCI is a voluntary partnership of government agencies, conservation groups, academic institutions, private businesses, and citizens.

NEED FOR ACTION

Many of Arizona's bird species have limited distribution, and thus are poorly monitored by the BBS, CBC, and other large-scale surveys. These surveys do not adequately sample major bird groups, including: 1) species that breed in marsh, riparian, and grassland habitats, 2) Sonoran Desert species that breed earlier or later than when most BBS surveys are conducted, 3) colonial nesting species, and 4) nocturnal species. Existing avian monitoring projects are local in nature, often short or intermittent in duration, and are not coordinated on a statewide level. In addition, there is no central repository for information these monitoring efforts generate. Therefore, biologically important population trend information is lacking for these species. The Department and other land and wildlife managing entities are in need of statewide data to prioritize species of concern and identify distribution, population size, and trends in order to undertake conservation and/or research, evaluate management actions, or modify conservation actions and plans to stabilize or increase populations.

To prioritize bird species that are in need of population monitoring and research in Arizona, an ABCI working group conducted a Monitoring Needs Assessment in 2006. Assessment scores were derived from the Partners in Flight North American Landbird Conservation Plan (Rich et al. 2004) in conjunction with an analysis of Arizona BBS data. The assessment identified 181 priority species, of which approximately 168 should be monitored during the breeding season. Based on this assessment, the ABCI working group adopted a long-term, landscape-scale, multi-species monitoring approach. That approach will: 1) maintain coordination and support for long-term monitoring projects with established protocols (e.g., BBS, CBC), 2) implement or expand monitoring of aquatic species and habitats, particularly colonial nesting waterbirds and marsh birds, and 3) design and implement multi-species monitoring projects addressing terrestrial species and priority habitats. To coordinate this approach, interested ABCI partners, established the Arizona Coordinated Bird Monitoring (AZCBM) Program under the Department's coordination.

Coordinating projects through the AZCBM Program facilitates the pooling of resources (i.e. more economical) to obtain more robust datasets across large landscapes, and the implementation of standardized protocols. Multiple agency support is essential for AZCBM's long-term sustainability and is necessary to achieve many objectives whose outcomes can inform land management agencies on a myriad of decisions and actions.

General objectives of the AZCBM Program for monitored bird species include:

- Determine current population status and detect biologically important trends.
- Determine current distribution and detect future distributional changes.
- Determine seasonal habitat associations.
- Coordinate short-term population monitoring projects to determine the effectiveness of specific management activities.
- Assist in establishing management and conservation priorities.
- Support integration of data into the Avian Knowledge Network.
- Identify new species of concern and refine current Species of Greatest Conservation Need in Arizona (SGCN).

Species-specific surveys will be implemented to monitor populations of rare and locally distributed species, where multi-species protocols may not be suitable.

PROGRAM DIRECTION

Mission

Coordinate an all-bird monitoring program statewide that contributes to informed management decisions for bird conservation and regional and national assessments of bird populations.

Operating Principles

Science - The AZCBM will use the most current and defensible scientific monitoring techniques in order to collect the best data.

Partnerships - Through cooperative planning, information sharing, pooled resources, and collaboration across multiple geographies, all stakeholders are focused on common goals and objectives.

IMPLEMENTATION THROUGH PARTNERSHIPS

Project Design and Management

AZCBM Program coordinates implementation of existing projects, supports projects implemented by partners, and collaborates on the design and implementation of new projects (e.g., Riparian Breeding Bird Surveys) with interested stakeholders.

New projects are developed through informal working groups, where partners provide scientific review of the design elements and pool financial resources for implementation. Projects are implemented with a strong contingency of volunteers, seasonal survey crew (when sufficient funding is available), and assistance from biologists of partner agencies.

Surveyors – A key approach to implementing AZCBM projects is coordination with partners so their biologists can incorporate surveys into their routine field responsibilities. When sufficient funding is available, a seasonal field crew can be hired or contracted to conduct surveys.

Volunteers - The AZCBM Program relies on volunteers to conduct many surveys. These dedicated volunteers have the ability to conduct point-counts, area searches, and other multi-species surveys to compliment the work of staff biologists.

Training workshops – Training workshops are periodically organized to train experienced volunteers on specific survey protocols. Less experienced volunteers can be trained to conduct species or habitat specific surveys where the calls and songs of a smaller set of species can be learned. For example, annual training workshops are conducted by partners (with AZCBM Program staff support) for marsh birds, Southwestern Willow Flycatcher, and Yellow-billed Cuckoo surveys. The Arizona Important Bird Areas (IBA) Program, jointly implemented by Tucson Audubon Society and Audubon Arizona, train and maintain a core group of volunteers who gather bird data across the IBA network, as well as assist with AZCBM Program projects.

Avian Databases – Since species populations occur across large political geographies, facilitating data availability at a regional scale would allow for planning, and answering conservation questions and needs at a landscape-level. The vision of the AZCBM Program is to make data readily available to all partners, while being cognizant of the need to protect any sensitive information. One approach is to integrate AZCBM Program data the Avian Knowledge Network (AKN). The AKN is a partnership supporting the conservation of birds and their habitats based on data, adaptive management, and best available science.

ARIZONA COORDINATED BIRD MONITORING PROJECTS

This report summarizes the following list of monitoring projects independently. Some are long-term national efforts, others are new statewide habitat based, while still others are one time surveys to address a specific data need. Each project narrative is organized into six sections: Description, Study Area, Methods, Results and Discussion, Recommendations, and Acknowledgments. The scope of the Results and Discussion, and the Recommendations sections varies by project.

AZCBM Coordinated or Supported Projects (2006-2012):

Waterbirds

- Reservoir Waterbird Survey
- Greater Phoenix Area Waterbird Survey
- Colonial Waterbird Nest Survey
- North American Marshbird Survey

Landbirds

- North American Breeding Bird Survey
- Nightjar Survey Network
- Riparian Breeding Bird Survey
- Sonoran Desert Breeding Bird Survey

Single Species

- Mountain Plover Winter Surveys
- Least Tern Breeding Surveys
- Snowy Plover Breeding Surveys

WATERBIRDS

RESERVOIR WATERBIRD SURVEY

Clark's Grebe - Photo/Marceline VandeWater

Project Description

The U.S. Mid-Winter Waterfowl Survey is conducted annually (the survey was scheduled to cease in Arizona after the 2013 season) in early January, but it does not typically include other aquatic birds (e.g., waterbirds). To address this gap, in 2007 the AZCBM Program began conducting boat-based surveys at several of the larger reservoirs in southcentral and southwestern regions of Arizona. Surveys are conducted in mid-January to census aquatic bird species, in particular ducks, geese, grebes, loons, pelicans, cormorants, gulls, shorebirds, and several other fish-eating birds.

Study Area

The decision to include a particular reservoir in the survey is determined by several factors, including: 1) consistent lack of ice in January, 2) navigable waters, 3) survey can be completed in a single day, and 4) if a majority of the reservoir does not fall within a CBC circle. Based on these criteria, eight reservoirs are surveyed including: Alamo, Apache, Bartlett, Canyon, Martinez, Pleasant, Roosevelt, and Saguaro. Six are on three river systems just north and east of Phoenix, and two are in western Arizona (Figure 1).

Methods

Weather permitting, surveys are conducted between January 10th – 23rd using one or two boats. Each year, only one survey is conducted at each reservoir. However, some reservoirs are surveyed annually (weather permitting), while others are surveyed on a rotational two or three year schedule.

A minimum of one boat operator and one observer conduct the surveys. Boat operators also assist with observing and counting birds, but their primary duty is to safely maneuver watercraft. Boat speed is a consistent 5-10 mph, stopping briefly to identify species, count high concentrations of birds, or photo document a rare species.

Surveys are initiated within 1.5 hours of sunrise, and continue until the entire water body is surveyed including all coves or secluded arms. Days with excessive wind or rain are avoided to maximize survey effectiveness and for safety. Surveyors attempt to avoid flushing birds to minimize disturbance and double-counting .

All aquatic birds are recorded on a two-page data form (Appendix A). Species recorded includes all wild waterfowl (ducks and geese), loons, grebes, pelicans, cormorants, bitterns, herons, egrets, ibis, rails, gallinules, coots, shorebirds (plovers, sandpipers, etc.), gulls, and terns. Additional fish-eating species such as Osprey (*Pandion haliaetus*), Bald Eagle (*Haliaeetus*

leucocephalus) and Belted Kingfishers (*Megaceryle alcyon*) are also counted. For Bald Eagles, individuals are tallied as either immatures (1-4 year olds) or adults (pure white head and tail).

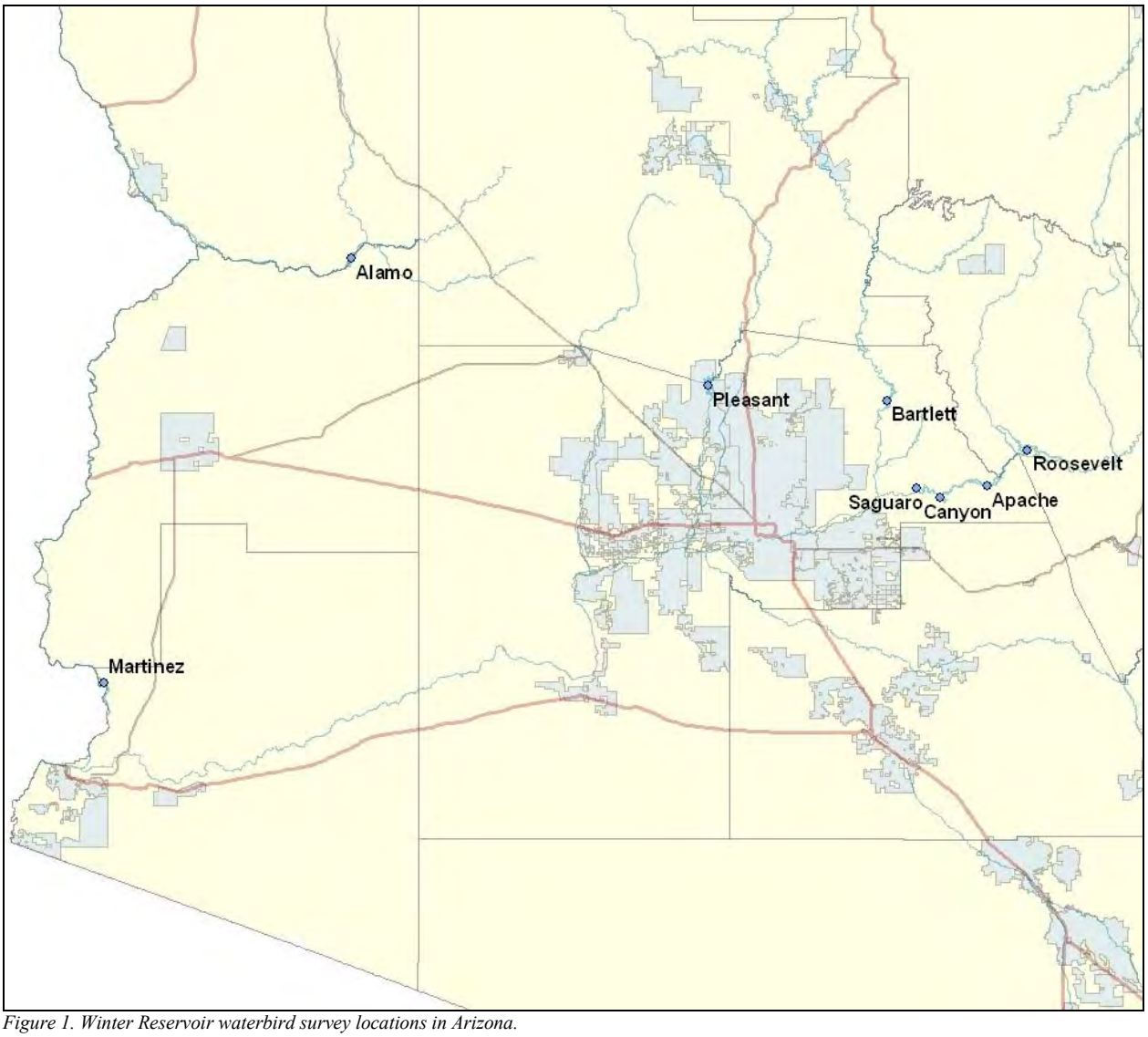

Figure 1. Winter Reservoir waterbird survey locations in Arizona.

Results and Discussion

The survey findings discussed in this section can be referenced in the appropriate tables found in Appendix C. The cumulative total of 60 species and an annual average of 11,146 waterbirds were detected from 2007 to 2012. This includes 25 species of ducks and geese, six species of grebes, and two species of loons.

The number of individual waterbirds and species identified varied from one winter to the next with each reservoir (Table 1). The reservoir with the highest diversity of species during this period was Saguaro (n=39), followed by Roosevelt (n=38), Alamo (n=37), and Martinez (n=32). Not surprisingly, Roosevelt Lake had the highest average count of waterbirds (mean=6,214), followed by Saguaro Lake (mean=2,357), Alamo Lake (mean=1,690), and Lake Pleasant (mean=1,471).

Of the eight reservoirs, only Alamo and Roosevelt lakes are annually surveyed by the U.S. Mid-Winter Waterfowl Surveys (using fixed-wing aircraft). Since the Reservoir Waterbird Survey also includes waterfowl (and is conducted approximately the same time of year as the U.S. Mid-Winter Waterfowl Surveys), this data was used to evaluate difference in species/numbers detected between boat and aircraft surveys. At Roosevelt Lake, the boat surveys consistently produce a higher diversity of waterfowl, but typically overall lower numbers of the more common species such as Mallards (*Anas platyrhynchos*), Northern Shovelers (*Anas clypeata*), and Green-winged Teal (*Anas crecca*), when compared to the U.S. Mid-Winter Waterfowl Survey data (M. Rabe, pers. com.). This difference is likely due to boat inaccessibility of flooded dense tamarisk and other vegetation at the inflows, where the Salt River and Tonto Creek enter the reservoir. Aircraft surveys can flush these hidden waterfowl to be counted.

Table 1. Number of individual waterbirds and total species at reservoirs surveyed in Arizona, 2007-2012.

Reservoir	2007		2008		2009		2010		2011		2012		Total	
	Count	# Species	Count	Species	Count	Species	Count	Species	Count	Species	Count	Species	Average Count	Average Total Species
Martinez	-	-	473	23	296	17	1952	15	655	18	1072	19	890	18
Alamo	404	18	1176	18	1560	26	1736	25	1763	26	3504	27	1690	23
Saguaro	2492	31	2034	25	1729	29	2157	21	2427	28	3302	26	2357	27
Roosevelt	3759	24	10,447	29	5504	29	-	-	6254	25	5107	26	6214	27
Apache	-	-	598	15	-	-	-	-	-	-	1960	14	1279	15
Canyon	-	-	-	-	241	8	-	-	-	-	619	16	430	12
Pleasant	902	13	-	-	-	-	2041	21	-	-	-	-	1471	17
Bartlett	-	-	562	22	-	-	-	-	151	13	-	-	356	18
Annual Count	7557		15,290		9330		7886		11,250		15,564			

- Not Surveyed

Although likely used annually during fall migration, surprisingly none of the eight reservoirs routinely harbored Common Loons (*Gavia immer*) into the winter. Of the six reservoirs north and east of the greater Phoenix area, Common Loons were observed at Roosevelt Lake once in five surveys (no surveys in 2010 due to weather), and Alamo Lake has harbored one to two Common Loons twice in six years of surveys. This is in contrast to Lake Havasu and Lake Mohave on the lower Colorado River where Common Loons are reported to winter annually in fair numbers (Rosenberg et al. 1991, eBird 2016).

Western (*Aechmophorus occidentalis*) and Clarks Grebes (*Aechmophorus clarkia*) were found to winter annually on all surveyed reservoirs, with the highest concentration averaging approximately 2,400 individuals on Roosevelt Lake (range 1,200 in 2007 to 3,400 in 2011). Roosevelt Lake is also the only known surveyed reservoir in south-central Arizona in which both of these grebes attempt to nest. During the January surveys, surveyors occasionally observed and documented several family groups of dependent calling chicks that were only ½ to ¾ grown. This indicated active nesting into late Fall.

Interestingly, these surveys revealed Eared Grebes (*Podiceps nigricollis*) rarely winter on Roosevelt Lake. However, several hundred Eared Grebes winter at each of three smaller reservoirs just downstream on the Salt River. Also interesting, an exceptional concentration of nearly 1,000 Eared Grebes wintered on Apache Lake in 2012, which is the highest number reported for Maricopa County. One possible reason for the high numbers is that the concentration of exotic threadfin shad (*Dorosoma petenense*) could be much higher on these smaller, deeper reservoirs than on Roosevelt Lake. Native to southeastern U.S., these small fish have been stocked widely as forage for bass and other large introduced game fish and are a commonly observed winter prey item for these small grebes on the reservoirs.

Consistency of water levels varied annually from one reservoir to another, with Alamo and Roosevelt Lakes having the most variation during the survey period. Water levels fluctuated from 62-98 percent at Roosevelt, while downstream reservoirs such as Apache, Canyon, and Saguaro consistently remained above 93 percent. The lower reservoirs are maintained at near capacity to reduce water loss from evapotranspiration on the shallower Roosevelt Lake. Waterfowl numbers on Roosevelt Lake varied greatly due to this fluctuation, which caused a change in food availability and cover (i.e. increasing when shoreline vegetation is flooded). However, it is important to note that Roosevelt Lake is the only surveyed reservoir that has specific designated areas (several large coves) closed to hunting and boat traffic for wintering waterfowl. These closures also benefit other waterbirds, and encourage many more to remain to winter on the reservoir.

Only Martinez, Alamo, and Roosevelt Lakes have documented wintering American White Pelicans (*Pelecanus erythrorhynchos*). However, they were documented inconsistently and in small numbers (maximum 45). Double-crested Cormorants (*Phalacrocorax auritus*) are most abundant on Alamo and Roosevelt Lakes, where several nesting colonies exist. The average count was 120 individuals on Roosevelt, with a high of 184 in 2009. With expanding southwestern U.S. populations, the first individual Neotropic Cormorants (*Phalacrocorax brasilianus*) detected during these surveys was at Saguaro Lake in 2008 and at Roosevelt Lake in 2012.

The winter survey provided some insight into the winter distribution and status of several uncommon and rare waterbirds in the state. For example, individual Horned Grebes (*Podiceps auritus*) were documented wintering on one or more reservoirs in Maricopa County each year except in 2009. Canyon Lake produced an exceptional high count of four Horned Grebes in 2012. Previously, this grebe was known to winter annually in in Arizona only along the Colorado River on Lake Havasu and Lake Mohave. The first documented record of Red-throated Loon (*Gavia stellate*) for Gila County was on Roosevelt Lake in 2009. Other species typically not found annually in south-central Arizona during the winter, were detected at Saguaro Lake, including a Black-legged Kittiwake (2011; *Rissa tridactyla*), a White-winged Scoter (2008; *Melanitta fusca*), and a Black Scoter (2011; *Melanitta americana*). A Red-necked Grebe (*Podiceps grisegena*) and Eurasian Wigeon (*Anas penelope*) were also discovered on Lake Pleasant (2010). A Caspian Tern (*Hydroprogne caspia*) was found at Alamo Lake in 2007, which is possibly a first mid-winter record for Arizona outside the lower Colorado River.

It has been reported that populations of Lesser (*Aythya affinis*) and Greater Scaup (*Aythya marila*) at Lake Erie have shifted traditional migration routes to possibly take advantage of the presence of the zebra mussel (*Dreissena polymorpha*; Wormington and Leach 1992, Hamilton et. al 1994). This mussel was accidentally introduced in the 1980s, and has spread throughout the Great Lakes, parts of the Mississippi River, and other rivers and inland lakes (Wormington and Leach 1992, Hamilton et. al 1994). Populations of the similar, exotic quagga mussel (*Dreissena bugensis*) were first reported on the lower Colorado River at Lake Mead in January 2007 (Turner et al. 2011), and have since spread downstream to Lake Havasu, Yuma and the Central Arizona Project Canal to Lake Pleasant. Greater Scaup, Common Goldeneye (*Bucephala clangula*), and even the rare Barrow's Goldeneye (*Bucephala islandica*) wintering populations have recently increased in the Bill Williams River delta of Lake Havasu where this mussel is well established (L. Harter and D. Vander Plyum pers. comm., eBird 2016). During the winter of 2011-2012 at this location, exceptional high counts of Greater Scaup (n=285), Common Goldeneye (n=150), and Barrow's Goldeneye (n=25) were reported (eBird 2016). Future surveys will determine if there will also be a winter increase of scaup, goldeneyes, and other diving ducks at Lake Pleasant, since the quagga mussel was first reported in December 2007 (T. McMahon pers. comm.). Similarly, clams and mussels are a common food item for scoters, and may encourage these rare ducks in Arizona to persist following typical fall migration in late October and November.

Recommendations

- Survey Canyon and Bartlett Lakes once every three years. These reservoirs average less than 500 individual per survey.
- Survey Apache Lake and Lake Pleasant once every other year. These reservoirs average between 1200-1500 individuals per survey.
- Maintain annual surveys for the four other reservoirs.

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GREATER PHOENIX AREA WATERBIRD SURVEY

Photo/Barb Winterfield

Project Description

According to Census Bureau estimates, based on population size, Phoenix is the sixth largest city in the United States (Census Bureau 2010). With numerous adjacent cities incorporated into the greater Phoenix metropolitan area, it has become one of the fastest growing regions of the country. With this growth, numerous residential lakes and golf course ponds continue to be constructed and maintained, which attract increasing numbers of wintering aquatic birds.

Very few of these urban water impoundments are included in the local CBC boundaries (Figure 2), and none are surveyed during the U.S. Mid-Winter Waterfowl Survey. Therefore, most of these waterbirds are excluded from any population counts. In January 2006, the Department coordinated a preliminary survey of urban waterfowl and other waterbirds in the greater Phoenix metropolitan area. Following this effort, in 2007 a full monitoring survey was initiated to determine the species diversity, numbers, and distribution of these urban populations. During this annual one-day effort, surveyors count waterfowl, grebes, cormorants, herons, egrets, coots, and shorebirds, as well as fish-eating birds such as Osprey, Bald Eagles, and Belted Kingfishers.

This survey identifies high waterbird concentration areas, and areas with the potential for urban wildlife conflicts. The information can assist biologists in identifying research needs and important areas. It will also provide information to urban planners and wildlife managers to make educated, cost-effective decisions regarding management of urban waterbird populations.

Study Area

Surveyed areas are within the urban and residential areas of the greater Phoenix metropolitan boundaries in Maricopa County, with a few in adjacent northern Pinal County (Figure 2). Surveys are conducted as far north as Anthem, south to Sun Lakes, and from Gold Canyon to the east, to Surprise to the west. The study area encompasses approximately 2,200 square miles and include the man-made lakes, ponds, canals and wetlands within 26 cities. However, actual surveyed area is approximately six square miles.

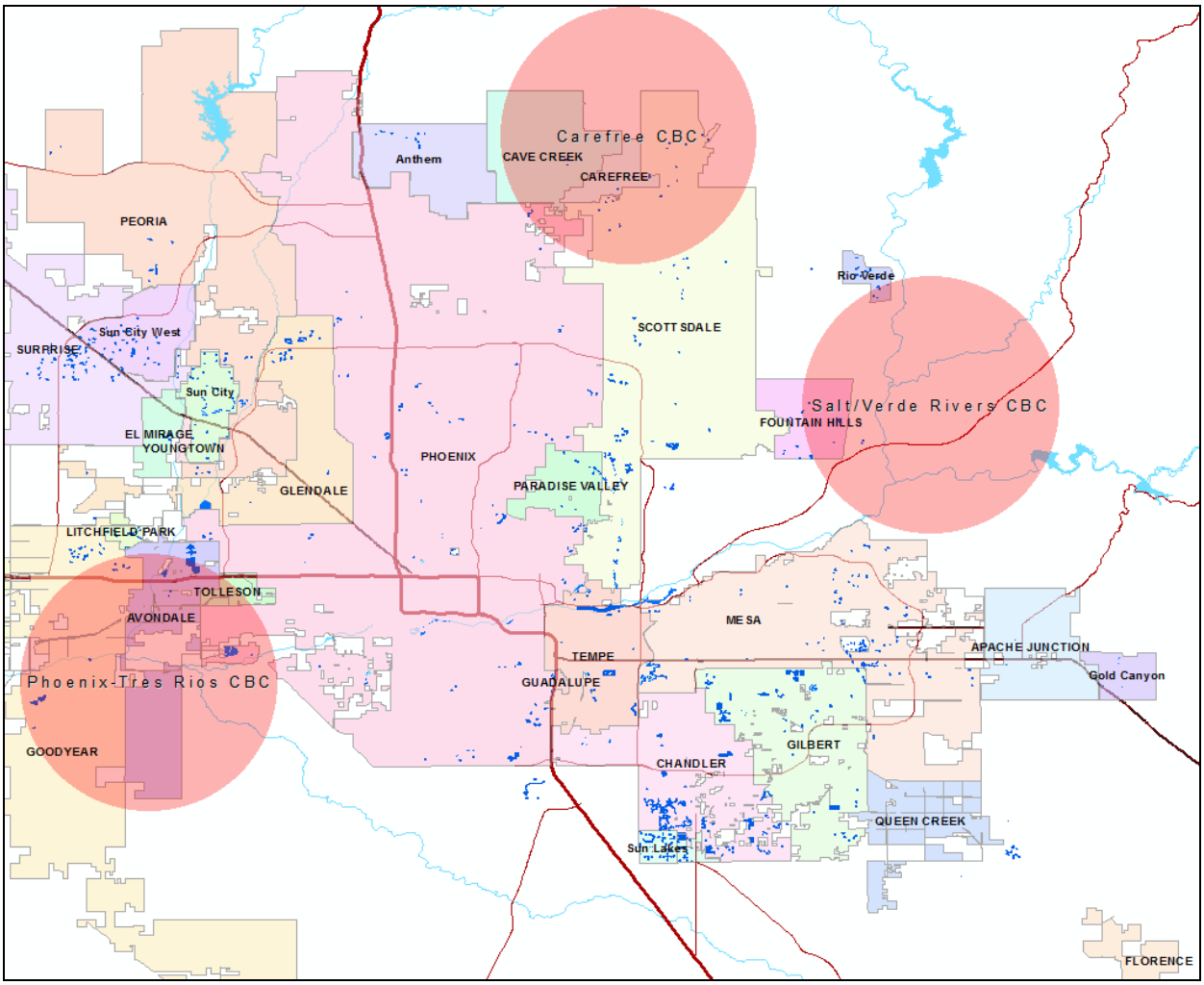


Figure 2. Phoenix area cities and Christmas Bird Count boundaries with water body locations in dark blue.

Methods

All surveys are conducted on the third Saturday in January. Scheduling on a weekend maximizes volunteer participation, and a one-day survey helps minimize double-counting. Individual surveyors or teams are assigned an area (Figure 3), typically within one city limit, and visit all water bodies with safe and reasonable viewing access. Permission to access restricted or closed areas, such as gated communities, resorts, and golf courses, is obtained annually before entering.

Participants survey the entire water body when possible, including the immediate environments (i.e. shoreline, lawns, roost trees), and count all wild waterbirds detected (domestic or exotic ducks, geese, and swans are not counted). Surveyors use spotting scopes for proper identification on larger lakes, and also photo document any rare or unidentifiable species with written details of such observations. Surveyors record miles driven, and begin and end time to document hours surveyed on a two-page data form (Appendix A).

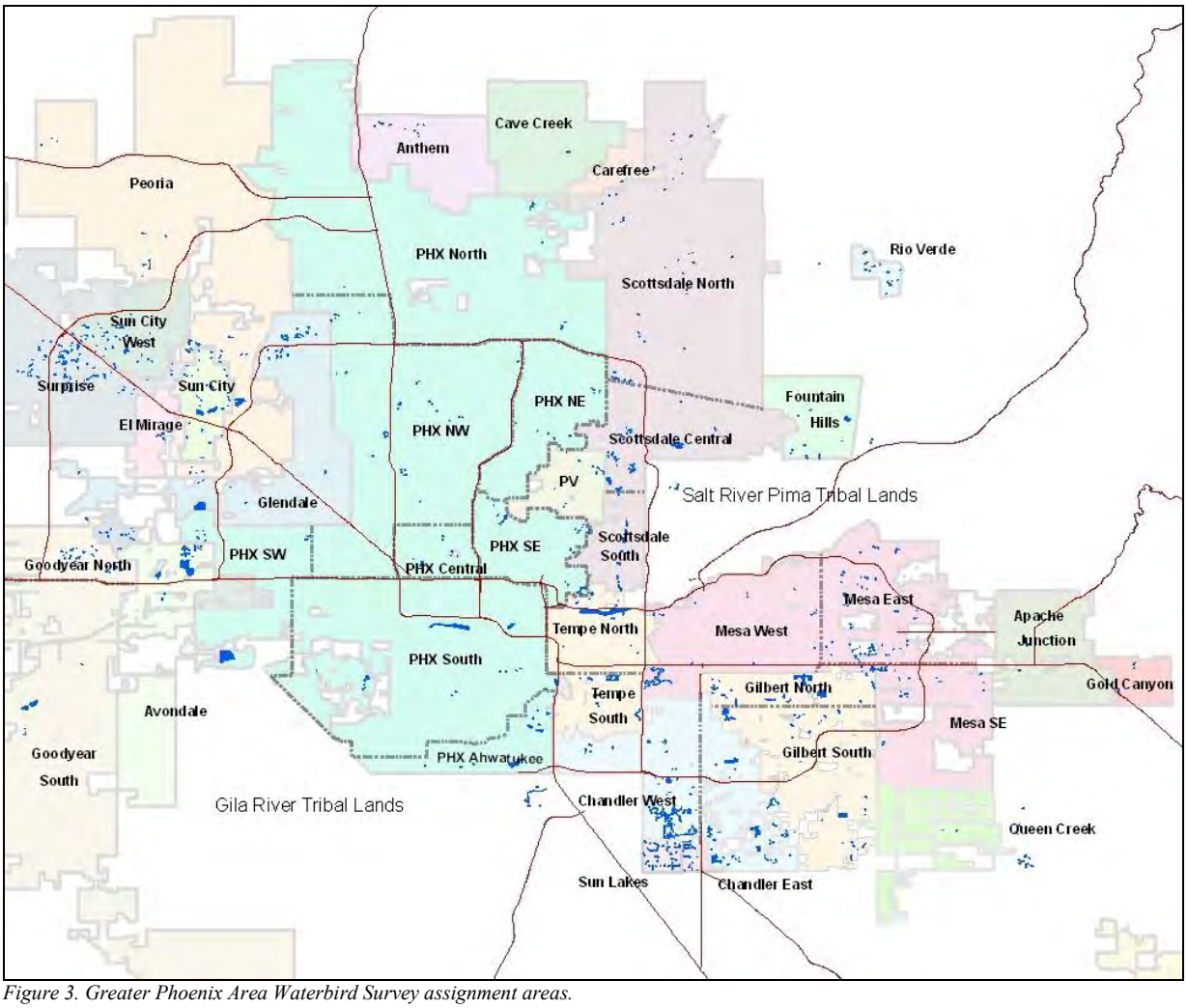


Figure 3. Greater Phoenix Area Waterbird Survey assignment areas.

Results and Discussion

Annual Department participation has averaged 4-5 individuals, while volunteer participation has steadily increased from 47 in 2007, to 68 in 2012 (average 63). This survey counts an average of nearly 50,000 wild waterbirds of 50-60 species (Table 2). Of comparable sized survey area, no other region in Arizona has a higher diversity or density of wintering waterbirds. Complete survey results (i.e., species and their numbers by urban area) are posted at the Arizona Field Ornithologists (AZFO) website at http://azfo.org/namc/IndexphoenixUrban.html.

Table 2. Participant survey effort and count summary for Greater Phoenix Area Waterbird Survey (2007-2012).

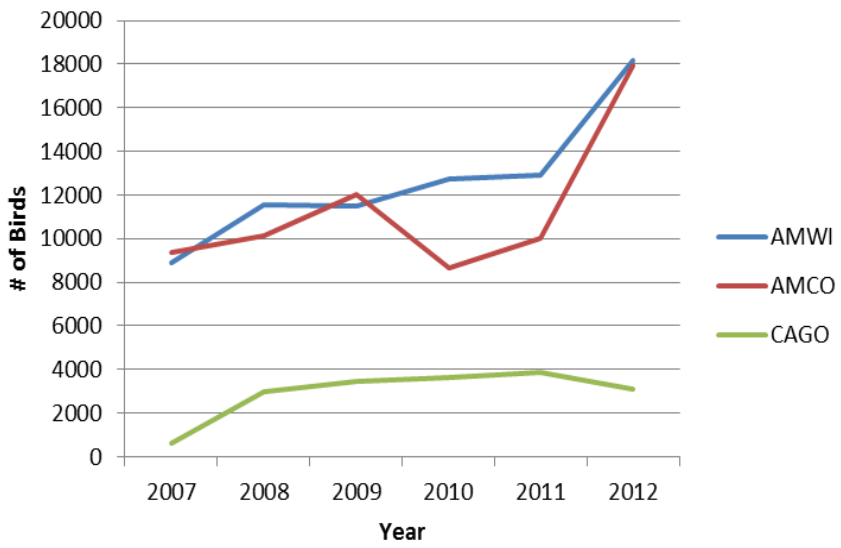
	Survey Year						Average
	2007	2008	2009	2010	2011	2012	
Participants	52	57	64	63	70	73	63
Party Hours	150	180	192	177	201	226	188
Party Miles	683	1024	1087	855	823	961	910
Waterbirds	36,412	46,457	50,567	46,748	50,994	67,022	49,701
Species	55	60	54	53	61	59	57
Birds/Party Hour	243	258	263	264	253	297	263

The most abundant species documented is the American Wigeon (*Anas americana*) and American Coot (*Fulica americana*; Table 3). These two species account for an average of nearly 50% of all waterbirds recorded for the past five years with a high of 54% in 2012. Both species regularly congregate in large grazing flocks (i.e. >500 individuals) and feed primarily on the abundance of perennial ryegrass (*Lolium perenne*) used for winter lawns, parks, and golf courses. American Wigeon numbers have steadily increased from 2008 through 2011. However, a high of 18,159 individuals was recorded in 2012 (Figure 4). American Wigeons are not typically detected in significant numbers in Arizona during the U.S. Mid-Winter Waterfowl Survey flights (e.g. the past five-year average total for all wildlife refuges along the lower Colorado River is 922 individuals), therefore this concentration was unexpected (M. Rabe, pers. com.).

Table 3. Eight most abundant species on Greater Phoenix Area Waterbird Survey, 2008-2012.

Species	5-year Average Count	Annual Count Range	Percent
American Wigeon	13,510	12,101 – 18,159	31.3
American Coot	12,119	9025 – 17,962	28.0
*Mallard	5438	3713 – 6714	12.6
Canada Goose	3399	2756 – 3932	7.9
Northern Shoveler	2956	2096 – 4069	6.8
Ring-necked Duck	2604	2399 – 3112	6.0
Common Merganser	1738	1327 – 2243	4.0
Ruddy Duck	1461	954 – 2193	3.4

*Count likely includes many resident Mallards of some domestic stock



American Coot numbers have been more variable, with a noticeable drop in 2010 to only 9,025 individuals. Similar to American Wigeons, we documented a high of 17,962 individuals in 2012 (Figure 4). Similar, American Coot numbers during the Reservoir Waterbird Surveys at both Roosevelt and Saguaro Lakes in 2012 were well above the past five-year average for those reservoirs.

Figure 4. Annual abundance of grazing waterfowl during the Greater Phoenix Area Waterbird Survey, 2007-2012. AMWI – American Wigeon, AMCO – American Coot, and CAGO – Canada Goose.

The vast majority of the over 3,000 Canada Geese (*Branta canadensis*) concentrate in three main residential areas, the Scottsdale greenbelt along the Indian Bend Wash, Sun Lakes and Chandler in the southeast, and in Avondale in the southwest. All of these harbor numerous lakes and ponds for loafing, drinking, foraging, and overnight roosting. They are also adjacent to extensive irrigated agricultural areas which are used as primary foraging areas as the geese were

documented routinely flying to the fields and back twice a day. Survey times for these areas were modified to capture these movements.

The recent establishment, and continued increase of resident Neotropic Cormorants populations within central Arizona, and particularly the greater Phoenix Area, during the past decade is exceptional (Radamaker and Corman 2010; Figure 5). The greater Phoenix area now attracts the highest winter density of both Neotropic and Double-crested Cormorants in Arizona. For Neotropic Cormorants, the greater Phoenix area has the highest winter density anywhere in the western United States.

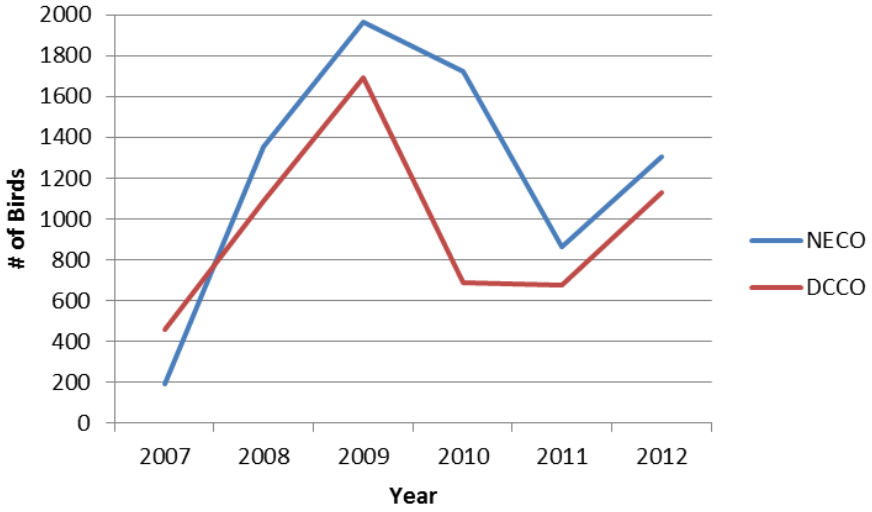


Figure 5. Annual abundance of cormorants during Greater Phoenix Area Waterbird Survey, 2007-2012. NECO – Neotropic Cormorant and DCCO – Double-crested Cormorant

In the greater Phoenix area, both cormorant species often form huge evening roosts along large sand and gravel extraction ponds within or near the Salt and Gila rivers, sometimes just outside city limits. From these roosts, they travel in large flocks each morning to various lakes and ponds where the appropriately sized fish can be found. Flocks will return to the same foraging pond each day until numbers of suitable-sized fish are reduced. Some ponds may eventually attract >200 cormorants.

Several cities attract higher numbers of the two cormorant species, although the numbers can vary annually (Table 4). In addition, a few cities attract higher numbers of one cormorant species over another. For example, Phoenix waterbodies seems to attract a higher percent of both species, while Chandler has more Neotropic Cormorants than Double-crested Cormorants. The opposite is true for Sun Lakes. This variation could be due to monthly changes in abundance of appropriately-sized fish.

Table 4. Five-year average and annual count range of cormorants in select cities.

*City	5-Year Average		Annual Count Range		Percent	
	DCCO	NECO	DCCO	NECO	DCCO	NECO
Chandler	140	520	22 - 206	264 - 1207	13.78	36.47
Gilbert	33	176	6 - 96	59 - 294	3.25	12.34
Phoenix	349	495	110 - 742	46 - 1259	34.35	34.71
Scottsdale	123	65	67 - 172	4 - 130	12.11	4.56
Sun Lakes	231	49	8 - 423	2 - 102	22.74	3.44
Tempe	140	121	76 - 184	21 - 243	13.78	8.49

**Cities with consistently high concentrations of one or both species from 2008-2012. NECO – Neotropic Cormorant and DCCO – Double-crested Cormorant*

Cormorant daily movements between foraging areas and evening roosting often encompass large areas and create a high potential of double counting by multiple surveyor teams (Table 5). However, annual cormorant counts can also be quite variable depending upon the preferred foraging area on the survey day. As an example in 2011, both species numbers were noticeably less, however, above average numbers were found on the two local CBCs within the lower Salt and Gila rivers just to the southwest of the urban survey areas (NAS 2010).

Table 5. Annual cormorant abundance on Greater Phoenix Area Waterbird Survey.

Species	2007	2008	*2009	2010	2011	2012
Neotropic Cormorant	191	1357	1974	1821	852	1306
Double-crested Cormorant	456	1056	1704	919	644	1129

**Some double counting may have occurred as large flocks were counted at dawn as they exited a roost at one location to go to day foraging areas into several other surveyor areas.*

Excessive concentrations of wintering waterbirds in urban settings do occasionally lead to health, safety, and property damage issues. Turf damage on perennial ryegrass by large flocks of grazing species such as Canada Geese, American Wigeons, and American Coots is a common winter issue in the greater Phoenix area. Human health and safety concerns have also been expressed from excessive amounts of excrement that accumulate on sidewalks, pathways, and golf courses. Each fall and winter, some urban lakes are periodically stocked with sportfish such as rainbow trout (*Oncorhynchus mykiss*) and bluegill (*Lepomis macrochirus*) to provide fishing opportunities. Unfortunately, this local stocking activity has occasionally attracted concentrations of cormorants (Radamaker and Corman 2010). These annual surveys document high concentration areas to determine the species involved, which could help determine how populations may react to specific non-lethal deterrents or other management actions.

Recommendations

- If the pool of volunteers continues to increase, expand coverage at multiple golf courses by strategically placing additional surveyors at dawn (prior to the first tee-time). This will allow more ponds within each course to be surveyed that are inaccessible later in the day (due to golfing activities).
- Encourage the release of larger, longer lived triploid white amur (*Ctenoparyngodon idella*; grass carp) for controlling submergent vegetation in urban waterbodies. This transition would decrease the prey abundance (i.e. tilapia) for fish-eating birds, such as cormorants.
- Discourage property managers from seeding perennial ryegrass within a minimum of 30 m of pond and lake edges to reduce damage caused by grazing waterbirds, such as American Coots and American Wigeons.
- Promote research to test possible methods of deterrents to reduce high concentrations of American Coots and American Wigeons at golf courses and parks.
- Encourage research to determine the primary prey base and prey size of urban cormorants in an effort to propose the most practical population reduction strategies.
- Because of the difficulty in differentiating between Neotropic and Double-crested Cormorants, provide surveyors helpful illustrations and tips on how to identify the two species in the field.

Acknowledgements
This cooperative effort has been conducted by several Department personnel and numerous volunteers. We wish to thank the following dedicated surveyors: Joey Alsadi, Herb Andrews, John Arnett, Tammy Baker, Randy Baker, Carol Beardmore, Harvey Beatty, Mariko Bigler, C.J. Biller, Phyllis Bofferding, Sandra Bondy, Terry Brodner, Bill Burger, Gretchen Burgess, Stacy Burleigh, Laurence Butler, Ricki Carlson, Richard Carter, Greg Clark, Troy Corman, Jesse Cuilty, Dominick D'Agosto, Julian Darren, Gayann Dean, Tommy DeBardeleben, Dawn Dell'Ergo, Pierre Deviche, Johnida Dockens, Patrick Dockens, Robert Dummer, Michael Eakin, Marjorie Eckman, Geoffrey Eden, Laura Ellis, Patrick Ellis, Heather English, Mike Erickson, David Ferreira, Dwayne Fink, Neil Fisch, Elizabeth Fisch, Craig Fischer, Mike Foley, Stacy Ford, Larry Ford, Ken Furtado, Thomas Gaskill, Ann Givey, Joyce Goodman, Molly Hanson, Candy Haslam, Michael Hawk, Melanie Herring, Bill Herron, Diana Herron, Paul Hershberger, Kristen Hildebrandt, Tom Hildebrandt, Joann Hill, Robert Hindle, Mel Hoffman, Triska Hoover, Joan Hosmer, Stephen Hosmer, Frank Insana, Sam Insana, Brian Ison, Bud Johnson, Justin Jones, Edwin Juarez, Richard Kaiser, Mary Kiamar, Scott Kierstin, Paul Kinslow, Andy Laufman, Diane Laush, Vic Lewis, Tom Lewis, Joan Luehrs, Dean Luehrs, Kathy Madsen, Jon Mann, Tracy McCarthey, James McKay, Barb Meding, Jay Miller, Robert Mortensen, William Murdock, Jr., Marti Murray, Phil Norton, Doug O'Bannon, Les Olson, Joyce Paloma, Nancy Pearson, David Pearson, Anita Peterson, Ethan Peterson, Benjamin Peterson, Dave Powell, Stephanie Prevost, Timothy Price, Mike Rabe, Jean Rigden, Shirley Ritz, Jeffrey Ritz, Kathy Robertson, Carlos Ross, Alan Sapakie, James Scarlett, Cecilia Schmidt, Richard Schooler, Carol Schooler, Pat Scott, Eyal Shochat, Kenneth Smith, Evelyn Smith, Donna Smith, Alex Smith, Nina Smith, Adam Stein, Jeff Stemshorn, Fred Stewart, Mary Strang, Diana Stuart, Karen Stucke, Brian Sutter, David Taylor, Devahni Taylor, Peggy Thomas, Walter Thurber, Stig Tjotta, Jolan Truan, Nick Vandehei, Marceline VandeWater, Theona Vyvial, Magill Weber, Justin Winter, Lou Winterfield, Barb Winterfield, Donald Witter and Daniela Yellan.

COLONIAL WATERBIRD NEST SURVEY

Great Blue Herons - Photo/Barb Winterfield

Project Description

In Arizona, colonial nesting aquatic birds include White-faced Ibis and several species of herons, egrets, cormorants, and grebes. However, no formal survey existed to inventory existing colonies, identify new colonies, or to document colony sustainability over time.

In 2006, the Department conducted nest counts at various known active Great Blue Heron (*Ardea herodias*) and Double-crested Cormorant colonies. This preliminary effort identified which attributes should be collected for a long-term monitoring project. In 2007, a data collection form was finalized (Appendix A) and the survey effort expanded statewide. Later, the USFWS coordinated a three-year survey of western colonial waterbirds (2009 – 2011) in 11 western states (USFWS 2008).

Study Area

Statewide surveys focus on specific locations or colonies adjacent to natural and man-made ponds, lakes, and watercourses.

Methods

For this project, a "colony" is defined as a site containing one or more nests of any of the 11 species listed in Table 6. Due to relatively limited open water resources, sufficient prey availability, and/or nearby trees or structures for constructing nests in Arizona, a "colony" may begin with a single nest.

Table 6. Colonial Nesting Waterbirds in Arizona.

Eared Grebe	Western Grebe	Clark's Grebe
Neotropic Cormorant	Double-crested Cormorant	Great Blue Heron
Great Egret	Snowy Egret	Cattle Egret
Black-crowned Night-Heron	White-faced Ibis	

Each existing or newly discovered colony is visited one or more times during the breeding season. Surveyors document the breeding status/behavior, number of active nests and adults present, and nest-supporting substrate. At newly discovered colonies, the observer records the GPS location, elevation, and notes the general description of the area. All observations are conducted from a point distant enough as to not disturb nesting activity.

Colony status is designated annually as active, inactive, or abandoned. An active colony is where breeding behavior is observed, including courtship or nest building. Colonies designated as inactive still have some evidence of nest structures remaining, or have a history of being active only when appropriate water levels exist, but no birds are observed that year. An abandoned

colony no longer contains any evidence of nest structures, and is unlikely to be used again in the near future.

Results and Discussion

As of 2012, 132 nesting colonies had been identified and mapped within Arizona (Figure 6). This includes 18 colonies abandoned prior to 2006. The overwhelming majority of active colonies were Great Blue heronries (n = 74), where an average 380 active nests were counted annually from 2009 to 2012 (high 433 at 45 colonies in 2011, Table 7). The largest Great Blue heronry held 60 active nests near the confluence of the Gila and Agua Fria rivers in 2006. This colony declined to 25 active nests by 2012.

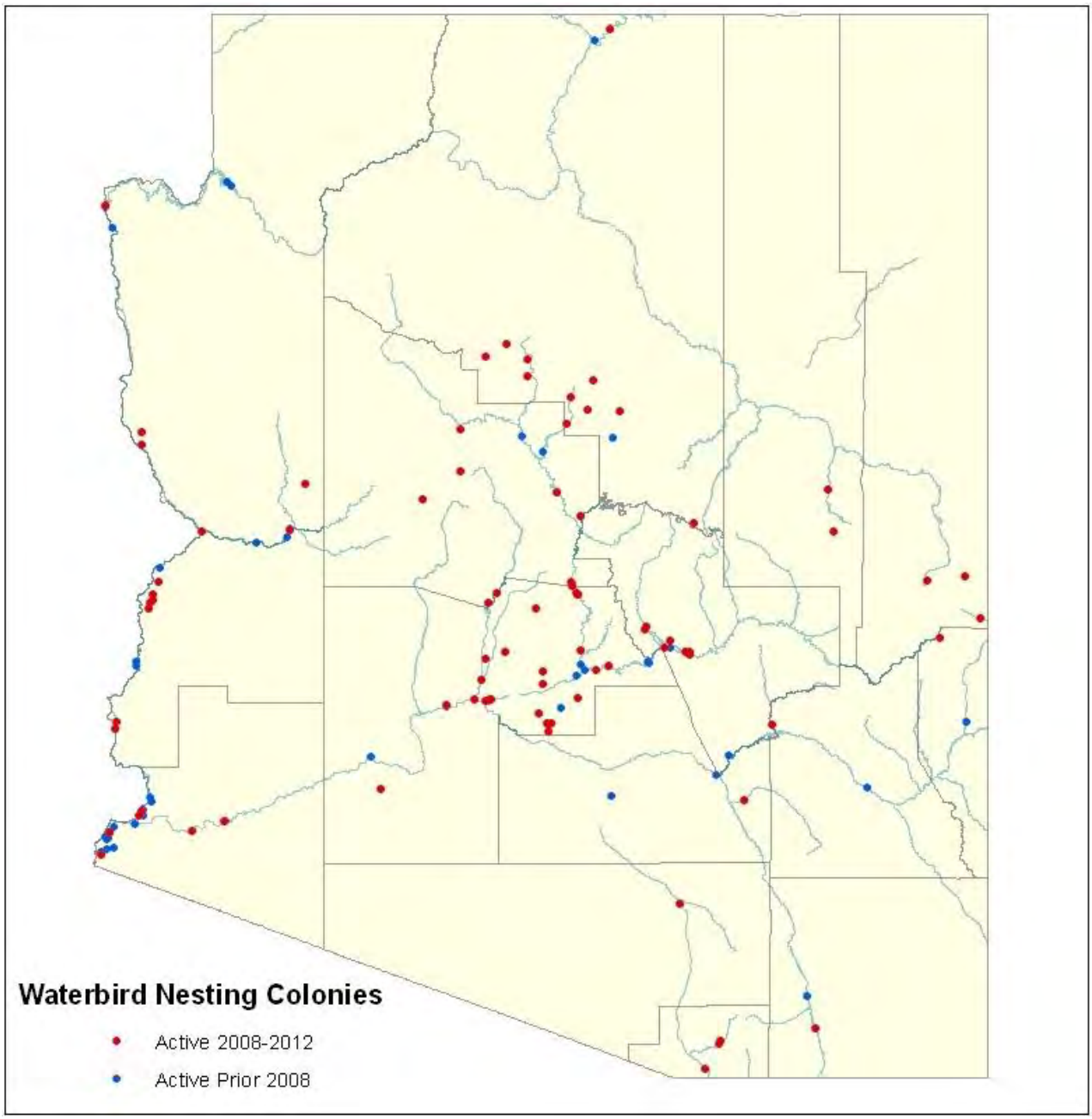


Figure 6. Waterbird nest colony locations in Arizona.

Table 7. Annual number of active Great Blue Heron and Double-crested Cormorant nests counted and number of colonies (#) visited by species (2009-2012).

Species	2009	2010	2011	2012	Average
Great Blue Heron	361 (34)	382 (42)	433 (45)	371 (44)	387 (41)
Double-crested Cormorant	289 (10)	324 (9)	284 (8)	169 (5)	267 (8)

The largest single species concentration was a Cattle Egret (*Bubulcus ibis*) colony in the Parker Valley, which was estimated to contain 2,200 nesting pairs in 2011. Although poorly documented in the literature (Telfair 1994), several of our observations suggest that Cattle Egrets occasionally double-clutch in Arizona. As an example, in 2011, this colony was active from mid-April through August, with eggs documented from May 9 to June 3. There were no eggs in July, but a subset of the colony was active again on August 10.

Depending on elevation, region, and species, some active nesting can be documented almost year-round in Arizona. For example, Clark's Grebes have been observed with dependent young in the fall and early winter at several Colorado River reservoirs and at Roosevelt Lake. Similarly, Great Blue Herons and Double-crested Cormorants were observed nest building in November and December and locally tending nestlings in late December and January. These two species have occasionally been noted with active nests into early August.

Nineteen Double-crested Cormorant colonies were documented by 2012 (Figure 7). An average 267 active nests were counted annually from 2009 to 2012, with a high of 324 at nine colonies in 2010 (Table 7). The largest colony held 117 active nests in 2010, which was near the Tonto Creek inflow to Roosevelt Lake.

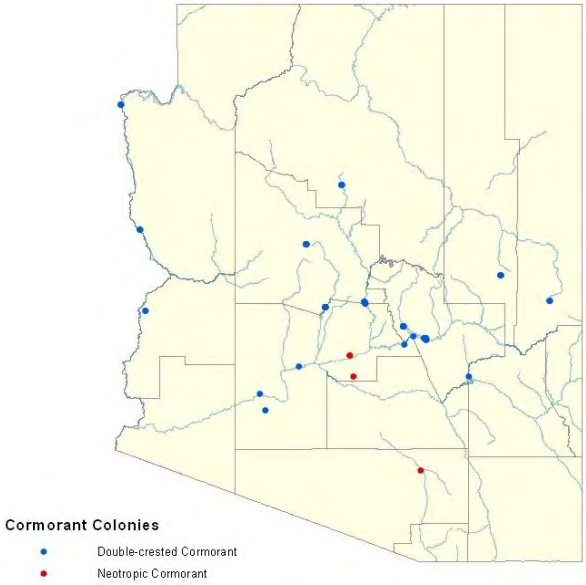


Figure 7. Double-crested and Neotropic Cormorant colonies in Arizona.

Changing water levels and prey availability influence the annual occurrence and number of nesting waterbirds. For example, nearly 200 pairs of Double-crested Cormorants were documented at Roosevelt Lake in 2010 when water levels were elevated and the base of the nesting trees were flooded. This number decreased to 109 pairs in 2011, and 29 in 2012 as water levels dropped.

Several colonies established by Great Blue Herons were gradually overtaken by Double-crested Cormorants. Quite adaptable in Arizona, Double-crested Cormorants have been documented nesting from 140 m to 2,500 m in elevation, while Great Blue Herons have nested from 30 m to 2,500 m (Corman 2005b, Latta 2005). Recent surveys have not found either species nesting outside these elevations.

Some colonies are ephemeral and become inactive when water is low, such as the colony below Painted Rock Dam on the Gila River. This colony attracts 100-200 nesting pairs of egrets (three species), herons (three species) and Double-crested Cormorants once a sufficient amount of water returns and the tamarisk-covered nesting islands are isolated from ground predators. Similarly, the Horseshoe Reservoir cormorant colony first reported in 2010 was active again in 2011, but not in 2012 when the reservoir levels were low. Several factors may influence the abandonment of a colony, such as loss of nearby water, reduced prey base, excessive human disturbance, or loss of nest trees. The reason for abandonment may not always be clear as established colonies may shift locations for no readily apparent reason.

Egrets, herons, and cormorants in Arizona typically nest in native trees such as willow (*Salix* spp.), cottonwood (*Populus* spp.), Arizona sycamore (*Platanus wrightii*), mesquite (*Prosopis* spp.), and pines (*Pinus* spp.). However, they also nest in exotic tree species such as tamarisk (*Tamarix* spp.), eucalyptus (*Eucalyptus* spp.), and citrus (*Citrus* spp.). Some egrets, night-herons, and ibis nest locally within large stands of emergent vegetation such as cattails (*Typha* spp.), and bulrush (*Schoenoplectus* spp.). Double-crested Cormorants and Great Blue Herons have adapted to the absence of vegetation and have locally established colonies on cliffs (i.e., cliff nesting colonies of Double-crested Cormorants along the Colorado River just below Hoover Dam, and one small cliff nesting colony of Great Blue Herons along Burro Creek) and on man-made structures (i.e. a colony of herons and cormorants nesting on an inactive sand and gravel extracting rig near Buckeye (Figure 8).

Although a few new colonies are reported annually, there are likely many additional unknown active colonies along seldom-visited sections of perennial drainages and residential neighborhoods of the greater Phoenix area.

During the course of this study, the USFWS established a Western Colonial Waterbird Survey effort across 11 western states. The purpose was to document and inventory all known colonies and determine the minimum regional breeding population size for each species. Western surveys were conducted from 2009 through 2011. Department staff provided data for the effort in order to prepare an Atlas of Breeding Colonial Waterbirds for the Interior Western United States (Cavitt et al. 2014).

Figure 8. Great Blue Herons and Double-crested Cormorants nesting on dormant machinery. Photos/Troy Corman

Recommendations

1) Expand outreach for partners to report new colony locations through the use of newsletters and websites.
2) Continue to have all active colonies visited annually by ensuring full volunteer coverage of existing colonies.
3) Use eBird to address information gaps and verify observer data.

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Pederson, Lin Piest, Maureen Price, Tom Puckett, Marcia Radke, Marie Renner, Jan Richmond, Danny Rodriguez, Ronald Ryder, Joe Sayer, Ian Sexton, Andre Silva, Sue Sitko, Tim Snow, Jean Spiker, David Stejskal, Mark Stevenson, Bill Stewart, Jen Stroh, Sarah Svovoda, Cary Thompson, Dick Todd, Carl Tomoff, K. Tso, Leah Vader, Ruth Valencia, David Vander Pluym, Kristin Ward, John West, Linda WhiteTrifaro, Joan Wike, Emily Willard, Todd Willard, Greg Yoder, Anna Young and Brenda Zaun.

National waterbird monitoring website: Waterbird Conservation for the Americas http://www.waterbirdconservation.org/monitoring.html.

NORTH AMERICAN MARSH BIRD SURVEY

Virginia Rail - Photo/Marceline VandeWater

Project Description

The first Yuma Ridgway's Rail (*Rallus obsoletus yumanensis*; formally Yuma Clapper Rail; herafter RIRA) surveys in Arizona were completed in 1968, after being listed as endangered under the Endangered Species Preservation Act in 1967. More comprehensive surveys were not conducted until 1973 (Todd 1986). Since 1973, annual surveys have continued and expanded. Until 2003, surveys targeted RIRA using call-playback survey protocols. In 2003, field trials with multi-species marsh bird survey protocols were initiated. After several years of experimentation, the implementation of the new "multi-species" protocol began in 2006.

At first, the multi-species protocol was used only within the range of the RIRA along the lower Colorado and Gila river drainages. Since, the multi-species protocol has evolved into the Standardized North American Marsh Bird Monitoring Protocol (Conway 2009, Conway 2011), the AZCBM has expanded the surveys to include northern and eastern Arizona marshes. Species composition varies regionally, but protocol typically consists of four to five species calls at each surveyed location (including several species of rails and bitterns). Data collected from each location are entered into the National Marsh Bird Database, which is housed at Point Blue's node of the Avian Knowledge Network located at http://data.prbo.org/cadc2/.

Study Area

The study area is statewide where appropriate marsh habitat exists in Arizona, however, the current focus remains on the lower Colorado and Gila river drainages within the range of the RIRA (Figure 9). This includes downstream of Lake Mead on the Colorado River to the Yuma area, and within the immediate Gila River valley southwest of Phoenix downstream to Painted Rock Dam. Outside the range of RIRA, survey locations are also established in northern and eastern Arizona primarily above the Mogollon Rim and locally in Yavapai and Navajo counties.

Methods

Survey locations are based on the annual availability of shallow water and emergent vegetation (e.g. cattails and bulrush), and reasonable accessibility by foot, vehicle, or watercraft. Larger, continuous stands of marshland habitat are selected over smaller stands, however, some locations contain less than a quarter hectare of vegetation. The specific locations surveyed, and number of survey stations (each station approximately 250-400 m apart) established, annually depends on habitat availability, accessibility, and the number of surveyors.

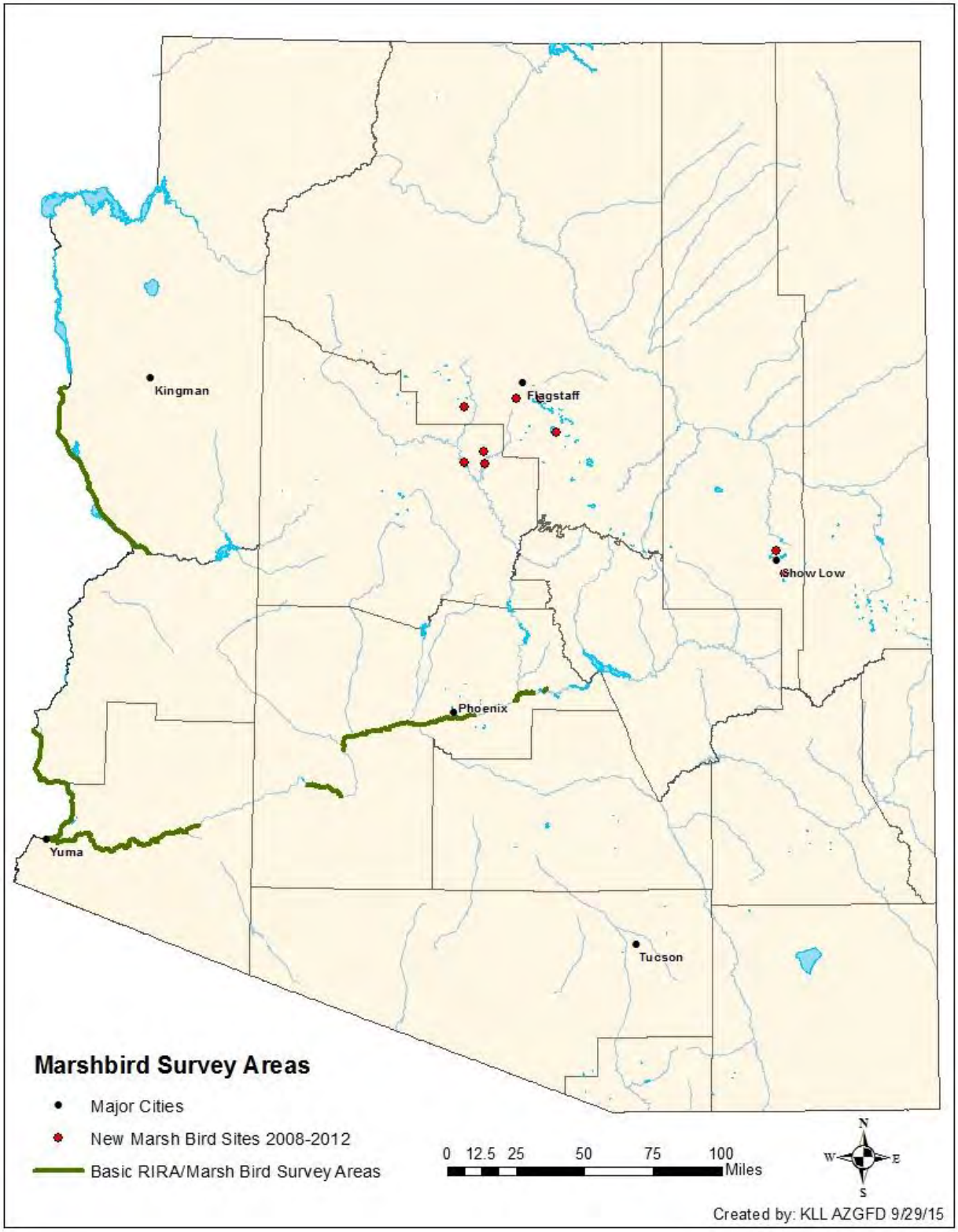


Figure 9. Primary and new marsh bird survey areas in Arizona.

The survey protocol was standardized in 2006 (Conway 2009, Conway 2011), and includes five minutes of silence, followed by four to five 1-minute periods of 30-second vocalizations of one of the target species, followed by 30-seconds of silence. Species included in the call-playback series vary depending on the ecological region of Arizona. Each series includes vocalizations of four to five of the following six species: American Bittern (*Botaurus lentiginosus*; AMBI), Least Bittern (*Ixobrychus exilis*; LEBI), Black Rail (*Laterallus jamaicensis*; BLRA), RIRA, Virginia Rail (*Rallus limicola*; VIRA), and Sora (*Porzana carolina*; SORA). Incidental detections of more common marsh-birds are also recorded including Pied-billed Grebe (*Podilymbus podiceps*; PBGR), Common Gallinule (*Gallinula chloropus*; COGA; formerly Common Moorhen), and American Coot (AMCO). Individual responses from the primary target species were recorded at each station.

An annual Marsh Bird Survey Training Workshop in Yuma each March certifies biologists and volunteers planning on conducting surveys within the range of the RIRA. Outside the range of RIRA, AZCBM provides an abbreviated marsh bird training for those individuals conducting surveys. Briefly, the survey methodology consists of the following:

- For new survey locations, permanent stations are created (number of stations depends on marsh size and suitable habitat).
- Surveys are not conducted during excessive wind or rain.
- The appropriate official call-playback series for each region is used.
- All individuals detected by sight and sound are recorded at each station.
- Surveys are conducted 2-3 times annually between 15 March and 30 June, with more restricted timing depending on the area being surveyed. Timing depends on elevation and mean annual temperatures (Figure 10).

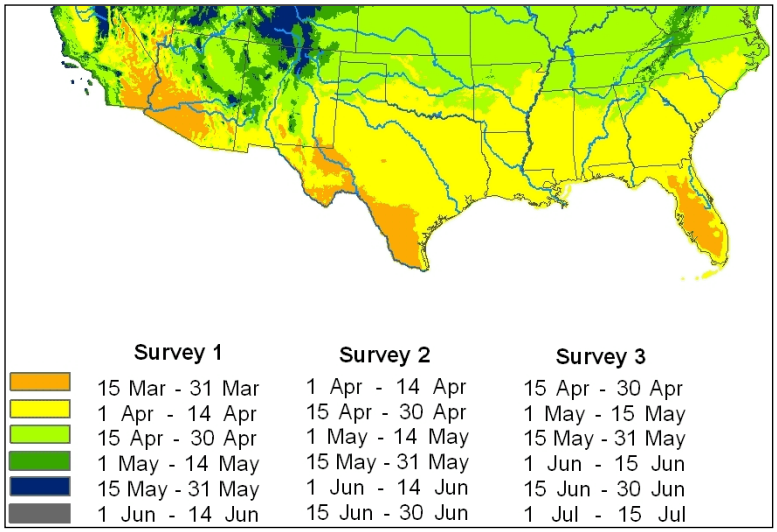


Figure 10. Official dates of annual marsh bird survey windows for southern United States. (Adapted from Conway 2009). Survey dates have been slightly modified for southwestern Arizona (see results below).

Results and Discussion

RIRA-Specific vs. Multi-Species Protocol - After several years of surveying using both the RIRA-specific and multi-species protocols, followed by the consistent use of only the multi-species protocol after 2005, surveyors chose to use the new protocol as they found it beneficial to have additional data on species beyond RIRA. There is debate about which species to include in the call-playback series, and the importance of documenting numbers of AMCOs. For example, BLRAs are included for surveys within the range of RIRAs even though there are no documented records of the species in Arizona away from the immediate lower Colorado River and Bill Williams River drainages. Similar, SORAs were added to surveys in south-central Arizona in 2008, and are regularly detected early in the survey season. However, SORA

detections decline near the end of the season, which supports the current understanding that the species breeds elsewhere. All other species (i.e. RIRA, VIRA, LEBI, COGA, PBGR, and AMCO) are known to breed throughout central and western Arizona, where patterns in detections can be derived. It was decided that COGAs, PBGRs, and AMCOs should be passively surveyed, to provide a shorter survey-time per station allowing for more stations to be surveyed. It has been suggested that prolonging the time spent at each station, and playing some of the louder more raucous calls such as PBGR following the RIRA call, increases detections of RIRA.

There are concerns the multi-species protocol under-samples RIRAs, as compared to RIRA-specific surveys, however, there is a suitable trade-off for the additional data obtained on other species (Nadeau et al 2013). It appears the initial 2003-2005 trials, which included calls from AMBI, COGA, AMCO, and PBGR, had favorable results as compared to the prior RIRA-specific surveys. Even though they were longer (14-minutes per station rather than the current 9-10-minutes per station adopted in 2009), those surveys resulted in more RIRA and other species detections. Specifically, truncating the 2004 and 2005 multi-species survey data after the RIRA call period to eliminate detections achieved only during the AMBI, COGA, AMCO or PBGR calls resulted in a 29% reduction in the number of RIRA detected. The increase in detections after the RIRA call period could be attributable to a combination of the following three factors:

- More time spent at each station results in more RIRA detections even if no calls are actively played.
- Additional call-playback vocalizations trigger additional birds of various species to call, which in turn might stimulate more RIRA calls.
- Remaining at a station and playing COGA, AMCO, and PBGR calls following the RIRA calls, gives more time and perhaps encouragement for RIRAs to respond.

Another aspect of the survey protocol is to survey the same stations and locations each year. While this contributes to data consistency, this standardization is only suitable for large areas of marshland and/or areas with little variation in water levels and habitat. However in some areas, such as along the Gila River where water levels are less regulated, the best habitat can change drastically to where it is unsuitable for marsh birds. Therefore, surveying the same stations becomes inappropriate. Efforts are made to annually survey the same locations and specific stations, although occasional adjustments are made as appropriate habitat is lost or becomes established in adjacent areas.

Central Region 2006-2012 Survey Results - Bill Burger, (Retired) Arizona Game and Fish Department.

<u>Yuma Ridgway's Rail</u> - The number of RIRAs detected in central Arizona, measured by total numbers and numbers per location, has been trending downward since 2006 (Tables 8 and 9). Additionally, the 2010, 2011, and 2012 surveys were among the six lowest RIRA totals in central Arizona since 1992 (i.e. 21-years). Survey methods and effort have varied, however, they have been relatively consistent since 2006. One possible contributor to the downward trend was extensive vegetation clearing and changes to water channel structure and flow along the Gila between 107th and 123rd avenues in Phoenix/Avondale in 2011 and 2012 as part of the Tres Rios project. However, the trend preceded those activities, and low survey numbers in 2012 were not

limited to the Tres Rios area. The number of RIRA detected relative to the number surveyed locations from 2010-2012 show 2012 values dropping approximately 50% (Table 9). Typically in central Arizona, all RIRA detections are largely along the Gila River downstream of 107th Avenue. Conversely, in 2012 the furthest upstream RIRA were detected was at Dean Road (~13 miles downstream of 107th Avenue).

Table 8. Yuma Ridgway's Rail numbers detected at each location in central Arizona.[1]

Survey Site	2006	2007	2008	2009	2010	2011	2012
Saguaro Lake		0	0	0	0	0	0
Salt River @ Blue Point - Granite Reef	0	0	0	0	0	0	
Salt River @ 101/202	0	0	0	0	0	0	0
Salt River @ Tempe Town Lake to SR143							0
Salt River @ Central to 15th Ave.		0	0	0	0	0	0
Tres Rios Hayfield demo wetlands	0	0	0	0	0	0	
Tres Rios regulating wetlands						0	0
Tres Rios overbank wetlands							0
Salt/Gila Rivers @ 91st-107th[2]		0	1	1	0	0	
Base & Meridian WA (107th - 123rd)[3]	1						
Salt/Gila Rivers @ 107th - 115th		0	0	1		0	0
Gila River @ 115th - 123rd		9	4	3	2	4	0
Gila River @ 123rd – Goodyear Butte		0	2	1		2	0
Goodyear Butte	1	4	0	2		0	0
Dean Road Drain	3	3	0	2	2	0	1
Wilson Road Drain	1	3	2	0			
Gila River @ Jackrabbit Rd.	0	1	0	0			
Gila River @ Hwy. 85	1				0		
Gila River @ Robbin's Butte WA	7	5	1	3		0	
Gila River @ Power's Butte-Arlington	0						
Gila River @ Arlington-Gillespie Dam	3	2	4	2		0	1
Arlington Drain	2	1	1	1	2	0	
Arlington Wildlife Area	4	7	7	3	7	9	4
Agua Fria River @ Avondale WTP		0	0	2	0		
Hassayampa/Gila Rivers Confluence		2	5	7	2	1	0
Other or unspecified	0	0	0	0	0	0	
TOTAL	23	37	27	28	15	16	6

[1]Numbers indicate the maximum number of Ridgway's Rails detected during a survey at each location in each year including incidental detections, and regardless of survey method from 2006-2012. Blank fields indicate no survey was conducted at that location that year.
[2]The 91st to 107th route was modified and only three stations (7, 8, 9) were included in that route in 2011. In 2012, the final station was incorporated into the 107th-115th survey.
[3]The 107-123 stretch was split into two surveys starting in 2007.

Table 9. Number of areas surveyed and Ridgway's Rail detected in central Arizona.

Year	All Areas Included			Only Areas 107th & Downstream*		
	N Areas	N RIRA	N RIRA/Areas	N Areas	N RIRA	N RIRA/Areas
2006	16	23	1.4	11	23	2.1
2007	17	37	2.2	12	37	3.1
2008	20	27	1.4	12	26	2.2
2009	20	28	1.4	13	27	2.1
2010	16	15	0.9	9	15	1.7
2011	19	16	0.8	13	16	1.2
2012	14	6	0.4	8	6	0.8

*Ridgway Rails (RIRA) in central Arizona are found annually from along the Salt/Gila River at 115th Avenue and in areas downstream (west). They are seldom found in areas upstream, so data for areas downstream of 107th Avenue is shown separately. Areas along the Agua Fria River are included in the "downstream of 107th"category; however, RIRA have yet to be found along the Agua Fria.

Unlike the lower Colorado River population, RIRA have not been documented wintering elsewhere in Arizona, including the Gila River drainage. This suggests that this population is mostly, if not fully, migratory.

Other Marsh Bird Species – Other marsh bird species have not shown a similar trend to RIRA (Table 10). As noted, there have been no BLRA documented in central Arizona, and although AMBI are occasionally seen, none have been detected during our surveys. The number of other surveyed species detected varied, but without an apparent trend. In 2012, numbers of LEBI and VIRA were near 2007-2011 average, PBGR were at their average, and SORA, AMCO, COGA were all above their average.

Table 10. Central Arizona marsh bird survey totals and annual average by species.

Year	BLRA	LEBI	VIRA	RIRA	SORA[1]	AMCO[2]	COGA	PBGR	AMBI
2006	0	37	27	23	11	Lots	Lots	19+	0
2007	0	47	33	37	10	>248	88	77	0
2008	0	44	27	27	21	>91	70	43	0
2009	0	48	38	28	42	190	86	62	0
2010	0	14	11	15	8	98	51	37	0
2011	0	44	26	16	29	230	91	49	0
2012	0	36	24	6	35	404	99	54	0
Average/Year	0	38.6	26.6	21.7	22.3	210.2	80.8	48.7	0

[1]Few SORAs are detected on surveys after early May, suggesting the majority are nonbreeders and simply lingering winter residents or migrants.
[2]The average for AMCO is lower than it should be because that species was not consistently enumerated in 2006 -2008.

Southwestern Region 2006-2012 Survey Results - Linden Piest, Arizona Game and Fish Department

Department biologists are responsible for conducting marsh bird surveys in the Limitrophe, Yuma, and Laguna Divisions of the Colorado River, and on the lower Gila River drainage upstream to near Gila Bend. USFWS and U.S. Bureau of Reclamation (USBR) biologists conduct surveys along much of the lower Colorado River. Since 2006, Fred Phillips Consulting has been conducting surveys at the reconstructed and expanded Yuma East Wetlands, which had previously been included in the Yuma Division surveys as Prison Hill Marsh. For consistency, we are including their data.

Laguna Division - Mittry Lake - RIRA were surveyed on ten routes (each route consists of multiple survey stations) at Mittry Lake, including adjacent Hidden Shores Marsh. Four routes, North and South Yuma Proving Grounds (YPG) Slough and North and South Teal Alley cover the main marsh habitat at Mittry Lake. These are considered the core monitoring routes which have been surveyed most years since 1981, and annually since 1989. In 2006, West YPG Slough route was established on the west side of the upper portion of the marsh to cover gaps including some areas of newly created habitat.

Because of continued low water resulting from USBR maintenance operations to implement the Multi-Species Conservation Plan (MSCP) restoration project at the upper end of the old river channel, we were unable to access the North Old River Channel route in 2012. Similarly, along the South Old River Channel route, several years of such conditions have resulted in the transition of open water areas to emergent vegetation marshes. Therefore, access to that route will not occur in the future absent a major scouring or dredging event.

The 75 RIRAs detected at Mittry Lake in 2012 was the lowest number recorded (Table 11). The number may have been higher if access to the two old river channel routes was possible as those areas average approximately 15 RIRAs annually. Regardless, overall survey results show a general downward trend (Figure 11). In 2012, 38 RIRAs were detected just at the core monitoring routes, the second lowest total, and a decrease from 52 in 2011. The last eight years represent eight of the ten lowest years since 1990. A possible cause for these declines may be gradually diminishing water depths due to the accumulation of residual wetland vegetation.

Table 11. Maximum numbers of Yuma Ridgway's Rails detected annually in sw. Arizona.

Location	Year						
	2006	2007	2008	2009	2010	2011	2012
Laguna Division (primarily Mittry Lake area)							
North YPG Slough	14	5	7	14	17	9	10
South YPG Slough	10	18	7	20	15	25	12
North Teal Alley	9	15	9	8	4	5	8
South Teal Alley	12	12	6	8	7	13	8
(Core monitoring routes total)[1]	(45)	(50)	(29)	(50)	(43)	(52)	(38)
Mittry Lake East	4	5	6	4	4	1	1
Mittry Lake West	4	2	2	8	0	3	3
North Old River Channel	2	6	8	10	7	11	NS
South Old River Channel	4	13	6	5	NS	NS	NS
Old Inlet Channel	11	10	15	12	13	15	15
West YPG	9	6	11	10	14	2	7
Hidden Shores Marsh	12	3	7	7	9	12	11
Total	91	95	84	106	90	96	75
Yuma Division							
Prison Hill Marsh[2]	*	1	0	3	5	5	3
Backwater 33	0	0	0	0	0	0	0
Other	0	1	2	1	3	1	1
Total	0	2	2	4	8	6	4
Lower Gila River							
North Gila Valley	0	3	6	8	9	4	6
Wellton-Mohawk	15	10	16	12	11	14	6
Quigley Marsh[3]	(8)	(4)	(1)	(1)	(0)	(0)	(0)
Citrus Valley (Paloma Ranch)	9	0	1	4	0	0	1
Total	24	13	23	24	20	18	13
Annual Total	115	110	109	134	118	120	92

NS = No survey conducted
[1]Cumulative total from the four core Mittry Lake routes (each route consists of multiple survey stations) listed above. The four core routes cover the main marsh habitat at Mittry Lake and have been the most consistently surveyed over the years.
[2] Survey data from Fred Phillips Consulting at Yuma East Wetlands, all other data collected by Department.
[3]Quigley Marsh totals are included in the Welton-Mohawk location listed above.

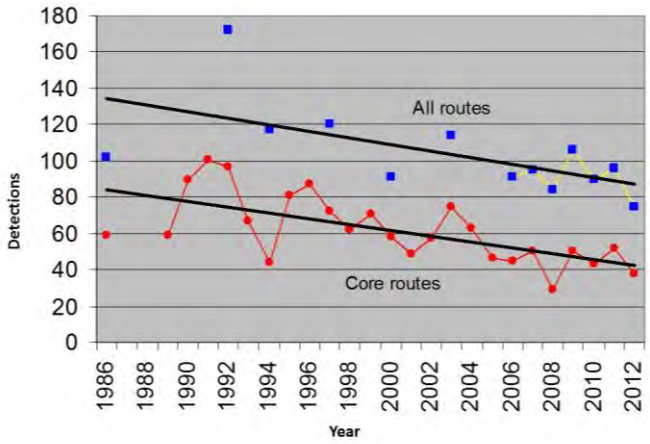


Figure 11. Annual Yuma Ridgway's Rail numbers at Mittry Lake, 1986-2012. A route consists of multiple survey stations. Four core routes cover the main marsh habitat at Mittry Lake and have been the most consistently surveyed over the years.

Numbers of other marsh bird species at Mittry Lake are within the general range of fluctuation, though we detected much higher numbers of SORAs in 2012 and BLRA counts were higher than average in 2011 and 2012 (Table 12). However, overall trends are difficult to distinguish due to the switch to the multi-species protocol, which greatly increased the detection rates for these species (Figure 12).

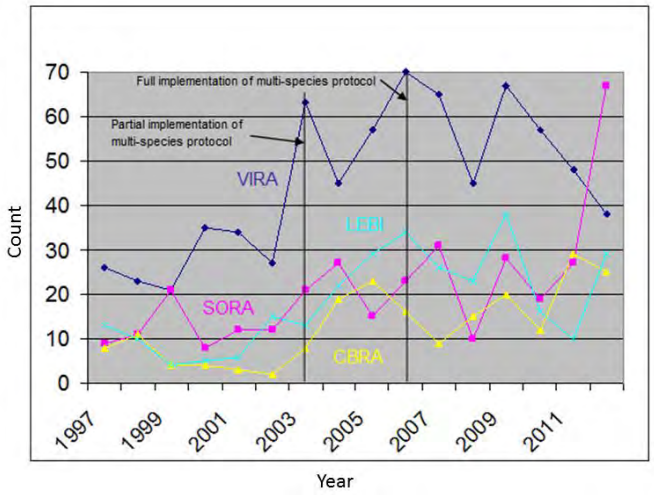


Figure 12. Annual marsh bird numbers detected at Mittry Lake core routes, 1997-2012. A route consists of multiple survey stations. Four core routes cover the main marsh habitat at Mittry Lake and have been the most consistently surveyed over the years.

<u>Colorado River, Yuma Division</u> - No RIRAs were detected within the upper Yuma Division in 2012. Along the main channel, habitat patches are generally too small for RIRA occupancy. However, restored habitat at the Yuma East Wetlands Park continues to improve. Bulrush stands at the former site of Prison Hill Marsh (i.e. Ibis Lake) have returned after several years of desiccation due to park development. This area now provides suitable habitat, though smaller than its historical size. This area previously had the most RIRA habitat within the Yuma Division, and the most detections in the past.

<u>Colorado River, Limitrophe Division (south of Yuma)</u> - Because of safety concerns from U.S./Mexico border-related activity, we have not conducted surveys in the Limitrophe Division since 2006.

<u>Lower Gila River</u> - The habitat within the lower Gila River drainage has become limited in recent years. The marsh habitat maintained by irrigation runoff at Paloma Ranch near Gila Bend has diminished, but not to an extent that would explain the scarcity of RIRAs. The river corridor through the Tacna Valley area has become increasingly desiccated, and very few marsh birds were detected in 2011. Because of a poor likelihood of detecting RIRAs, surveys were not conducted in 2012, and will not be conducted again until habitat conditions improve. The water level decline at Quigley Wildlife Area continues after the cessation of agriculture on an adjacent mesa ten years ago. There is only a small amount of marsh immediately below the pipeline

outlet, where no marsh birds of any species have been detected since 2009. Similarly, the marshes at Effie May dried completely in 2009, and no surveys have been conducted. In the North Gila and Wellton-Mohawk Valleys, the number of RIRAs detected continued to steadily decline.

Table 12. Maximum numbers of focus species recorded at "core" routes at Mittry Lake.*

Location	Year	RIRA	VIRA	SORA	BLRA	LEBI
North Teal Alley	2006	9	10	6	1	7
	2007	15	13	5	0	5
	2008	9	4	0	0	4
	2009	8	6	0	2	7
	2010	4	5	3	1	4
	2011	5	5	8	1	2
	2012	8	11	9	2	5
North YPG Slough	2006	14	24	4	5	6
	2007	5	27	1	2	3
	2008	7	20	1	6	3
	2009	14	27	5	4	11
	2010	17	24	4	6	2
	2011	9	19	0	11	2
	2012	10	22	4	10	7
South Teal Alley	2006	12	20	10	2	13
	2007	12	13	18	1	12
	2008	6	6	9	2	10
	2009	8	11	18	2	15
	2010	7	4	9	0	6
	2011	13	10	16	0	5
	2012	8	9	18	0	10
South YPG Slough	2006	10	16	3	8	8
	2007	18	12	7	6	6
	2008	7	15	0	7	6
	2009	20	23	5	12	5
	2010	15	24	3	5	4
	2011	25	14	3	17	1
	2012	12	25	10	13	7
Total by year	2006	45	70	23	16	34
	2007	50	65	31	9	26
	2008	29	45	10	15	23
	2009	50	67	28	20	38
	2010	43	57	19	12	16
	2011	52	48	27	29	10
	2012	38	67	41	25	29
Average/Year		43.9	59.9	25.6	18.0	19.7

*Numbers indicate the maximum number of birds detected during an entire survey. A route consists of multiple survey stations. Four core routes cover the main marsh habitat at Mittry Lake and have been the most consistently surveyed over the years.

Summary of Southwestern Region Survey Results - The trends for the focus marsh bird species in the southwestern Arizona region since 2006 are inconsistent and depend on species (Table 13). BLRA and VIRA have trended slightly upward, while overall LEBI and PBGR detections have declined.

Table 13. Southwestern Arizona marsh bird survey totals and annual average by species.

Year	BLRA	LEBI	VIRA	RIRA	SORA1	AMCO2	COGA	PBGR	AMBI
2006	32	127	158	115	60	n/a	200	85	0
2007	11	120	147	110	71	n/a	160	91	0
2008	28	77	120	109	47	n/a	156	68	0
2009	44	118	165	134	115	n/a	189	86	0
2010	21	67	145	118	63	n/a	167	62	0
2011	46	64	119	120	56	n/a	169	70	0
2012	41	84	163	92	106	n/a	193	55	0
Average/Year	31.9	93.9	145.3	114	74	n/a	176.3	73.9	0

[1]There is no evidence suggesting SORAs breed within the lower Colorado River corridor, thus those detected on surveys are likely all simply lingering winter residents or migrants.
[2]Due to the abundance of AMCO at most locations, this species is not counted during surveys.

Survey Timing Analysis – Overtime the protocol end date has varied from April 30, to May 15, to May 30 without knowing the effects to detection rates. To quantify the possible effects this may have on the survey results, the number of RIRAs detected per station (excluding duplicates) were calculated at Mittry Lake for half-month intervals from March 16 to May 31, 1996-2012 (Table 14). Detections were similar through mid-May, but much lower during the last half of May. Therefore, it appears that surveys for RIRA and other marsh bird species can be extended through mid-May in southwestern and central Arizona without biasing the results. Although our data suggests extending the survey period to mid-May has no effect on RIRA detectability, future surveys will continue to follow the National Multispecies protocol survey periods (Figure 10), and completing all surveys along or near the lower Colorado River before May 1.

Table 14. Mean numbers of Yuma Ridgway's Rails recorded at "core" routes at Mittry Lake.*

Survey Timing Range	Mean	N RIRA	N Stations
March 16-31	0.93	251	269
April 1-15	0.88	269	304
April 16-30	1.03	600	582
May 1-15	0.96	603	626
May 16-31	0.6	55	92

*Surveys occurred from 1996-2012. A route consists of multiple survey stations. Four core routes cover the main marsh habitat at Mittry Lake and have been the most consistently surveyed over the years.

Northern and Eastern Region

Following the establishment of the Standardized North American Marsh Bird Monitoring Protocol (Conway 2009, Conway 2011), the Department expanded surveys to additional regions of the state. During regional ABCI meetings, partners in northern and eastern Arizona were encouraged to evaluate marsh habitats to determine if establishing survey stations would be feasible. Priority areas would provide adequate marsh habitat annually, and could readily be surveyed. Department staff and partners, including Northern Arizona Audubon volunteers, began surveys in 2008, and established nine new marsh bird survey locations in northern and eastern Arizona by 2012 (Figure 9, Table 15).

Table 15. Numbers of marsh birds recorded during newly established surveys.*

Site	Year	VIRA	SORA	LEBI	PBGR	COGA	AMCO
Kachina Wetlands (1 station)	2008	3	2				25
	2009	1	2				38
	2010	4	6				
	2011	2	2		3		
	2012	3	5				1
JD Dam (1 station)	2008	1	1		1		
	2009		1		2		8
	2010	1	1		3		
	2011		1		4		
	2012	Too Dry – No Habitat					
Lower Lake Mary Wetland (1 station)	2008	2	2				
	2009	2	2				1
	2010	2	2				
	2011	2					
	2012	3					1
Marshall Lake (3 stations)	2008		5		1		50
	2009						
	2010	2	17		6		34
	2011	5	11		18		
	2012	Too Dry – No Habitat					
Mormon Lake (12 stations)	2008	First Established in 2009					
	2009	3	19		1		38
	2010	4	18		15		20
	2011	8	7		17		30
	2012	1					8
Tavasci Marsh (4 stations)	2008	13	5	2		2	
	2009	14	5			2	
	2010	11	4	3		1	
	2011	22	8	3		2	
	2012						
Bubbling Pond Fish Hatchery (2 stations)	2008	First Established in 2012					
	2009						
	2010						
	2011						
	2012	2		1		1	
Pintail Lake (2 stations)	2008	First Established in 2012					
	2009						
	2010						
	2011						
	2012		2		3		55
Jacques Marsh (3 stations)	2008	First Established in 2012					
	2009						
	2010						
	2011						
	2012	2	12		5		

*Numbers at each site indicate the maximum number of each species detected during one of two or three surveys conducted each year

Historical marsh bird survey effort has focused on lower elevations in southern and western Arizona where RIRA are present. Although SORAs are often detected on these surveys early in the season, later surveys to the same site often produce few or no detections, suggesting these are non-breeding individuals. The most common rail nesting in northern and higher elevations in Arizona is SORA. Since additional surveys have become established within this region, there is now a mechanism to collect data from the state's nesting population.

Many established survey areas north of the Mogollon Rim are subject to annual water fluctuations that are dependent on seasonal precipitation levels, particularly the prior winter's snow pack. During years of poor snow accumulation, some areas become too dry to attract rails or other marsh birds for the following breeding season. However, once sufficient water levels return, and subsequent marsh habitat becomes established, these migratory species readily return to breed.

Recommendations

1) Continue to encourage the establishment of additional marsh bird surveys areas to obtain more statewide coverage.
2) The apparent steady downward trend of RIRA warrants additional research to determine if periodic burning of marshes or other habitat manipulation techniques should be encouraged.
3) Encourage research to determine the percentage of RIRA that are migratory and where survey windows could be adjusted.

Acknowledgements

This cooperative effort has been conducted by personnel and volunteers from the Arizona Game and Fish Department, Bureau of Reclamation, Salt River Project, U.S. Fish and Wildlife Service and U.S. Forest Service. We would like to thank the following dedicated surveyors: Janie Agyagos, Joey Alsadi, John Arnett, Scott Blackman, Bill Burger, Dave Cagle, Kriselle Colvin, Troy Corman, John DeLuca, Scott Fischer, Leslie Fitzpatrick, Jon Hanna, Tom Hildebrandt, Kathy Hilton, Celia Holm, Michael Ingraldi, Diane Laush, Shawn Lowery, Suzi MacVean, Elaine Morrall, Mike Myers, Richard Myers, Alicia Nemlohill, Linden Piest, Tyler Raspiller, Randi Rath, Cecilia Schmidt, Courtney Shanley, Mark Stewart, Mike Sumner, Tice Supplee, Lesly Swanson, Dan Urquidez, Ruth Valencia, Bea Vizcarra, and Rene Wilcox.

LAND BIRDS

NORTH AMERICAN BREEDING BIRD SURVEY

Photo/Kurt Licence

Project Description

Responding to the concern of pesticides effects on bird populations, the North American Breeding Bird Survey (BBS) coordinated by the USGS Patuxent Wildlife Research Center is a long-term, large-scale, international avian monitoring program initiated in 1966 to track the status and trends of North American bird populations. Although initial concerns over pesticide use have subsided in recent decades, bird populations continue to be subjected to numerous widespread threats. These threats include habitat loss, habitat fragmentation, land-use changes, new pesticides, and habitat alterations due to climate change. Today, the BBS informs researchers and wildlife managers of significant changes in bird population levels, so the cause can be identified, and appropriate actions taken before populations reach critically low levels.

Each year during the breeding season, participants skilled in avian identification collect bird population data along established, randomly selected, roadside survey routes. Over 4,100 survey routes are located across the continental U.S. and Canada. In Arizona, there are 64 currently active survey routes, including three non-random routes. One coordinator for each state enlists qualified surveyors to conduct the surveys, and suggests route changes when safety or other issues arise. A surveyor is assigned a route with the expected commitment of conducting the route once each year for a minimum of three years.

Once analyzed, BBS data provide an index of population abundance that can be used to estimate population trends and relative abundances at various geographic scales. Trend estimates for more than 420 bird species and the data are currently available at https://www.pwrc.usgs.gov/bbs/index.cfm.

Study Area

Randomly established BBS routes are distributed across Arizona where roadways exist (Figure 13). However, within the past decade, a few routes near the Mexico/U.S. border in Pima and Santa Cruz counties were discontinued due to border safety issues.

Methods

Each March and April, BBS packets are sent to every surveyor assigned to conduct routes. The packets include route maps, stop coordinates/descriptions, field survey forms, self-addressed return envelope, and other informative documents for surveying assigned routes.

Figure 13. Currently active Breeding Bird Survey route locations in Arizona.

In Arizona, survey routes are conducted once a year during the peak of nesting season, primarily early May through June. However, the lowest elevation routes in the southwestern corner of the state can be conducted as early as late April. The timeframe to conduct surveys is based on elevation and the physiographic region in which the route was established. Most desert routes (<1067 m elevation) are to be conducted in early to mid-May; desert grasslands, sagebrush, Madrean oak woodlands, and pinyon pine-juniper woodlands (1067-1829 m elevation) in late May-early June; ponderosa pine, mixed-conifer, spruce-fir forests, and high elevation grasslands (>1829 m elevation) in early to mid-June. Late June surveys are avoided at lower elevations, but are still acceptable at the higher elevations. Some routes include a full range of elevations and habitats. In these instances, surveyors are asked to choose median dates.

Each route is 24.5 mi (39.4 km) long, with a total of 50 stops located at 0.5 mi (0.8 km) intervals. These surveys start one-half hour before local sunrise, and take 4.5 to 5 hours to complete. A three-minute point count is conducted at each stop, during which the observer records all individual birds detected within a 0.25 mi (0.4 km) radius. Data is recorded, and totaled over the entire route. Time, temperature, cloud cover, and wind speed are also recorded at the beginning and end of each survey.

The BBS was designed to provide a continent-wide perspective of population change. With such a broad range of information collected by various individuals, special precautions are taken to produce comparable data over time. This requires consistent methodology and observer expertise, as well as visiting the same stops each year. In addition, surveys should be conducted under suitable weather conditions, and during the most appropriate survey period for each route. Established routes are randomly located to sample habitats that are representative of the entire region.

Results and Discussion

The number of completed survey routes in Arizona has declined since 2006 (Table 16). Extreme fire danger and subsequent wildfires in 2011 and 2012 led to forest closures, which blocked access to about a dozen BBS routes. These closures resulted in a record low number of completed BBS routes in Arizona those years.

Table 16. Number of Breeding Bird Survey routes completed in Arizona, 2006-2012.							
Survey Year	2006	2007	2008	2009	2010	2011*	2012*
N Routes Completed	56	50	45	51	45	38	35

*Wildfires and U.S. Forest closures prohibited some routes from being completed.

Finding surveyors was challenging for the nine BBS routes on Navajo and Hopi tribal lands in northeastern Arizona (Figure 14). Most of these routes are well away from urban areas, therefore greatly limiting the potential pool of experienced surveyors. Although there are some exceptions, many routes also have limited habitat diversity, and thus, very limited bird diversity to keep a surveyor committed to the route.

Travel costs also greatly increased, particularly the exponential rise in fuel expenses during this period. This discouraged some volunteers from continuing to participate, particularly when their routes were more distant.

First detected and documented breeding in Arizona in 2000 (Corman 2005c), the rapid colonization and population increase of Eurasian Collared-Dove (*Streptopelia decaocto*) in the state is well documented by the BBS. By 2008, this species became the 23rd most abundant species detected in Arizona. By 2012, it was the 13th most detected species and reported on over half (56%) of the BBS routes surveyed.

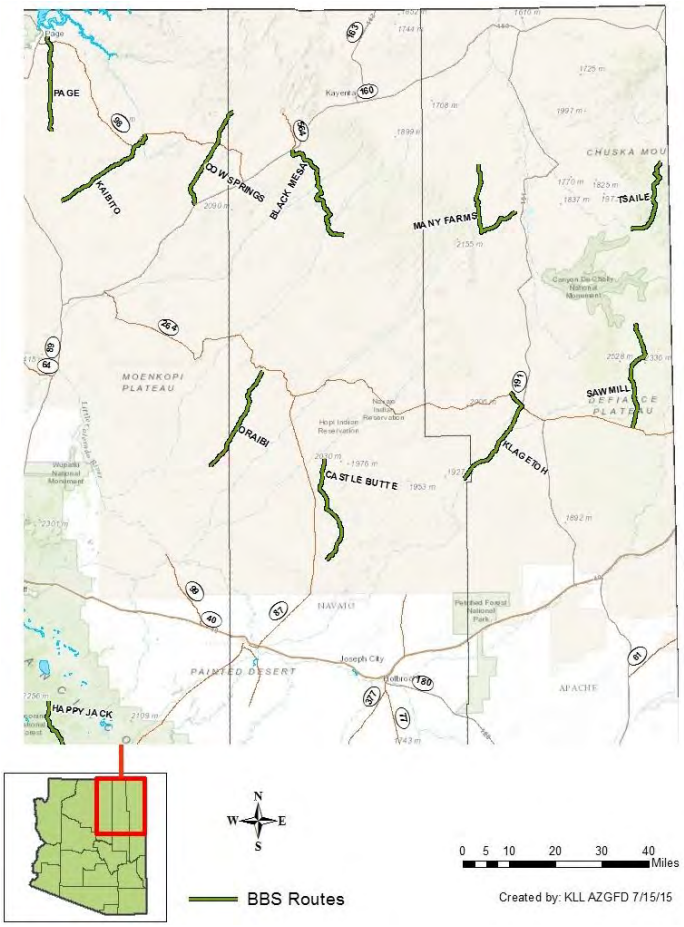


Figure 14. BBS routes in northeastern Arizona, primarily on Hopi and Navajo tribal lands.

Recommendations

1. Maintain Department coordination of this survey effort in Arizona.
2. Continue efforts to find surveyors for currently unassigned routes.

Acknowledgements

This cooperative effort has been conducted by personnel and volunteers from the Department, Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Forest Service, and Audubon Arizona. We would like to thank the following dedicated surveyors: John Arnett, Carol Beardmore, Mary Ellen Bittorf, Richard Carlson, Greg Clark, Bea Cooley, Troy Corman, Gary Crandall, DeeDee Delorenzo, Johnida Dockens, Lu Gidding, Steve Goodman, CJ Grimes, Kathy

Groschupf, William Grossi, Homer Hansen, David Hawksworth, Thomas Hayes, Robert and Susanna Henry, Celia Holm, Eric Hough, Doug Jenness, Edwin Juarez, Mark Larson, Melody Kehl, Glenn Klingler, Shawn Langston, Tom Linda, Steve Marlatt, Tracy McCarthey, Curt McCasland, Arnold Moorhouse, Elaine Morrall, Phil Norton, John Nystedt, Sue Ordway, Cecelia Overby, Linden Piest, Timothy Price, David Smith, Tice Supplee, Carl Tomoff, Jimmy Videle, Russell Widner, Cathy Wise, Joseph Woodley, John Yerger, and Brenda Zaun.

NIGHTJAR SURVEY NETWORK

Lesser Nighthawk - Photo/Marceline VandeWater

Project Description

There has been increasing concerns of declining populations of some nightjar species across the U.S.. Modeled after the BBS, the Nightjar Survey Network (NSN) is coordinated by the Center for Conservation Biology at the College of William & Mary. This program was established to better understand population status and trends of nightjars, which are not well captured by BBS surveys. Similar to the BBS, the NSN relies on dedicated volunteers and biologists for implementation. Arizona has been participating in this survey since 2008, under the coordination of the Department and Sonoran Joint Venture (SJV). The species targeted in Arizona are: Common Nighthawk (*Chordeiles minor*), Lesser Nighthawk (*Chordeiles acutipennis*), Mexican Whip-poor-will (*Antrostomus arizonae*), and Common Poorwill (*Phalaenoptilus nuttallii*). A fifth Arizona nightjar species, the Buff-collared Nightjar (*Antrostomus ridgwayi*) is a local and irregular borderland species, and therefore is not a target.

Similar to the BBS, nightjar surveys are standardized point counts conducted along road-based routes in the early evening hours. Most routes follow established BBS routes, with some additional routes to target specific species or habitats. Surveys are conducted during specific lunar windows to enhance species detectability as nightjar activity, and calling increases during the evening when the moon is visible above the horizon. Different than BBS surveys, a surveyor only needs to be familiar with each nightjar's characteristic calls. Thus, in Arizona a surveyor only needs to know 2-3 species calls to effectively survey a route, which enables recruiting volunteers who are less experienced in bird identification by sound.

Study Area

Nightjar survey routes are distributed statewide in Arizona and primarily follow established BBS routes (Figure 13). However, some additional non-BBS routes are also surveyed. Mexican Whip-poor-will is a species of particular interest in Arizona, but very few BBS routes travel through this species' preferred habitat. Therefore, four non-BBS routes have been established targeting Mexican Whip-poor-wills, but more routes are needed to provide better coverage for this SGCN species (Figure 15).

Methods

Each assigned route is surveyed once annually during any of three separate 7-day lunar windows in the months of April, May or June. The survey dates are specifically chosen each year to coincide with the nights of brightest moonlight and expected greatest nightjar calling frequency. Adhering to these annual lunar windows is important for maintaining consistent survey conditions. When circumstances do not allow for a route to be surveyed during the lunar windows, a survey may be conducted while the moon is visible or at least half full. Routes in lower elevations and latitudes where Lesser Nighthawks are anticipated to be present are

conducted in April or May. For northern Arizona and higher elevations in southeastern Arizona where Mexican Whip-poor-wills and/or Common Nighthawks may be present, routes are conducted in May or June.

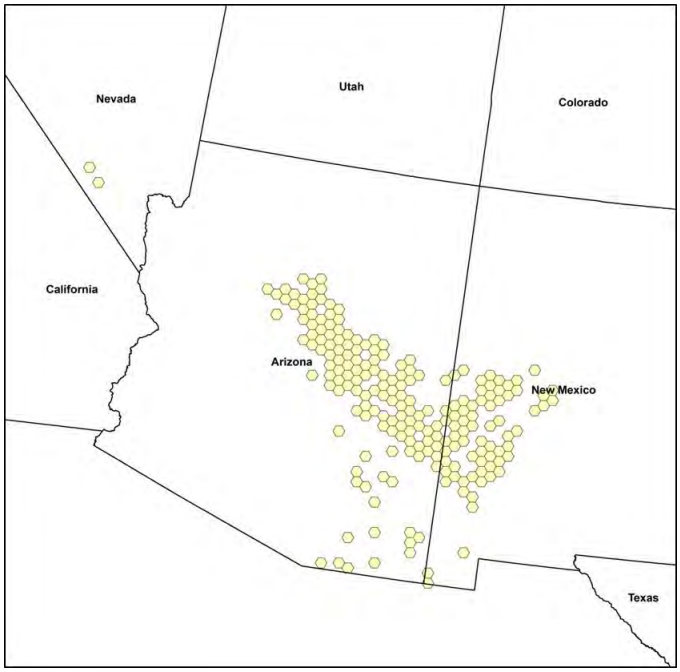


Figure 15. Potential survey area/life zone for the Mexican Whip-poor-will. Sampling grid cells are based on topography. Map courtesy of Michael Wilson, Center for Conservation Biology, College of William and Mary.

Each survey route is nine miles (14.5 km) in length with survey points at one mile (1.6 km) intervals for a total of ten point counts. Starting at local sunset, it takes approximately 1.5 hours to complete one survey. At each point count, all nightjars detected during a six-minute period are recorded, as are environmental variables (e.g., temperature, cloud cover).

Results and Discussion

The number of routes surveyed has gradually increased from a low of eight in 2008, to a high of 29 in 2010 and 2012 (Table 17). From 2010 to 2012, Arizona was one of the leading states for the number of routes surveyed.

Table 17. Number of Arizona routes surveyed and species/numbers of nightjars detected, 2008-2012.

Year	N Routes Surveyed	Lesser Nighthawk		Common Nighthawk		Common Poorwill		Mexican Whip-poor-will	
		Mean	Total/Year	Mean	Total/Year	Mean	Total/Year	Mean	Total/Year
2008	8	3.00	24	2.63	21	5.25	42	0.00	0
2009	19	6.37	121	0.79	15	3.21	61	0.68	13
2010	29	8.93	259	1.66	48	2.55	74	0.21	6
2011	25	6.64	166	2.12	53	2.20	55	0.04	1
2012	29	8.52	247	0.66	19	1.76	51	0.17	5

Following discussions with biologists from New Mexico and Arizona, it was determined that the start time should vary slightly in the southwest U.S. from the national protocol. The national protocol was originally designed to detect Eastern Whip-poor-wills (*Antrostomus vociferous*) and Chuck-will-widows (*Antrostomus carolinensis*) in the eastern U.S., which requires surveys to start 30 minutes after sunset. Arizona followed the national protocol first year of the surveys, but Lesser Nighthawks, which only occur in the West, become most active and easily detected just before or at sunset. Therefore, in 2009 and 2010 surveys were adjusted to 30 minutes before sunset in southern Arizona and low elevations where Lesser Nighthawks are likely to be encountered. In northern Arizona and high elevations where Common Poorwills and Mexican Whip-poor-wills are likely to occur, the surveys followed the national protocol. However, a review of the 2009-2010 data indicated that on several routes, the 30 minutes before sunset was

detecting a high concentration of Lesser Nighthawks, but it was too early for detecting Common Poorwills. Thus in 2011, it was decided that a start time of sunset was the best compromise for Arizona's nightjar species (Table 18).

Table 18. Shifting start time changes for nightjar surveys by regions in Arizona.

Route Region	Year				
	2008	2009	2010	2011	2012
Southern or low elevations	30 min. after sunset	30 min. before sunset	30 min. before sunset	sunset	sunset
Northern or high elevations	30 min. after sunset	30 min. after sunset	30 min. after sunset	sunset	sunset

Recognizing the established BBS routes have been detecting only a few Mexican Whip-poor-wills, and because Arizona and New Mexico encompass much of this species' U.S. breeding range, expanding the survey area with new routes within potential habitat needs to occur. An approach could be to delineate a survey area using 16-km grids within the species' potential habitat and randomly selecting routes within each grid (Figure 16). eBird data can assist in this effort.

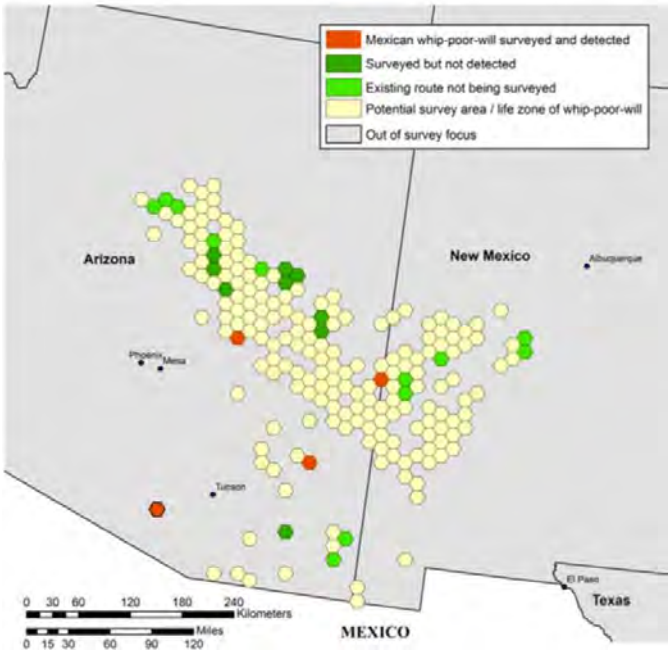


Figure 16. Detections and survey effort within the general habitat and range of Mexican Whip-poor-will in the U.S .Map courtesy of Michael Wilson, Center for Conservation Biology, College of William and Mary.

Buff-collared Nightjars occur very locally and irregularly in the border region of Arizona (Corman 2005a). Some years the species has not been reported, but this could partially be due to biologists and birders reducing visits to these areas at night due to border safety issues. The locations where this species has been recorded are not along well-established roadways where nightjar surveys could be conducted. Therefore, unless a specific project is established, monitoring populations of this species in Arizona will rely on birding reports like those entered into eBird.

Recommendations

1) Continue to encourage more participation in the NSN to increase the number of routes surveyed.
2) Limit BBS routes for conducting nightjar surveys to only active BBS routes. Obsolete BBS routes should be removed from the NSN website.
3) Established additional routes to increase potential opportunities to detect Mexican Whip-poor-wills.

Acknowledgements
This cooperative annual effort has been coordinated in Arizona by Carol Beardmore, Sonoran Joint Venture, with support from Edwin Juarez, ABCI. Personnel and volunteers from the Arizona Game and Fish Department, U.S. Fish and Wildlife Service, U.S. Forest Service, The Nature Conservancy, and Audubon Arizona assisted in conducting the surveys. We would like to thank the following dedicated surveyors: Katie Anderson, Celeste Andresen, John Arnett, Carol Beardmore, Lois and Clark Bloom, Shawn Carroll, Greg Clark, Jeff Corcoran, Jennifer Cordova, DeeDee Delorenzo, Johnida Dockens, Robert Dummer, Bob Evans, Joe Ford, Peter Friederici, Dina Ginter, Homer Hansen, Tom Hildebrandt, Elaine and Bob Hough, Richard Inman, Emily Jeffreys, Edwin Juarez, Christina Kondrat-Smith, Diane Laush, L. LeSuer, Susan MacVean, Janine McCabe, Elaine Morrall, Linden Piest, Stephanie Prevost, Tim Price, Jim Schroeder, Deborah K. Sebesta, Kristen Wert, Michael Wienholt, Cathy Wise, and Brenda Zaun.

RIPARIAN BREEDING BIRD SURVEY

Project Description

Yellow-breasted Chat - Photo/Bruce Taubert

Many of Arizona's bird species have limited distribution in the U.S., and their populations are poorly monitored by the BBS and other large-scale breeding season surveys. These annual surveys inadequately sample major bird groups in the state, including species that breed in riparian and grassland habitats, Sonoran Desert species that breed earlier or later than most BBS surveys are conducted, and nocturnal species. Thus, population trend information for these species is poor or lacking.

Riparian communities and aquatic habitats comprise less than 2% of the total land area in the arid western United States (AGFD 2012). However, they are considered the most productive, ecologically diverse, and threatened habitats in the state. Due to the extensive loss and alterations of this habitat in Arizona, it is not surprising that a significant number (47 species or 32%) of birds listed on Arizona's SGCN list, also regularly nest in this habitat.

The objectives of the Riparian Breeding Bird Survey are to obtain population and density estimates of birds that breed in riparian habitats, as well as explore their spatial distribution, and habitat preferences. A long term objective is to detect population trends over time.

In 2008, a pilot study was conducted to survey for breeding birds at randomly selected plots along permanent and intermittent drainages. Using the results from this preliminary study, a full-scale project was designed and implemented between 2009 and 2012. Work was completed by volunteers, with some biologists from partner agencies.

Study Area

The study area includes riparian habitat across Arizona, however tribal and some local areas with physical access issues (e.g. Colorado River in the Grand Canyon) were excluded (Figure 17). Additionally, the lower Colorado River corridor and the lower Bill Williams River were also excluded as similar surveys were being conducted as part of the Lower Colorado River Multi-Species Conservation Program (LCRMSCP 2004).

Riparian habitat was stratified based on vegetation dominance and condition, ownership, and region. Nearly 5,000 plots were delineated with a subset randomly selected for actual surveys. Plots along small streams were 100 m wide, approximately 1.6 km long, and covered about 16 ha. Plots along larger streams and wider floodplains were partitioned into 16 ha plots.

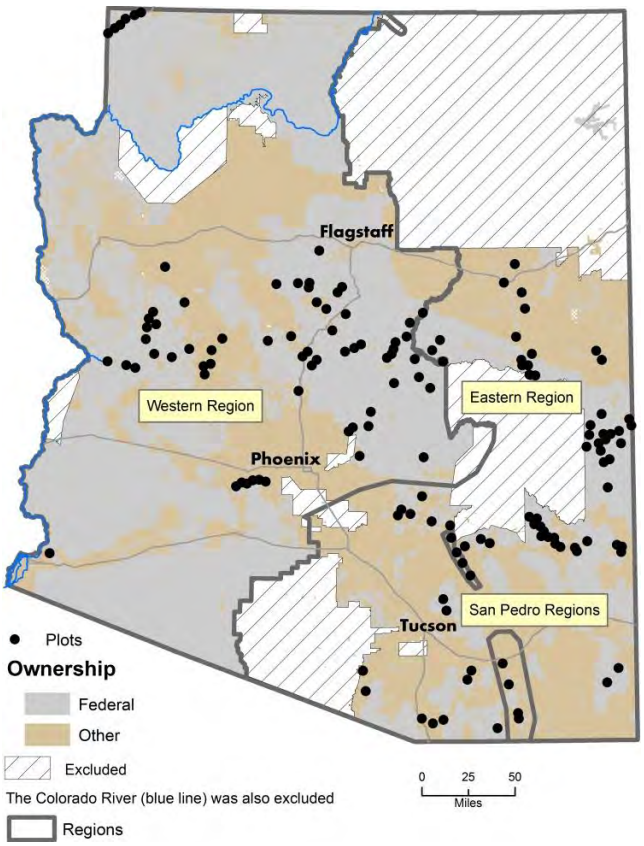


Figure 17. Regions, excluded areas, riparian surveyed plots, and ownership in the study area.

Methods

We used a double sampling design with an area search approach. A large sample of plots was surveyed using a rapid method (e.g., 2-3 repeat surveys using area search), and a subsample of those were resurveyed by a different surveyor using an intensive method (e.g., 4-6 repeat surveys using area search). The ratio of results from the rapid survey to the intensive surveys provided a "detection rate" used to adjust the results from rapid surveys (Cochran 1977).

Survey timing was dependent on elevation and region. Typically surveys occurred between mid-April and late June, with some southeastern Arizona plots conducting a final survey between late July and mid-August during the monsoon season. A comprehensive field manual was prepared with specific instructions and data forms (Bart et al. 2012), including:

- On each survey visit, an area search was conducted during the first 4-5 hours of daylight with the surveyor covering the entire area of a 16 ha plot.
- On a plot map, the surveyor marked the location, habitat, and behavior of each individual bird or pair detected (by sight and sound).
- The number of breeding pairs or territories/per species for the entire plot was determined by compiling detections by visit and generating a final count from all visits.
- During one survey visit, certain habitat variables were recorded from five vegetation points distributed across the plot.

Results and Discussion

Corman et al. (2017b) compiled a final report on this project, and the following is an abbreviated summary of those results. We surveyed 146 plots from 2009 to 2012, and intensive surveys were conducted at 14 (10%). During the rapid surveys, we recorded 34,748 birds of 197 species excluding incidental observations. This survey provided good coverage (≥100 individuals recorded) for 59 species and fair coverage (25-99 individuals) for 52 additional species. Of the 47 birds which are SGCN and regularly nest in riparian habitats, this study provided good and fair coverage for 17 and 6 species, respectively. Few or no records for the remaining 24 SGCN were obtained, indicating species-specific surveys may be required to successfully monitor their populations. Total population size in the study area was estimated at about 1.5 million birds, with a density of 1,950 birds per km^2. Data describing the diversity and structure of vegetation were collected at 141 plots. Plot habitat analysis revealed intuitive patterns between breeding birds and

their environment. Long-term monitoring will facilitate identification of population and/or suitable habitat trends.

Acknowledgements
This cooperative effort has been conducted by personnel and volunteers from the Department, Bureau of Land Management, Bureau of Reclamation, U.S. Fish and Wildlife Service, and U.S. Forest Service. We would like the thank the following dedicated surveyors: Bill Adler, Janie Agyagos, Joey Alsadi, Celeste Andersen, John Arnett, Joseph Barnett, Carol Beardmore, Carl Berger, Mary Ellen Bittorf, Scott Blackman, Geoffrey Bland, Brian Bock ,Bill Bogett, Bill Burger, Dave Cagle, Chris Calvo, Julia Camp, Carol Chambers, Greg Clark, Kriselle Colvin, Troy Corman, Barbara Davis, John DeLuca, Tom Denniston, Erin Divine, Samantha Dorr, Brian Dykstra, Suzi Ehret, Wendy Fair, John Felix, Robert Fink, Kelly Fleming, Cristine Francois, Terry Frederick, B. Garcia, Mary Gordon, Steve Gordon, Matt Griffiths, Dan Groebner, Curtis Herbert, Celia Holm, Elaine Hough, Eric Hough, Bill Hunter, Brian Ison, Liz Jernigan, Tom Jernigan, Edwin Juarez, Frank Kee, John Kraft, Karen LaFrance, Diane Laush, L. LeSueur, Mike Lommler, Grant Loomis, Tyler Loomis, Tom Loyd, Jennie MacFarland, Susi MacVean, Bryce Marshall, Paul McKeasey, Robert Mesta, Jake Mohlmann, David Moll, Mark Nigrelli, Wyatt Nimitz, Jill Oertley, Bruce Palmer, Jeff Pebworth, Rebecca Peck, Lloyd Pentacost, Brian Peterson, Lin Piest, Steve Prager, Stephanie Prevost, Tim Price, Marcia Radke, Tabata Reyna, Emily Ringelberg, Natalie Robb, Danny Rodriguez, Ricky Romea, Locana de Sauza, Kent Schipper, Susan Sferra, Maggie Shirlen, Miles Spathelf, Mike Sredl, Mike Sumner, Tice Supplee, Mark Swift, Larry Tripp, Bob Vahle, Ruth Valencia, Rachael Vaughn, Scott Wilbor, Ammon Wilhelm, Cathy Wise, Dan Wolgast, Fred Wong, Scott Woolbright and John Yerger.

SONORAN DESERT BREEDING BIRD SURVEY

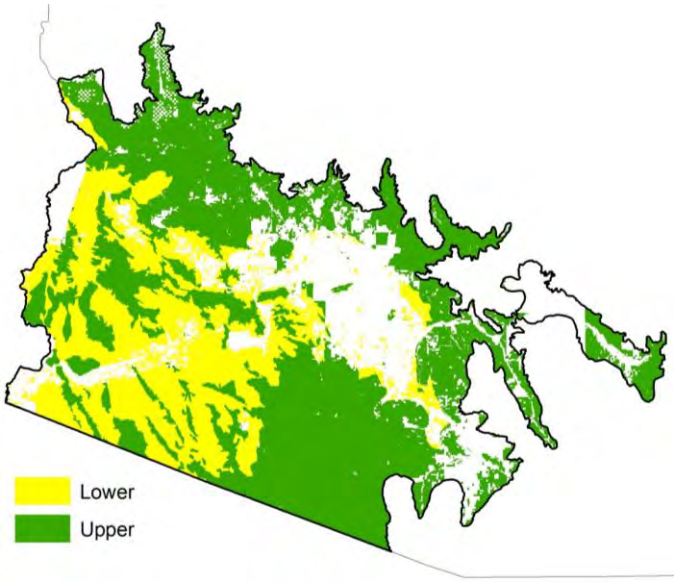
Le Conte's Thrasher - Photo/Bruce Taubert

Project Description

Arizona encompasses more Sonoran Desert habitat than any other U.S. state. Therefore, Arizona has the responsibility to monitor and maintain avian populations that depend on this unique habitat. However, population trend information for many desert species is poorly known. Populations of Sonoran desert birds are naturally small, typically at low density, and exist at or near their thresholds of physiological tolerances. As a result, these species are vulnerable to threats including habitat loss and fragmentation, border-related activities, and climate change. A total of 17 birds species (12%) listed on Arizona's SGCN list regularly nest in this unique habitat.

Similar to the Riparian Breeding Bird Survey, the objectives of the Sonoran Desert Breeding Bird Survey were to obtain population and density estimates of birds that breed in Sonoran Desert habitats, as well as explore their spatial distribution and habitat preferences. A long term objective is to detect population trends over time.

In 2011, a pilot study was conducted to identify a suitable method for conducting multi-species surveys in the Sonoran Desert. Following the adoption of a sampling framework, unique randomly selected plots were surveyed in 2012, 2013, and 2014. Surveys were completed with assistance from volunteers and biologists from partner agencies.



Study Area

The project encompasses the upper and lower Sonoran Desert regions of Arizona, excluding tribal, some military, agricultural lands, and habitats within urban and residential areas (Figure 18). Perennial or intermittent drainages were also excluded. The randomly selected plots where 16 ha (upper Sonoran Desert) or 24 ha (lower Sonoran Desert) in size.

Figure 18. Upper and Lower Sonoran Desert regions in Arizona based on Omernik's level IV eco regions (Omernik 1987).

Methods

Similar to the Riparian Breeding Bird Survey, we used a double sampling design with an area search approach. Survey timing was between mid-February and late May, with some southeastern Arizona plots conducting a final survey between late July and mid-August for species nesting during the monsoon season. A comprehensive field manual was prepared with specific instructions and data forms (Corman et al. 2015a), including:

- On each survey visit, an area search was conducted during the first 4-5 hours of daylight with the surveyor covering the entire area of a 16 or 24 ha plot.
- On a plot map, the surveyor marked the location, habitat, and behavior of each individual bird or pair detected (by sight and sound).
- The number of breeding pairs or territories/per species for the entire plot was determined by compiling detections by visit and generating a final count from all visits.
- During one survey visit, certain habitat variables were recorded from 4-6 vegetation points distributed across the plot.

Results and Discussion

Corman et al. (2017c) compiled a final report on this project, and the following is an abbreviated summary of those results. From 2012-2014 we surveyed 312 randomly selected plots, with a subset of these (28) also surveyed intensively. During rapid surveys, we recorded 15,909 birds of 74 breeding species with an additional 92 species recorded only as incidentals. Of the 17 SGCN, we obtained estimates of density and population size for ten of these species based on >30 individuals per species. The total population size in the study area was estimated at about 30 million birds with an overall density of 437 birds/km^2. The mean number of birds recorded per plot was 51 (35 in the Lower region and 64 in the Upper region).

Acknowledgements

This cooperative effort has been conducted by personnel and volunteers from the Department, Bureau of Land Management, Barry M. Goldwater Range – East, U.S. Fish and Wildlife Service, and U.S. Forest Service. We want the thank the following dedicated 2012 surveyors: Ellen Aikens, Joey Alsadi, John Arnett, Geoff Bland, Ashley Doyle, Cristina Francois, Mathew Hayes, Christina Kondrat-Smith, John Kraft, Andrew Van Lanen, Grant Loomis, Tyler Loomis, Rebecca Peck, Lin Piest, Andre Silva, Tim Snow, Kristin Terpening, Diane Tilton, Ammon Wilhelm and Emily Van Wyk

SINGLE SPECIES

WINTER MOUNTAIN PLOVER (*Charadrius montanus*) SURVEYS

Mountain Plover - Photo/Keith Graves

Project Description

In June 2010, the USFWS published a proposed federal register notice to list the Mountain Plover as threatened under the Endangered Species Act. Major threats include continued loss of native grassland habitat and changing practices on agricultural lands. A native of short-grass prairie and shrub-steppe-landscapes, the Mountain Plover breeds in the western Great Plains and Rocky Mountain states, and winters in California, southern Arizona, Texas, and Mexico. Wintering areas in California are particularly important, supporting approximately 50-88% of the global population, which is estimated at 8,000–10,000 individuals (Knopf 1996). In 2011 and 2012, Arizona and California coordinated statewide Mountain Plover surveys in an effort to gather information on wintering Mountain Plover abundance, geographic distribution, and habitat associations.

Three primary objectives of the surveys were to:

1. Determine the abundance of Mountain Plovers wintering in Arizona in late January.
2. Identify or confirm important Mountain Plover wintering areas.
3. Ascertain which habitat types and management practices support wintering Mountain Plovers.

Two secondary goals were to:

1. Collect similar abundance, geographic distribution and habitat association data for the Long-billed Curlew.
2. Evaluate residency patterns of Mountain Plovers by conducting a second smaller survey of key wintering areas in February.

Methods

The AZFO, with support from USFWS and the Department, coordinated the survey effort in Arizona. In coordination with Audubon California, AZFO prepared a winter Mountain Plover survey protocol and data forms (Appendix B), including:

- Survey areas were designed to be completed in a half-day to a full-day by a team of two or more surveyors.
- Surveyors could conduct their survey on any day during the 4-day survey window in late January.

- A second survey was scheduled in mid-February in areas where plovers were detected during the prior survey.
- Surveys started after sunrise to ensure complete coverage of assigned area.
- Surveyors traveled on publicly accessible roads surveying all suitable habitat.
- Surveyors scanned all the potentially suitable areas to determine plover presence.
- If detected, surveyors obtained a count and recorded GPS location and habitat type using the form provided (Appendix B).

Results and Discussions

Wintering Mountain Plovers are found primarily in agricultural areas of southern and western Arizona. Typical wintering habitats are sod farms, recently cut alfalfa lands, and flat fallow fields with little vegetation and lacking dirt furrows. Unlike most agricultural habitats, only sod farms remain unchanged from one year to the next, allowing more consistency in wintering areas.

Plovers begin to arrive, or migrate through, Arizona in early August and September with numbers slowly increasing through November and December. Peak numbers are typically recorded in December and January, with most departing the wintering areas by mid-March. Due to their cryptic coloration and passive behavior, plovers are difficult to detect and easily missed. Private property and tribal access issues to extensive agricultural areas in southern and western Arizona also limit detection.

In 2011, surveys were conducted in five Arizona counties (where most wintering plovers have been reported in the past): Yuma, La Paz, Maricopa, Pinal and Cochise. The first surveys were conducted from January 21-24 by 19 different teams. A total of 176 Mountain Plovers were counted at four widely scattered locations in southern Arizona (Figure 19). This number was lower than expected. Although many new locations were visited, no new occupied locations were discovered. Compared to prior surveys, numbers were significantly lower in California (1,235; >50% decrease from previous surveys), where a substantial percentage of the population is believed to winter. Follow-up surveys in late February produced only 94 plovers at three locations in Arizona. These surveys showed an increase in plovers in the Santa Cruz Flats area of Pinal County, but a reduction elsewhere, compared to the January survey.

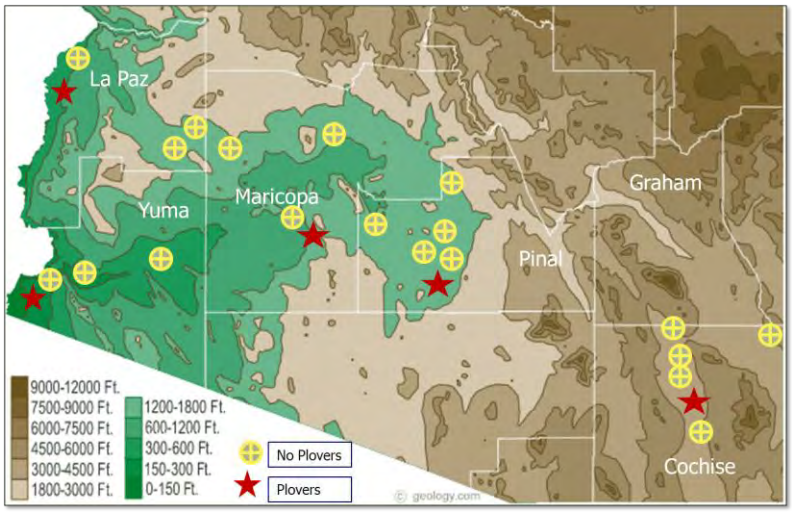


Figure 19. General winter Mountain Plover survey location in southern Arizona, 2011-2012.

A repeat of the 2011 survey was conducted from January 13-16, 2012 by 19 different teams. A total of 120 Mountain Plovers were recorded at four locations in southern Arizona, with 27 detected in the southern Parker Valley (La Paz County), where no plovers were detected in 2011. No plovers were detected in Cochise County in 2012. Follow-

up surveys on February 18-19 produced only 81 plovers at two locations in Maricopa and Pinal Counties.

Surveyed areas in 2011 and 2012 focused on agricultural lands due to prior occurrence records in this habitat. One exception was an active military airstrip near Gila Bend, where a flock of plovers consistently inhabit each winter (J. Arnett, pers. com.). The only other known location that consistently attracts plovers each winter is a sod farm in the Santa Cruz Flats area south of Eloy. Otherwise, occupied agricultural habitat varies from bare dirt and corn stubble, to cut alfalfa and Bermuda grass. Annual crop rotation increases variability in suitable habitat making it difficult to predict wintering locations.

The surveys also revealed variability in detecting individuals. Mountain plovers regularly moved to adjacent areas following a disturbance (natural or man-made), where they could remain a few hours or several days before returning to common wintering grounds. Multiple surveys throughout the winter months would increase the odds of detecting plovers, and thus more accurate winter population numbers.

A literature review documenting the general location, dates, and numbers of Mountain Plovers reported in Arizona suggests the winter concentration has decreased since the 1980s (T. Corman, unpub. data). As an example, at a location near Gila Bend with consistent historical data, winter flock sizes regularly surpassed 100 individuals, with a high of 340 individuals in 1978. Since the 1980s, numbers have ranged from 0 to less than 50. Since 2000, only two areas in Arizona have had plovers in numbers exceeding 100, and they occurred during the same year. In 2005, an area south of Yuma recorded a high of 300, and the Santa Cruz Flats recorded 177 individuals. There could be many factors influencing these trends in Arizona, including changes in agricultural practices and crop rotations, prosperous wintering grounds elsewhere such as California or northern Mexico, or a true population decline.

Acknowledgements
The USFWS provided funding support for volunteer surveyors (mileage reimbursement) and Audubon California assisted in developing the protocol and data form.

Special thanks to the County Coordinators and surveyors who made the surveys possible: John Arnett, Alexander Baish, Harvey Beatty, Thomas Bommarito, Al Borgardt, Emily Butler, Richard Carlson, Troy Corman, Henry Detwiler, Merce Dostale, Laura Ellis, Isaac Field, Thomas Gaskill, Bill Grossi, Homer Hansen, Lauren Harter, Jack Holloway, Mike Hawks, Rich Hoyer, Brian Ison, Doug Jenness, Jennifer Johnson, Keith Kamper, Claudia Kirscher, Nancy Lange, Tom Leskiw, Tom Lewis, Kay and Isaac Levy, Suzanne Parelman, Linden Piest, Stephanie Prevost, Arlene Ripley, Adam Sapakie, Adam Stein, Michael Tarachow, Rick Taylor, Walter Thurber, David Vander Plyum, Joe Veverka, Erika Wilson, John Yerger, and Brenda Zaun.

OBSERVATIONAL NOTE: BREEDING LEAST TERNS (*Sterna antillarum*)

Banded Least Tern w/hatchling - Photo/Brendon Grice

The California and interior populations of Least Tern were federally listed as endangered in 1970. In Arizona, this tern is a casual to rare late spring and summer vagrant, with a few individuals remaining at a location for no more than a few days. However, in the summer of 2009, the first known nesting attempt in Arizona was documented.

In mid-May 2009, Department personnel observed a single adult Least Tern at a water recharge pond in Glendale, Arizona. Following the initial observation, a local birder, Melanie Herring, noted two pairs of Least Terns exhibiting breeding behavior. The site was monitored every few days, sometimes daily, to monitor progress of the terns' nesting attempts (M. Herring, pers. com.).

On May 22, two courting and copulating pairs of Least Terns were observed. By the last week of May, one pair was investigating a potential nest location on a gravel road separating two pond basins. They began incubating two eggs on May 30. One of the terns was banded with numbers indicating it derived from the coastal California population (*S. a. browni*). This was the first known nesting attempt of this species in Arizona.

In late May, the Department and the USFWS coordinated with the property owners (Salt River Project) to establish a nest-site protection and monitoring plan. By June 2, the property owners had placed barricades to keep all activity from entering the nest site area. The first pair successfully hatched one young on June 19, the second egg was abandoned. On June 21, the young was observed in one of the nearby dry pond basins with some small scattered rocks, shallow furrows, and very sparse vegetation for cover and shade. The property owners agreed not to flood the basin as long as the chick was present. The chick began exercising its wings on July 5, and was observed making short flights by July 10.

By mid-June, the second pair had established a nest adjacent to the first pair, but soon abandoned the breeding attempt. However, on June 24, the pair attempted to nest again within the dry pond basin. They began incubating two eggs, but daytime temperatures climbed to 115° F on July 13 and the pair abandoned the attempt by July 15, and only one adult was observed (M. Herring, pers. com.). Upon close investigation, only one egg remained, suggesting the other had hatched, but the chick did not survive. The abandoned egg was collected and provided to the USFWS to test for contaminants.

Analysis of the egg indicated the presence of a fully developed chick. This may indicate an adult mortality that lead to the nest abandonment. Through August 2, three adults and the juvenile

remained in the area. By August 7, the juvenile was the only tern observed, and it was not seen beyond this date (M. Herring, pers. com.).

In subsequent years, Least Tern observations were as follows:

- 2010 – One adult Least Tern had returned to the area in May, and stayed through late June. No nesting activity was confirmed.
- 2011 – No Least Terns observed.
- 2012 – Two adult Least Terns were observed on May 19 with one remaining through May 25.

OBSERVATIONAL NOTE: BREEDING SNOWY PLOVERS (*Charadrius nivosus nivosus*)

Snowy Plover - Photo/Bruce Taubert

No comprehensive assessment of Snowy Plovers abundance and distribution in North America has been completed (Thomas et al. 2012). In an effort to obtain this information, the USFWS and partners implemented (in 2007 and 2008) Snowy Plover surveys to assess the breeding population within its known and historical range. As part of this range-wide effort, in 2007 the Department surveyed the only known nesting location in Gila Bend, Arizona.

Snowy Plover are only irregular breeders in Arizona with confirmed breeding along the ephemeral Painted Rock Reservoir northwest of Gila Bend. This large flood control basin has been dry since 1993, with no available breeding habitat during this period. However, breeding was suspected below the dam in 1995, when low levels of water continued for several additional years following 1993 (Wise-Gervais 2005).

In 2005, a few pairs of Snowy Plovers were discovered in a small section of retired agricultural lands near Gila Bend (B. Grossi, pers. com.). This unique site contained high levels of salt precluding normal agricultural use, and had very shallow run-off water from adjacent fields. In 2007, the site was visited on May 25 and all appropriate habitat surveyed. A total of four pairs of Snowy Plovers were observed, with three pairs incubating eggs, and one pair with three 1.5 to 2.5 week-old young. Snowy Plovers continued to be reported through 2010 near Gila Bend (B. Grossi, pers. com.). After 2010, the area dried and was unsuitable for nesting. No additional nesting locations were discovered in Arizona through 2012.

The 2007 Arizona data was compiled with the range-wide effort to obtain regional and overall population estimates (Thomas et al. 2012). The data suggests Snowy Plovers remain a relatively uncommon North American shorebird (Morrison et al. 2006).

SUPPLEMENTARY DATA TO THE BREEDING BIRD ATLAS

The Arizona Breeding Bird Atlas project (ABBA; 1993-2000) mapped the distribution, documented the relative abundance, and described the natural history, including breeding phenology and nest site characteristics, of more than 280 species of birds that breed in Arizona. Fieldwork for the project was completed in 2000 and the ABBA published in 2005. Since the completion of the ABBA, the Department has continued to compile similar data in the following two datasets:

AVIAN NEST DATA

The nesting phenology of bird species varies regionally, even within a state. Similarly, nest placement varies regionally across a species' range. Many published natural history resources for birds are often compiled from other parts of a species' range, where different subspecies may have been studied. Even with common species, many natural history aspects are unique to a geographical location in the state. Therefore, this local information is more useful to Arizona land and wildlife management agencies when making land-management recommendations. To obtain these important data, the ABBA project established a database for nest placement measurements, nesting phenology, and other attributes obtained at nests discovered by field crews and a few specially trained volunteers. At the end of the ABBA project this database contained specific data for over 3,500 nests of 184 species.

This database was resurrected in 2011 when Department biologists had the opportunity to collect the same type of data at nests encountered while conducting various other projects. These additional data will enhance the usefulness of the database, and will assist to document any changes in nesting phenology due to climate change or other factors. Since the 2011 field season, 225 nests have been added to the original ABBA nest database.

AVIAN OCCURRENCE DATA

Although the Avian Occurrence Data includes a few records from as early as 2001, this post-ABBA database was established in 2005 to includes new locality records of possible, probable, and confirmed breeding for species in the state (Table 19). For a suite of species, the database also tracks any earlier or later date nesting records than documented during the ABBA period. Many sources are used for obtaining new records, and include casual observation reports from birders and data gleaned from various bird monitoring projects across the state.

Table 19. Annual number of new records added to the avian occurrence database by year.

Year	N Records
1996-2004	25
2005	30
2006	68
2007	103
2008	112
2009	325
2010	123
2011	146
2012	51
TOTAL	983

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APPENDIX A: DATA FORMS

Arizona Coordinated Bird Monitoring *Arizona Bird Conservation Initiative*

Greater Phoenix Area Waterbird Survey
Third Saturday of January

Survey Details
Start Time:_____ Total Survey Hours (to the 1/4 hour): _____ Total Survey Miles: _____
City:_____ Location(s): _____

Surveyor(s) & Contact info: _____

NOTE - A new survey form must be used if surveys are conducted within more than one city limit (see map)
OR if a single location holds 300 or more individual wild aquatic birds. If the latter then also check one of the following:

Estimated % Water Capacity: ☐ Full 100% ☐ Nearly Full <100% but >90% ☐ Low <90% but >50% ☐ Very Low <50% but >25% ☐ Nearly Dry <25%

Waterfowl	Tally & Notes	TOTAL	CODE
Black-bellied Whistling-Duck			BBWD
Gr. White-fronted Goose			GWFG
Snow Goose			SNGO
Ross's Goose			ROGO
Canada Goose (large race)			CAGO
Canada Goose (lesser race)			SCGO
**Cackling Goose			CACO
Wood Duck			WODU
Gadwall			GADW
**Eurasian Wigeon			EUWI
American Wigeon			AMWI
Am. X Eur. Wigeon Hybrid			
Mallard			MALL
** (Mexican Duck) Mallard			MEDU
Mex. Duck X Mallard Hybrid			
Blue-winged Teal			BWTE
Cinnamon Teal			CITE
Northern Shoveler			NSHO
Northern Pintail			NOPI
Green-winged Teal (American)			AGWT
Canvasback			CANV
Redhead			REDH
Ring-necked Duck			RNDU
**Greater Scaup			GRSC
Lesser Scaup			LESC
Bufflehead			BUFF
Common Goldeneye			COGO
Hooded Merganser			HOME
Common Merganser			COME
Red-breasted Merganser			RBME
Ruddy Duck			RUDU
**			
**			

Aquatic Birds List Continues on page 2

Page 1

Greater Phoenix Area Waterbird Survey- continuation

Water & Marsh Birds	Tally & Notes	TOTAL	CODE
Pied-billed Grebe			PBGR
Eared Grebe			EAGR
Western Grebe			WEGR
Clark's Grebe			CLGR
American White Pelican			AWPE
Neotropic Cormorant			NECO
Double-crested Cormorant			DCCO
American Bittern			AMBI
Least Bittern			LEBI
Great Blue Heron			GBHE
Great Egret			GREG
Snowy Egret			SNEG
Cattle Egret			CAEG
Green Heron			GRHE
Black-crowned Night-Heron			BCNH
White-faced Ibis			WFIB
Virginia Rail			VIRA
Sora			SORA
Common Gallinule			COMO
American Coot			AMCO
**			
**			
Shorebirds & Gulls			
Killdeer			KILL
Black-necked Stilt			BNST
American Avocet			AMAV
Greater Yellowlegs			GRYE
Spotted Sandpiper			SPSA
**Western Sandpiper			WESA
Least Sandpiper			LESA
Long-billed Dowitcher			LBDO
Wilson's Snipe			COSN
Ring-billed Gull			RBGU
**			
**			
Other Water Oriented Birds			
Osprey			OSPR
Bald Eagle			BAEA
Belted Kingfisher			BEKI
**			
**			

** Indicate species which are unusual or rare and additional details are required: bird description (or photo) &

Comments/Notes:

All scanned completed forms must be returned by **4 February** via email at **tcorman@azgfd.gov** or mailed to:
Troy Corman, AZ Game and Fish Department, 5000 W. Carefree Hwy., Phoenix, AZ 85086-5000

Page 2

Greater Phoenix Area Waterbird Survey- Instructions

Equipment

Binoculars, clip board, survey forms, field guides, plus each team should have at least one spotting scope
Also suggest having a camera to help document any rare or difficult to identify birds you may discover

General Survey Methodology

1) Visit as many of the water bodies noted in blue within your assigned area as possible, including golf course ponds
2) Survey as much of the entire water body as possible; unless you have special permission, beware of all closed area signs
3) Count all wild aquatic birds observed (or heard) using the open water, shoreline, or wetlands of urban ponds, lakes, or canals
4) Do not count obvious domestic (exotic) ducks, geese and swans, which include the dumpy park Mallards and their hybrids

Survey Form Details

Start Time:	Note the time the count/survey was initiated
Total Survey Time:	Note the total number of hours (to nearest 1/4 hr.) it required to conduct the count/survey as a group
Total Survey Miles:	Note total number of miles you drove while actually conducting survey; begin keeping track once you arrive in your area
City:	Using the enclosed map, list the city/town you are surveying in; If you survey within a new city limit, begin new data form
Location:	For each location where aquatic birds were counted, list one of the following: Name of water body, housing development, park, or golf course, or if needed, major cross streets (check map for names)
Surveyors:	List the name, phone number, email address, etc. for each surveyor and data recorder

Aquatic Bird Tally/Notes

Use this space to tally species numbers and estimates while conducting survey; note location of rare or unusual species; note location of active heronries

Comments/Notes

Use this space to include such things as: directions to the best vantage point for conducting the survey; in regards to lighting note if morning or afternoon is best; contact information for land owner, golf course manager, etc.; location name of ponds or lakes where access was not granted and could not be surveyed

Arizona Coordinated Bird Monitoring *Arizona Bird Conservation Initiative*

Reservoir Waterbird Survey

Survey Details

Date:_____ Start Time: _____ Total Survey Hours (to the 1/4 hour): _____

Lake/Reservoir Name: _____ County(s): _____

Current Lake Elevation: _____

Current % Full: _____

Survey Method: ☐ Boat ☐ Land-based

Weather Conditions: _____

Surveyor(s) & Contact info: _____

Waterfowl	Tally & Notes	TOTAL	CODE
Gr. White-fronted Goose			GWFG
Snow Goose			SNGO
Ross's Goose			ROGO
Canada Goose (large race)			CAGO
Canada Goose (lesser race)			SCGO
**Cackling Goose			CACG
**Tundra Swan			TUSW
Wood Duck			WODU
Gadwall			GADW
**Eurasian Wigeon			EUWI
American Wigeon			AMWI
Am. X Eur. Wigeon Hybrid			
Mallard			MALL
** (Mexican Duck) Mallard			MEDU
Blue-winged Teal			BWTE
Cinnamon Teal			CITE
Northern Shoveler			NSHO
Northern Pintail			NOPI
Green-winged Teal (American)			AGWT
Canvasback			CANV
Redhead			REDH
Ring-necked Duck			RNDU
**Greater Scaup			GRSC
Lesser Scaup			LESC
Bufflehead			BUFF
Common Goldeneye			COGO
Hooded Merganser			HOME
Common Merganser			COME
Red-breasted Merganser			RBME
Ruddy Duck			RUDU
**			
**			

Aquatic Birds List continues on page 2

Reservoir Waterbird Survey- continuation

Water & Marsh Birds	Tally & Notes	TOTAL	CODE
Common Loon			COLO
Pied-billed Grebe			PBGR
Eared Grebe			EAGR
Western Grebe			WEGR
Clark's Grebe			CLGR
Aechmophorus sp.			
American White Pelican			AWPE
Neotropic Cormorant			NECO
Double-crested Cormorant			DCCO
American Bittern			AMBI
Least Bittern			LEBI
Great Blue Heron			GBHE
Great Egret			GREG
Snowy Egret			SNEG
Cattle Egret			CAEG
Green Heron			GRHE
Black-crowned Night-Heron			BCNH
White-faced Ibis			WFIB
Clapper Rail			CLRA
Virginia Rail			VIRA
Sora			SORA
Common Gallinule			COMO
American Coot			AMCO
**			
**			
Shorebirds & Gulls			
Killdeer			KILL
Black-necked Stilt			BNST
American Avocet			AMAV
Greater Yellowlegs			GRYE
Spotted Sandpiper			SPSA
Least Sandpiper			LESA
Long-billed Dowitcher			LBDO
Wilson's Snipe			WISN
Ring-billed Gull			RBGU
**			
**			
Other Water Oriented Birds			
Osprey			OSPR
Bald Eagle			BAEA
Belted Kingfisher			BEKI
**			
**			

** Indicate species which are unusual or rare and additional details are required including description and location

Comments/Notes:

All Completed forms must be returned **by 31 January** to:
Troy Corman, AZ Game and Fish Department, 5000 W. Carefree Hwy., Phoenix, AZ 85086-5000

Page 2

Reservoir Waterbird Survey- Instructions

General Survey Methodology

1) Initiate surveys within 1.5 hrs. of sunrise on a single day between 10 - 23 January
2) Count all aquatic birds observed (or heard) using the open water, shoreline, or wetlands of reservoir or lake
3) Survey the entire water body, including all coves or secluded arms, while minimizing disturbance to birds
4) Conducting surveys during excessive wind or rain should be avoided if possible
5) Boat speed should be moderate (5-10 mph) and consistent throughout the survey, stopping only to identify species

Survey Form Details

Date:	Date survey conducted; survey period between 10 - 23 January
Start Time:	Note the time the survey was initiated
Total Survey Time:	Note the total number of hours (to nearest 1/4 hr.) it required to conduct the survey
Lake/Reservoir Name:	Name of lake or reservoir being surveyed
Lake Elevation:	Note elevation of lake level the day of survey; See: www.azgfd.gov/h_f/edits/lake_levels.shtml
Current % Full:	Note % of full the lake is the day of survey; See: www.azgfd.gov/h_f/edits/lake_levels.shtml
Survey Method:	Check if surveys were either boat or land-based
Weather Conditions:	Note temp., cloud cover, estimated wind speed, etc. during survey
Surveyors:	List the name, phone number, email address, etc. for each surveyor

Aquatic Bird Tally/Notes

Use this space to tally species numbers and estimates while conducting survey; note location of rare or unusual species; note location of active heronries; observations of grebes with dependent young (indicating unusual nesting period)

Comments/Notes

Use this space to include such things as: best starting point and direction to travel to conduct survey in regards to lighting; problems encountered while conducting survey

Arizona Coordinated Bird Monitoring *Arizona Bird Conservation Initiative*

Colonial Breeding Waterbird Nest Survey

Site Description

Site Name: _____ UTM Cordinates (NAD 83): _____ Elevation: _____ ☐ft. ☐m.

Land Ownership: _____ Drainage/body of water: _____ County: _____

Primary Habitat: ☐ Marshland ☐ Lowland Riparian (<4000 ft) ☐ Highland Riparian (>4000 ft) ☐ Coniferous Forest
☐ Urban/Residential ☐ Rural Orchard: ☐ citrus ☐ pecan ☐ other: _____

Aquatic System: ☐ Man-made lake/pond ☐ Reservoir ☐ Perennial drainage ☐ Marsh Natural lake/pond: ☐ Perennial ☐ Ephemeral

Survey Details

Survey Date: _____ Visit: ☐1 ☐2 ☐3 Start Time: _____ Total Survey Time (minutes): _____

Surveyors (affiliation) & Contact info: _____

Waterbird Species	# active nests	Estimated?	# adults	*Breeding status/behavior observed (mark all that apply)
_____	_____	☐Y ☐N	_____	☐ NB ☐ I/B ☐ NE ☐ NY ☐ FY
_____	_____	☐Y ☐N	_____	☐ NB ☐ I/B ☐ NE ☐ NY ☐ FY
_____	_____	☐Y ☐N	_____	☐ NB ☐ I/B ☐ NE ☐ NY ☐ FY
_____	_____	☐Y ☐N	_____	☐ NB ☐ I/B ☐ NE ☐ NY ☐ FY
_____	_____	☐Y ☐N	_____	☐ NB ☐ I/B ☐ NE ☐ NY ☐ FY

Nest Placement Substrate

☐ Cliff/Rock Vegetative: ☐ Tree ☐ Shrub ☐ Emergent ☐ Man-made structure

Vegetative species supporting nests	Total # of plants w/nests	# partially dead	# dead
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Comments/Notes: **Colony Status:** ☐ Active ☐ Inactive ☐ Abandoned

*NB = nest building; I/B = incubating/brooding; NE = nest w/eggs; NY = nest w/young; FY = feeding young near nest

Colonial Breeding Waterbird Nest Survey- Instructions

Site Description

Site Name:	This will eventually be a standardized name to be used annually
UTM:	GPS coordinates for location in UTM (NAD 83); collect after/prior to breeding season if possible
Elevation:	Use GPS unit to acquire this
Land Ownership:	Who owns the land where the colony exists? (e.g. USFS, BLM, State, private)
Drainage/Body of water:	Provide the name of the stream/river drainage or body of water the colony is along or near (e.g. Gila River below Painted Rock Dam, Mittry Lake, River Reservoir)
County:	Note the county(s) the colony resides in
Primary Habitat:	Mark the habitat that best represents where the colony is located
Aquatic System:	Mark the type of aquatic system that best describes where the colony is located or near

Survey Details

Survey Date:	Note the date the count/survey was conducted
Visit:	Mark if this is the 1st, 2nd, or 3rd visit to site this year; if 2nd or 3rd only note the Site Name under the Site Description (above)
Start Time:	Note the time the count/survey was initiated
Total Survey Time:	Note the total number of minutes it required to conduct the count/survey
Surveyors:	List the name, affiliation, phone number, email address, etc. for each surveyor and data recorder

Waterbird Species

Species:	List the names of each waterbird species observed actively nesting in the colony (see list below)
# active nests	For each aquatic bird species listed noted the number of active nests observed
Estimated?	Mark if the number of active nests entered was an estimate or a direct count
# adults:	For each aquatic bird species listed note the number of adults at and around the nesting colony
Breeding status...	For each waterbird species mark all the breeding status/behavior categories that were observed during the count/survey

Nest Placement Substrate

Substrate:	Mark the type of substrate the nests were supported by
Vegetative species..	For nests in trees, shrubs, or emergent vegetation, list the names for each of the plant species which supported nests
Total # of plants w/ nests:	If possible, please note the number of individual nest trees or shrubs for each of the plant species which supported nests
# partially dead:	Of the above, please note the number of individual nest trees or shrubs which are partially dead
# dead:	Of the above, please note the number of individual nest trees or shrubs which are dead

Comments/Notes/Site Status

Use this space to include such things as: directions to the best vantage point for conducting the nest count/survey, land owner contact information, additional bird species noted nesting in or near the colony, presents or absence of nearby suitable nesting substrate, water levels

Colony Status: **Active** = nesting activity; **Inactive** = no activity but old nest structures present; **Abandoned** = no nest structures present

AZ colonial nesting waterbirds:	Eared Grebe (EAGR)	Western Grebe (WEGR)	Clark's Grebe (CLGR)	Great Blue Heron (GBHE)
	Great Egret (GREG)	Snowy Egret (SNEG)	Cattle Egret (CAEG)	White-faced Ibis (WFIB)
	Black-crowned Night-Heron (BCNH)	Double-crested Cormorant (DCCO)		Neotropic Cormorant (NECO)

Regular nest support plants:	Fremont cottonwood	Goodding willow	tamarisk (salt cedar) spp.	mesquite spp.
	ponderosa pine	bulrush spp.	cattail spp.	AZ sycamore
	fan palm spp.	date palm spp.	athal tamarisk	eucalyptus spp.
	citrus spp.			

Return completed form to: Troy Corman, AZ Game and Fish Dept., 5000 W. Carefree Hwy., Phoenix, AZ 85086

National Marsh Bird Monitoring Program Survey Data Sheet

Pg____of____

Date: _____ **Location:** _____ **Before/After**

Route: _____ **Temperature** *(°F)* : ___/___

Observer(s): _____ **Wind speed** *(mph)* : ___/___

Instructor _____ **Cloud cover** *(%)* : ___/___

Survey replicate # : ____ **Precipitation** *(see below)* : ___/___

Total # during survey			
PBGR	___	VIRA	___
LEBI	___	RIRA	___
AMBI	___	COGA	___
BLRA	___	SORA	___
AMCO			

**list all observers in order of their contribution to the data collected*

put an "S" in the appropriate column if the bird was seen, a "1" if the bird was heard, and "1S" if both heard and seen

Station#	Start Time (military)	Background noise	Species	Responded During:												Call Type(s)	Direction	Distance (meters)	Detected at a Previous Point	Comments
				Before	Pass 0-1	Pass 1-2	Pass 2-3	Pass 3-4	Pass 4-5	BLRA 5-6	LEBI 6-7	SORA 7-8	VIRA 8-9	RIRA 9-10	After					
																	○			
																	○			
																	○			
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Call Types: BLRA: *kicky-doo, grr, churt* RIRA: cltr, kburr, kek, khurrah LEBI: *coo, kak, ert* VIRA: *grunt, ticket, kicker*
SORA: whinny, perweep, keep PBGR: owhoop, hyena COGA: wpt, giddy-up, beep AMBI: pump-er-lunk

If the call type is not one of the above listed types, describe the call in the comments column

Precipitation: light rain, rain, heavy rain, light snow, snow, heavy snow, fog, none

Background noise: 0 *no noise* 1 *faint noise* 2 *moderate noise (probably can't hear some birds beyond 100m)*
3 *loud noise (probably can't hear some birds beyond 50m)* 4 *intense noise (probably can't hear some birds beyond 25m)*

National Marsh Bird Monitoring Program Survey Data Sheet- continuation Pg___of___

Date *(eg 10-May-04)* : **Name of marsh or route :** **Observer(s)** *(list all)** :

Station#	Start Time (military)	Background noise	Species	Responded During:												Call Type(s)	Direction	Distance (meters)	Detected at a Previous Point	Comments
				Before	Pass 0-1	Pass 1-2	Pass 2-3	Pass 3-4	Pass 4-5	BLRA 5-6	LEBI 6-7	SORA 7-8	VIRA 8-9	RIRA 9-10	After					
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Call Types: BLRA: *kicky-doo, grr, churt* RIRA: cltr, kburr, kek, khurreh LEBI: *coo, kak, ert* VIRA: *grunt, ticket, kicker*
SORA: whinny, perweep, keep PBGR: owhoop, hyena COGA: wpt, beep AMCO: burup, honk, hicup AMBI: pump-er-lunk

If the call type is not one of the above listed types, describe the call in the comments column

National Marsh Bird Monitoring Program Survey Data Sheet

Pg_1_of_1_

Example Data

Date *(eg 10-May-04)* : *20 April 2006*

Name of marsh or route : *Hidden Shores Marsh*

Observer(s) *(list all)** : *Chris Nadeau, Bob Blabla*

Survey replicate # : *2*

	Before	After
Temperature *(°F)* :	73	78
Wind speed *(mph)* :	0	1
Cloud cover *(%)* :	15	60
Precipitation *(see below)* :	none	none

Total # during survey			
PBGR	___	VIRA	2
LEBI	___	CLRA	3
AMBI	___	COGA	1
BLRA	2	SORA	1
AMCO	19		

**list all observers in order of their contribution to the data collected*

put an "S" in the appropriate column if the bird was seen, a "1" if the bird was heard, and "1S" if both heard and seen

Station#	Start Time (military)	Background noise	Species	Responded During: Before	Pass 0-1	Pass 1-2	Pass 2-3	Pass 3-4	Pass 4-5	BLRA 5-6	LEBI 6-7	VIRA 7-8	CLRA 8-9	After	Call Type(s)	Direction	Distance (meters)	Detected at a Previous Point	Comments
HSM1	540	0	BLRA		1	1				1					grr		95	N	6 AMCO (1:3:2)
			BLRA			1				1	1	1	1	1	kicky-doo		110	N	
			VIRA				1S					1			ticket, grunt		30	N	
HSM2	604	1	CLRA	1											p-cltr		40	N	pair
			CLRA	1											p-cltr		45	N	
			VIRA									1			grunt		100	Y	2 AMCO (0:2:0)
			CLRA											1	throaty hoo		10	N	
HSM3																			Not surveyed unsuitable habitat
HSM4	633	1	COGA		1	1	1		1		1		1		wipeout		150	N	11 AMCO (1:7:3)
			SORA									1			peruweep		210	N	

Call Types: BLRA: *kicky-doo, grr, churt* CLRA: cltr, kburr, kek, khurrah LEBI: *coo, kak, ert* VIRA: *grunt, ticket, kicker*

If the call type is not one of the above listed types, describe the call in the comments column

Precipitation: light rain, rain, heavy rain, light snow, snow, heavy snow, fog, none

Background noise: 0 *no noise* 1 *faint noise* 2 *moderate noise (probably can't hear some birds beyond 100m)*
3 *loud noise (probably can't hear some birds beyond 50m)* 4 *intense noise (probably can't hear some birds beyond 25m)*

Quick Reference for the National Marsh Bird Monitoring Program Standardized Protocols

The following is a summary of the standardized protocols for the National Marsh Bird Monitoring Program. This summary was designed as a quick reference guide to be used as you are becoming familiar with the various procedures used to establish routes and conduct surveys. This is not a replacement for the protocols. All surveyors should read the standardized protocols prior to conducting surveys.

Creating permanent survey stations and routes

- Prior to the survey season create permanent survey routes to be replicated both within and between years. If you are surveying previously established routes or stations you should become familiar with the location of each route and station prior to the beginning of the survey season.
- Routes should be composed of permanent survey stations. Survey stations should be marked with stakes, flagging, or other markers in the field and recorded in a GPS to assure all replicate surveys are conducted at exactly the same location each year.
- The number of points on a particular survey route should correspond to the number that one surveyor can get done in a morning survey window (see below).
- If you are creating points for the first time, survey points should be spaced approximately 400m apart. All points should be located along either the wetland/upland interface (accessed by land) or the wetland/open water interface (accessed by boat).

Timing and completion of surveys

- The morning survey window should correspond to when marsh birds are most vocal in your area. Remember, marsh birds are typically most vocal in the 2 hours after sunrise. Hence, surveys should begin 30 minutes before sunrise (first light) and should be completed prior to the time when marsh birds cease calling (but never later than 10:00 am).
- Routes should always be completed in the same direction during each replicate survey (starting with the same point and ending with the same point) each year. This ensures that each station is surveyed at approximately the same time of day on each
- In the case that a survey has to be discontinued prior to completing the entire survey route due to unforeseen circumstances (wind, batteries died, etc) with more than 2 stations remaining unsurveyed, the entire route should be completely re-surveyed on a subsequent day. If you do not have enough time in the season to re-survey the entire route, then finish the remaining points on a subsequent day. However, you must start the remaining points at the same time you discontinued the previous survey. This assures that the remaining stations are surveyed during the similar time of day as all previous surveys at those stations.
- All stations should be surveyed on each replicate survey. Stations should not be removed from a survey route. If a station is determined to be unsuitable to survey during one or more replicate surveys, the station should still be recorded on the datasheet with a comment stating why the point was not surveyed.
- Surveys should only be conducted when wind speed is <20 km/hr, and not during periods of sustained rain or heavy fog.
- You can start the mp3 recording immediately after arriving at the point. No settling period is necessary.

Broadcast mp3 call-back track series

- The broadcast mp3 track should be obtained from the National Marsh Bird Monitoring Program Coordinator. The mp3 is composed of 1 track which contains 5 minutes of silence followed by 30 seconds of broadcast and 30 seconds of silence for each of 4 marsh bird species (Black Rails, Least Bitterns, Virginia Rails, and Ridgway's Rails).
- The mp3 track should be broadcast using a portable player and a set of portable amplified speakers (see protocol for recommended brand names and models and contact Lesley or Courtney if you have questions on broadcast equipment).
- Speakers should be placed on the ground or on the bow of the boat as close to the wetland interface as possible, facing into the center of the wetland.
- The broadcast should be played at a volume of 80-90 db measured 1 meter from the speakers.

Recording species detected

- Each **individual** marsh bird detected should be recorded on a **separate** line on the standardized datasheet.
- Record all 1 minute segments in which each individual bird was heard or seen (see Example data). For example, if a Virginia rail off to your right called during the third passive minute and again during the Virginia rail broadcast period, you would put a '1' in both the Pass 2-3 column and a '1' in the VIRA column in the row corresponding to that individual Virginia rail.
- 1' is recorded for all aural detections of an individual, 'S' is recorded for all visual detections, and "1S" is recorded if the bird was both heard and seen.

Quick Reference for the National Marsh Bird Monitoring Program Standardized Protocols- continuation

Recording species detected (continuation)

- Also record the type of call(s) given by each bird, whether the individual was a repeat detection from a previous station, and the estimated distance (in meters) to the individual bird at the time the individual was first detected at that point.
- You also have the option of recording the direction to the individual. This is recommended if multiple individuals of the same species are being detected at each point. By recording the direction to each individual bird, it is often easier and faster to keep track of which individual is which on the datasheet.
- If a bird is detected prior to pressing play on the mp3-player or after the player stops, record the detection of the individual in the Before or After columns on the datasheet
- If a pair of birds calls together (duet, common in RIRA and VIRA) record the call type as "p-" plus the call type and draw a line between the two entries on the data sheet. For example, if a pair of RIRAs clatter together, record each individual on a separate line of the datasheet following the procedures above. The call type for both individuals would be "p-cltr" and you would draw a line between both records on the datasheet to indicate that the two individuals were paired. Note, both individuals still get their own line on the data sheet.
- Although only 4-5 species are included in the broadcast sequence on the mp3 track, surveyors should record all individuals of all species of secretive marsh birds. Surveyors should include all individuals of the following species: Black Rails, Virginia Rails, Soras, Yuma Ridgway's Rails, Least Bitterns, American Bitterns, Common Gallinules, and Pied-billed Grebes.

APPENDIX B: ARIZONA WINTER MOUNTAIN PLOVER SURVEY PROTOCOL AND FORM.

ARIZONA STATEWIDE WINTER MOUNTAIN PLOVER SURVEY

Survey Protocol

BACKGROUND:

In June of 2010, the U.S. Fish and Wildlife Service reinstated a proposal to list the Mountain Plover as threatened under the Endangered Species Act. Major threats include continued loss of native grassland habitat and changing practices on agricultural lands used by Mountain Plovers. A native of short-grass prairie and shrub-steppe-landscapes, the Mountain Plover breeds in the western Great Plains and Rocky Mountain states, and winters in California, southern Arizona, Texas and Mexico. Wintering areas in California are particularly important, having been estimated to support 50-88% of the global population. The 2012 Arizona (and California) Statewide Mountain Plover survey is an effort to provide information on wintering Mountain Plover abundance, geographic distribution and habitat associations in the states.

Survey Objectives:

There are three primary objectives of the survey:

1. Determine the abundance of Mountain Plover (MOUP) wintering in Arizona;
2. Identify or confirm important Mountain Plover wintering area; and
3. Ascertain which habitat types and management practices support wintering Mountain Plovers.

Additionally, there are two secondary goals of the survey:

a. Collect similar abundance, geographic distribution and habitat association data for the Long-billed Curlew (LBCU); and
b. Evaluate residency patterns of Mountain Plovers by conducting a second smaller survey of key wintering areas in February.

MATERIALS:

Surveyors will be provided with:

-A survey area map (Google Earth maps), delineating publicly accessible roads (this map can be sent to you via email or snail mail) in your selected or assigned survey area;
-A digital copy of the survey protocol (this document); and
-A digital data sheet template (you will need to print out copies to record the data).

Surveyors are responsible for providing their own:

-Optics. Binoculars and a spotting scope
-Vehicle
-GPS unit (optional). If you have a GPS unit please bring it. It will be extremely helpful in recording Mountain Plover locations. If you do not have a GPS unit, you will just need to record Mountain Plover locations on the map provided to you.
-Cell Phone (optional).

METHODOLOGY:

In early January, surveyors will select (or be assigned) a predefined survey area. Survey areas are designed to be covered in a half-day to a full-day. Surveyors will be free to conduct their survey on any day during the 4-day survey window in mid-January.

A second survey is scheduled to be conducted in mid-February in select areas where Mountain Plovers are recorded during the mid-January surveys. This second survey effort will be used to assess if Mountain Plovers persist at key Arizona wintering areas over the winter.

Ideally, surveys should begin shortly after sunrise to ensure all the survey area can be covered at a leisurely pace. Surveyors will travel all publicly accessible roads, keeping an eye out for any suitable Mountain Plover habitat. A list and description of potentially suitable habitat types is provided at the end of this document.

Surveyors will scan all potentially suitable fields in your area from an access road to determine the presence/absence of the two target species, Mountain Plover (primary) and Long-billed Curlew (secondary). Please do not walk into any fields, simply scan them with your binoculars and spotting scope. Initial scrutiny of a field can be achieved in a slow moving vehicle with a passenger carefully scanning the area for the target species with binoculars. If plovers or curlews are detected, pull off to the edge of the road (if on main paved roads, pull completely onto the shoulder where dry) and scan with a scope to obtain an accurate count and document habitat type and management. To make this survey as complete as possible, we must be able to scrutinize all appropriate fields to the greatest extent possible, which means driving all paved and dirt access roads within your area.

If you encounter cabled or otherwise gated access roads that prohibit passage, scan the field from the best safe observation point. IMPORTANT – Please respect NO TRESPASSING signs. Do not drive or even walk on any posted roads unless you have previously obtained permission from the private property owner.

CAUTIONS:

Most roads are hard packed dirt surfaces and passable even in non-4WD vehicle. However, wet, sandy or soft patches, and potholes, could be present so watch for these and carefully drive around them. Also be aware that heavy farming equipment (tractors, balers, tractor trailers, etc.) may be operating in your area. Always drive slowly on field roads to minimize dust kick-up. If

you're near a working field, always yield the right of way to farm equipment or livestock. Even if you have 4WD, avoid traveling on dirt farm roads within 1-2 days following moderate rain as many roads will become impassable, plus you may create unwanted ruts, slide off the road, or simply become stuck.

DATA TO BE COLLECTED:

General Survey Information
Date – Date of the survey (mm/dd/yyyy).
Survey area – This will be given to you when you choose (or are assigned) an area.
County – What county your survey area is within.
Start – Time when your survey begins.
End – Time when your survey ends.
Miles traveled – To gauge the effort of the survey, we ask all surveyors to record the amount of ground covered during the survey. This can be done by simply setting your odometer at the beginning of the survey and then recording the value at the conclusion of the survey. We also ask that surveyors highlight all roads traveled during the survey on the map provided.
Weather – Basic weather conditions, such as temperature range, % cloud cover, wind conditions, etc.
Names – Names of all individuals participating in the survey.
Email – Email address of surveyor(s).

Observational Data – To be recorded when you observe Mountain Plovers (or Long-billed Curlews).
Flock # - Beginning with Flock #1, each flock you encounter (regardless of species) will be labeled sequentially (i.e., Flock #1, Flock #2, Flock #3…)
Time – Time at which a flock was first observed.
Flock size – Number of individuals within the flock. If the number is an estimate because it is not possible to count every bird (e.g., many birds in flight), please indicate so on the data form.
Location – If you have a GPS unit please record the UTM (NAD 83) of the observation. If you do not have a GPS unit, please provide a short description if possible. For example, "At the intersection of Main street and County Rd 29". Whether you have a GPS unit or not, please mark the observation on your survey map.
Habitat – Habitat where the flock was observed. A list of possible habitat categories is provided on the data form.
Field Stage – Note whether the field (if agricultural) where the birds are observed is bare dirt (tilled, smoothed or furrowed), a green and growing crop, recently mowed, recently burned, grazed, inactive or fallow.
Irrigation type and status –If irrigation is present please indicate if it is flood irrigation or sprinkler irrigation. If no irrigation is present, leave these fields blank. Also, indicate if the soil is wet or dry.
Vegetation height – The approximate average height of the vegetation the Mountain Plovers (or Long-billed Curlews) are using. Hint: Mountain Plovers stand approximately 20-24 centimeters tall and Long-billed Curlews stand approximately 45-66 centimeters tall. Also as an aid, 10 cm is approx. equal to 4 inches.

Behavior – Please indicate if the flock is feeding, roosting (resting, preening, bathing) or flying. If some members of a flock are feeding while others are roosting, check both of these behavior categories.

POTENTIAL MOUNTAIN PLOVER HABITAT (see habitat images on next page)

Mountain Plovers use a number of different habitats during the winter including:

Herbaceous grasslands
Pasture/grazed fields
Bermuda grass fields
Sod/turf fields
Alfalfa fields
Vegetables fields
Airfield
Alkaline flats

In addition, the fields of the following production stages are often used by Mountain Plovers:

Bare dirt (flat or furrowed)
Recently burned
Recently tilled
Recently harvested or cut
Grazed
Fallow

Arizona Winter Mountain Plover (and Long-billed Curlew) Survey Form

DATE:_____ SURVEY AREA: _____ COUNTY: _____

TIME START: _____ END: _____ MILES TRAVELED: _____ WEATHER: _____

OBSERVERS: EMAIL:

Flock	Species	Flock Size	Location (UTM NAD 83)	Habitat	Field Stage	Irrig. Type & Status	Veg Height	Behavior
#1	☐ MOUP		East.	☐ grass/pasture ☐ alfalfa	☐ bare dirt ☐ burned	☐ flood irrig.	☐ < 10 cm	☐ feed
Time:	☐ LBCU	estimate?	North.	☐ sod/turf ☐ vegetable	☐ growing ☐ grazed	☐ sprinkler	☐ 10-20 cm	☐ roost
		☐ yes ☐ no	Zone ☐ 11 ☐ 12	☐ airfield ☐ unkn.crop	☐ cut ☐ fallow	☐ dry ☐ wet	☐ > 20 cm	☐ fly
#2	☐ MOUP		East.	☐ grass/pasture ☐ alfalfa	☐ bare dirt ☐ burned	☐ flood irrig.	☐ < 10 cm	☐ feed
Time:	☐ LBCU	estimate?	North.	☐ sod/turf ☐ vegetable	☐ growing ☐ grazed	☐ sprinkler	☐ 10-20 cm	☐ roost
		☐ yes ☐ no	Zone ☐ 11 ☐ 12	☐ airfield ☐ unkn.crop	☐ cut ☐ fallow	☐ dry ☐ wet	☐ > 20 cm	☐ fly
#3	☐ MOUP		East.	☐ grass/pasture ☐ alfalfa	☐ bare dirt ☐ burned	☐ flood irrig.	☐ < 10 cm	☐ feed
Time:	☐ LBCU	estimate?	North.	☐ sod/turf ☐ vegetable	☐ growing ☐ grazed	☐ sprinkler	☐ 10-20 cm	☐ roost
		☐ yes ☐ no	Zone ☐ 11 ☐ 12	☐ airfield ☐ unkn.crop	☐ cut ☐ fallow	☐ dry ☐ wet	☐ > 20 cm	☐ fly
#4	☐ MOUP		East.	☐ grass/pasture ☐ alfalfa	☐ bare dirt ☐ burned	☐ flood irrig.	☐ < 10 cm	☐ feed
Time:	☐ LBCU	estimate?	North.	☐ sod/turf ☐ vegetable	☐ growing ☐ grazed	☐ sprinkler	☐ 10-20 cm	☐ roost
		☐ yes ☐ no	Zone ☐ 11 ☐ 12	☐ airfield ☐ unkn.crop	☐ cut ☐ fallow	☐ dry ☐ wet	☐ > 20 cm	☐ fly
#5	☐ MOUP		East.	☐ grass/pasture ☐ alfalfa	☐ bare dirt ☐ burned	☐ flood irrig.	☐ < 10 cm	☐ feed
Time:	☐ LBCU	estimate?	North.	☐ sod/turf ☐ vegetable	☐ growing ☐ grazed	☐ sprinkler	☐ 10-20 cm	☐ roost
		☐ yes ☐ no	Zone ☐ 11 ☐ 12	☐ airfield ☐ unkn.crop	☐ cut ☐ fallow	☐ dry ☐ wet	☐ > 20 cm	☐ fly
#6	☐ MOUP		East.	☐ grass/pasture ☐ alfalfa	☐ bare dirt ☐ burned	☐ flood irrig.	☐ < 10 cm	☐ feed
Time:	☐ LBCU	estimate?	North.	☐ sod/turf ☐ vegetable	☐ growing ☐ grazed	☐ sprinkler	☐ 10-20 cm	☐ roost
		☐ yes ☐ no	Zone ☐ 11 ☐ 12	☐ airfield ☐ unkn.crop	☐ cut ☐ fallow	☐ dry ☐ wet	☐ > 20 cm	☐ fly
#7	☐ MOUP		East.	☐ grass/pasture ☐ alfalfa	☐ bare dirt ☐ burned	☐ flood irrig.	☐ < 10 cm	☐ feed
Time:	☐ LBCU	estimate?	North.	☐ sod/turf ☐ vegetable	☐ growing ☐ grazed	☐ sprinkler	☐ 10-20 cm	☐ roost
		☐ yes ☐ no	Zone ☐ 11 ☐ 12	☐ airfield ☐ unkn.crop	☐ cut ☐ fallow	☐ dry ☐ wet	☐ > 20 cm	☐ fly
#8	☐ MOUP		East.	☐ grass/pasture ☐ alfalfa	☐ bare dirt ☐ burned	☐ flood irrig.	☐ < 10 cm	☐ feed
Time:	☐ LBCU	estimate?	North.	☐ sod/turf ☐ vegetable	☐ growing ☐ grazed	☐ sprinkler	☐ 10-20 cm	☐ roost
		☐ yes ☐ no	Zone ☐ 11 ☐ 12	☐ airfield ☐ unkn.crop	☐ cut ☐ fallow	☐ dry ☐ wet	☐ > 20 cm	☐ fly

Comments and Notes by Flock # (closest road intersection, private land contact info., etc.): _____

Page 1

Arizona Winter Mountain Plover (and Long-billed Curlew) Survey Form (continued)

Flock	Species	Flock Size	Location (UTM NAD 83)	Habitat	Field Stage	Irrig. Type & Status	Veg Height	Behavior
#9	☐ MOUP	☐ ☐	East. ☐ ☐	☐ grass/pasture ☐ alfalfa	☐ bare dirt ☐ burned	☐ flood irrig.	☐ < 10 cm	☐ feed
Time:	☐ LBCU	estimate?	North.	☐ sod/turf ☐ vegetable	☐ growing ☐ grazed	☐ sprinkler	☐ 10-20 cm	☐ roost
		☐ yes ☐ no	Zone ☐ 11 ☐ 12	☐ airfield ☐ unkn.crop	☐ cut ☐ fallow	☐ dry ☐ wet	☐ > 20 cm	☐ fly
#10	☐ MOUP		East.	☐ grass/pasture ☐ alfalfa	☐ bare dirt ☐ burned	☐ flood irrig.	☐ < 10 cm	☐ feed
Time:	☐ LBCU	estimate?	North.	☐ sod/turf ☐ vegetable	☐ growing ☐ grazed	☐ sprinkler	☐ 10-20 cm	☐ roost
		☐ yes ☐ no	Zone ☐ 11 ☐ 12	☐ airfield ☐ unkn.crop	☐ cut ☐ fallow	☐ dry ☐ wet	☐ > 20 cm	☐ fly
#11	☐ MOUP		East.	☐ grass/pasture ☐ alfalfa	☐ bare dirt ☐ burned	☐ flood irrig.	☐ < 10 cm	☐ feed
Time:	☐ LBCU	estimate?	North.	☐ sod/turf ☐ vegetable	☐ growing ☐ grazed	☐ sprinkler	☐ 10-20 cm	☐ roost
		☐ yes ☐ no	Zone ☐ 11 ☐ 12	☐ airfield ☐ unkn.crop	☐ cut ☐ fallow	☐ dry ☐ wet	☐ > 20 cm	☐ fly
#12	☐ MOUP		East.	☐ grass/pasture ☐ alfalfa	☐ bare dirt ☐ burned	☐ flood irrig.	☐ < 10 cm	☐ feed
Time:	☐ LBCU	estimate?	North.	☐ sod/turf ☐ vegetable	☐ growing ☐ grazed	☐ sprinkler	☐ 10-20 cm	☐ roost
		☐ yes ☐ no	Zone ☐ 11 ☐ 12	☐ airfield ☐ unkn.crop	☐ cut ☐ fallow	☐ dry ☐ wet	☐ > 20 cm	☐ fly
#13	☐ MOUP		East.	☐ grass/pasture ☐ alfalfa	☐ bare dirt ☐ burned	☐ flood irrig.	☐ < 10 cm	☐ feed
Time:	☐ LBCU	estimate?	North.	☐ sod/turf ☐ vegetable	☐ growing ☐ grazed	☐ sprinkler	☐ 10-20 cm	☐ roost
		☐ yes ☐ no	Zone ☐ 11 ☐ 12	☐ airfield ☐ unkn.crop	☐ cut ☐ fallow	☐ dry ☐ wet	☐ > 20 cm	☐ fly
#14	☐ MOUP		East.	☐ grass/pasture ☐ alfalfa	☐ bare dirt ☐ burned	☐ flood irrig.	☐ < 10 cm	☐ feed
Time:	☐ LBCU	estimate?	North.	☐ sod/turf ☐ vegetable	☐ growing ☐ grazed	☐ sprinkler	☐ 10-20 cm	☐ roost
		☐ yes ☐ no	Zone ☐ 11 ☐ 12	☐ airfield ☐ unkn.crop	☐ cut ☐ fallow	☐ dry ☐ wet	☐ > 20 cm	☐ fly
#15	☐ MOUP		East.	☐ grass/pasture ☐ alfalfa	☐ bare dirt ☐ burned	☐ flood irrig.	☐ < 10 cm	☐ feed
Time:	☐ LBCU	estimate?	North.	☐ sod/turf ☐ vegetable	☐ growing ☐ grazed	☐ sprinkler	☐ 10-20 cm	☐ roost
		☐ yes ☐ no	Zone ☐ 11 ☐ 12	☐ airfield ☐ unkn.crop	☐ cut ☐ fallow	☐ dry ☐ wet	☐ > 20 cm	☐ fly
#16	☐ MOUP		East.	☐ grass/pasture ☐ alfalfa	☐ bare dirt ☐ burned	☐ flood irrig.	☐ < 10 cm	☐ feed
Time:	☐ LBCU	estimate?	North.	☐ sod/turf ☐ vegetable	☐ growing ☐ grazed	☐ sprinkler	☐ 10-20 cm	☐ roost
		☐ yes ☐ no	Zone ☐ 11 ☐ 12	☐ airfield ☐ unkn.crop	☐ cut ☐ fallow	☐ dry ☐ wet	☐ > 20 cm	☐ fly
#17	☐ MOUP		East.	☐ grass/pasture ☐ alfalfa	☐ bare dirt ☐ burned	☐ flood irrig.	☐ < 10 cm	☐ feed
Time:	☐ LBCU	estimate?	North.	☐ sod/turf ☐ vegetable	☐ growing ☐ grazed	☐ sprinkler	☐ 10-20 cm	☐ roost
		☐ yes ☐ no	Zone ☐ 11 ☐ 12	☐ airfield ☐ unkn.crop	☐ cut ☐ fallow	☐ dry ☐ wet	☐ > 20 cm	☐ fly
#18	☐ MOUP		East.	☐ grass/pasture ☐ alfalfa	☐ bare dirt ☐ burned	☐ flood irrig.	☐ < 10 cm	☐ feed
Time:	☐ LBCU	estimate?	North.	☐ sod/turf ☐ vegetable	☐ growing ☐ grazed	☐ sprinkler	☐ 10-20 cm	☐ roost
		☐ yes ☐ no	Zone ☐ 11 ☐ 12	☐ airfield ☐ unkn.crop	☐ cut ☐ fallow	☐ dry ☐ wet	☐ > 20 cm	☐ fly

Comments and Notes by Flock # (behavior - foraging or roosting, closest road intersection, etc.):

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Recently tilled

Bare and flat

Sod/turf farm

Cut alfalfa

Grazed grass or alfalfa

Dry and cut Bermuda grass

Burned Bermuda grass

APPENDIX C: NUMBER OF INDIVIDUAL WATERBIRDS PER SPECIES AT EACH OF SEVERAL RESERVOIRS SURVEYED 2007-2012

Table 20. Number of individual waterbirds per species at Alamo Lake, 2007-2012.

Species	2007	2008	2009	2010	2011	2012	Total	Average/Year
American Avocet	0	0	0	0	0	6	6	1.0
American Coot	0	267	540	2309	610	645	4371	728.5
American White Pelican	42	19	45	15	0	0	121	20.2
American Wigeon	0	0	170	1	0	0	171	28.5
Bald Eagle	2	0	3	2	6	3	16	2.7
Belted Kingfisher	0	1	2	3	3	1	10	1.7
Black-crowned Night-Heron	0	3	0	0	0	4	7	1.2
Brown Pelican	0	0	2	1	0	0	3	0.5
Bufflehead	0	0	0	16	4	3	23	3.8
Canada Goose	0	0	10	4	0	0	14	2.3
Canvasback	0	0	0	0	0	1	1	0.2
Caspian Tern	1	0	0	0	0	0	1	0.2
Cinnamon Teal	0	0	4	0	1	0	5	0.8
Clark's Grebe	2	74	61	55	95	30	317	52.8
Common Loon	0	0	0	0	2	1	3	0.5
Clark's/Western Grebe	93	0	35	659	20	30	837	139.5
Common Merganser	44	82	4	39	3	13	185	30.8
Double-crested Cormorant	99	90	139	170	95	109	702	117.0
Eared Grebe	0	0	3	16	1	152	172	28.7
Gadwall	2	15	104	156	50	137	464	77.3
Great Blue Heron	18	39	16	57	47	57	234	39.0
Great Egret	2	16	11	20	9	17	75	12.5
Greater Yellowlegs	0	0	0	0	0	4	4	0.7
Green-winged Teal	38	18	68	29	180	150	483	80.5
Killdeer	1	1	0	0	1	19	22	3.7
Least Sandpiper	0	0	0	3	10	50	63	10.5
Lesser Scaup	0	0	3	3	0	0	6	1.0
Long-billed Dowitcher	0	0	0	33	0	1	34	5.7
Mallard	0	0	0	14	4	0	18	3.0
Northern Harrier	0	0	0	2	4	0	6	1.0
Northern Pintail	0	0	0	3	322	0	325	54.2
Northern Shoveler	9	50	3	479	1	1586	2128	354.7
Pied-billed Grebe	0	5	9	29	16	7	66	11.0
Redhead	14	0	7	19	10	0	50	8.3
Ring-billed Gull	8	17	25	19	4	6	79	13.2
Ring-necked Duck	0	0	5	4	30	0	39	6.5
Ruddy Duck	2	2	6	42	43	313	408	68.0
Spotted Sandpiper	0	1	2	7	1	1	12	2.0
Western Grebe	24	476	200	275	185	155	1315	219.2

Table 21. Number of individual waterbirds per species at Saguaro Lake, 2007-2012.

Species	2007	2008	2009	2010	2011	2012	Total	Average/Year
American Coot	356	446	565	965	1153	1857	5342	890.3
American Wigeon	0	0	2	0	2	0	4	0.7
Bald Eagle	0	3	3	3	4	6	19	3.2
Belted Kingfisher	2	4	2	0	0	0	8	1.3
Black Scoter	0	0	0	0	1	0	1	0.2
Black-crowned Night-Heron	15	1	1	0	0	0	17	2.8
Black-legged Kittiwake	0	0	0	0	1	0	1	0.2
Bufflehead	40	27	34	31	15	12	159	26.5
Canvasback	5	0	0	0	15	0	20	3.3
Cinnamon Teal	1	7	2	0	0	5	15	2.5
Clark's Grebe	2	5	2	1	5	2	17	2.8
Clark's/Western Grebe	0	15	65	0	50	0	130	21.7
Common Goldeneye	9	0	5	0	4	4	22	3.7
Common Merganser	0	94	115	23	37	4	273	45.5
Common Gallinule	103	6	1	3	7	20	140	23.3
Double-crested Cormorant	10	3	19	9	6	23	70	11.7
Eared Grebe	640	471	120	158	214	230	1833	305.5
Gadwall	10	0	12	0	2	1	25	4.2
Great Blue Heron	50	34	21	19	11	15	150	25.0
Greater Scaup	0	0	4	0	0	2	6	1.0
Green Heron	0	0	0	3	0	0	3	0.5
Green-winged Teal	3	0	1	0	4	4	12	2.0
Herring Gull	1	0	0	0	0	0	1	0.2
Horned Grebe	1	0	0	0	0	0	1	0.2
Least Bittern	1	0	1	1	0	0	3	0.5
Lesser Scaup	452	265	79	236	199	313	1544	257.3
Mallard	43	4	25	60	70	4	206	34.3
Neotropic Cormorant	0	1	0	2	1	2	6	1.0
Northern Pintail	2	0	3	0	0	0	5	0.8
Northern Shoveler	12	9	25	0	2	3	51	8.5
Osprey	1	3	1	1	2	1	9	1.5
Pied-billed Grebe	40	57	52	51	63	90	353	58.8
Redhead	10	0	0	15	8	10	43	7.2
Ring-billed Gull	42	12	8	7	16	17	102	17.0
Ring-necked Duck	56	23	116	36	44	50	325	54.2
Ruddy Duck	230	287	184	83	130	136	1050	175.0
Sora	1	2	1	0	1	2	7	1.2
Spotted Sandpiper	1	3	0	0	0	0	4	0. 7
Western Grebe	353	251	260	450	360	495	2169	361.5
White-winged Scoter	0	1	0	0	0	0	1	0.2

Table 22. Number of individual waterbirds per species at Roosevelt Lake, 2007-2012.

Species	2007	2008	2009	2010	2011	2012	Total	Average/Year
American Coot	1086	1772	1254	-	1235	1454	6801	1360.2
American White Pelican	0	39	9	-	3	8	59	11.8
American Wigeon	2	296	224	-	4	0	526	105.2
Bald Eagle	17	10	11	-	22	31	91	18.2
Belted Kingfisher	1	1	1	-	0	0	3	0.6
Bufflehead	0	0	4	-	0	0	4	0.8
Canada Goose	866	1467	243	-	138	199	2913	582.6
Canvasback	8	257	72	-	2	1	340	68.0
Cinnamon Teal	0	3	0	-	0	0	3	0.6
Clark's Grebe	141	131	276	-	417	166	1131	226.2
Clark's/Western Grebe	420	2020	476	-	1090	1015	5021	1004.2
Common Goldeneye	2	0	1	-	2	1	6	1.2
Common Loon	0	0	0	-	2	0	2	0.4
Common Merganser	0	1	3	-	19	5	28	5.6
Common Gallinule	6	0	0	-	0	0	6	1.2
Double-crested Cormorant	68	126	184	-	146	76	600	120.0
Eared Grebe	0	0	0	-	1	0	1	0.2
Gadwall	101	796	212	-	99	21	1229	245.8
Great Blue Heron	11	20	46	-	39	40	156	31.2
Great Egret	0	1	0	-	3	0	4	0.8
Green-winged Teal	145	795	3	-	15	39	997	199.4
Hooded Merganser	0	0	2	-	0	0	2	0.4
Horned Grebe	0	1	0	-	0	0	1	0.2
Killdeer	0	0	0	-	0	4	4	0.8
Lesser Scaup	23	45	12	-	0	1	81	16.2
Mallard	33	882	196	-	18	17	1146	229.2
Neotropic Cormorant	0	0	0	-	0	2	2	0.4
Northern Pintail	89	640	251	-	1	2	983	196.6
Northern Shoveler	49	84	156	-	952	240	1481	296.2
Pied-billed Grebe	5	15	23	-	30	11	84	16.8
Redhead	13	112	260	-	1	41	427	85.4
Red-throated Loon	0	0	1	-	0	0	1	0.2
Ring-billed Gull	22	34	82	-	80	153	371	74.2
Ring-necked Duck	4	160	271	-	0	6	441	88.2
Ross's Goose	0	0	0	-	0	1	1	0.2
Ruddy Duck	8	61	121	-	26	2	218	43.6
Snow Goose	4	5	2	-	0	0	11	2.2
Spotted Sandpiper	0	3	1	-	1	11	16	3.2
Western Grebe	635	667	1107	-	1908	1560	5877	1175.4
Wood Duck	0	3	0	-	0	0	3	0.6

Table 23. Number of individual waterbirds per species at Martinez Lake, 2007-2012.

Species	2007	2008	2009	2010	2011	2012	Total	Average/Year
American Bittern	-	0	1	0	0	0	1	0.2
American Coot	-	234	139	1687	430	850	3340	668.0
American White Pelican	-	16	2	0	0	0	18	3.6
American Wigeon	-	12	0	0	2	0	14	2.8
Bald Eagle	-	0	0	0	0	1	1	0.2
Belted Kingfisher	-	0	1	0	0	2	3	0.6
Black-crowned Night-Heron	-	0	0	0	0	6	6	1.2
Bufflehead	-	21	34	39	7	60	161	32.2
Canada Goose	-	12	0	0	0	0	12	2.4
Clark's Grebe	-	27	13	21	39	39	139	27.8
Common Goldeneye	-	0	10	0	0	0	10	2.0
Common Merganser	-	0	0	0	8	6	14	2.8
Common Gallinule	-	2	0	0	1	0	3	0.6
Double-crested Cormorant	-	8	25	59	24	39	155	31.0
Eared Grebe	-	2	1	13	0	2	18	3.6
Gadwall	-	18	0	0	3	0	21	4.2
Great Blue Heron	-	1	1	0	1	3	6	1.2
Great Egret	-	2	0	1	0	0	3	0.6
Green-winged Teal	-	2	0	0	0	0	2	0.4
Least Bittern	-	0	1	0	0	2	3	0.6
Lesser Scaup	-	0	0	13	0	0	13	2.6
Mallard	-	13	0	0	10	1	24	4.8
Northern Pintail	-	2	0	0	0	0	2	0.4
Northern Shoveler	-	15	43	6	4	25	93	18.6
Osprey	-	2	1	1	1	1	6	1.2
Pied-billed Grebe	-	24	2	10	23	7	66	13.2
Redhead	-	9	0	18	4	0	31	6.2
Ring-billed Gull	-	0	3	7	39	4	53	10.6
Ring-necked Duck	-	19	0	0	39	3	61	12.2
Ruddy Duck	-	17	10	27	36	12	102	20.4
Snowy Egret	-	1	0	2	2	9	14	2.8
Western Grebe	-	14	9	48	0	0	71	14.2

Table 24. Number of individual waterbirds per species at Lake Pleasant, 2007-2012.

Species	2007	2008	2009	2010	2011	2012	Total	Average/Year
American Coot	281	-	-	1334	-	-	1615	807.5
American Wigeon	53	-	-	93	-	-	146	73.0
Bald Eagle	0	-	-	2	-	-	2	1.0
Belted Kingfisher	1	-	-	0	-	-	1	0.5
Clark's Grebe	0	-	-	3	-	-	3	1.5
Common Goldeneye	0	-	-	4	-	-	4	2.0
Common Merganser	0	-	-	75	-	-	75	37.5
Common Gallinule	2	-	-	0	-	-	2	1.0
Double-crested Cormorant	1	-	-	6	-	-	7	3.5
Eared Grebe	0	-	-	1	-	-	1	0.5
Eurasian Wigeon	0	-	-	1	-	-	1	0.5
Gadwall	41	-	-	1	-	-	42	21.0
Great Blue Heron	16	-	-	21	-	-	37	18.5
Green-winged Teal	25	-	-	0	-	-	25	12.5
Horned Grebe	0	-	-	1	-	-	1	0.5
Killdeer	1	-	-	1	-	-	2	1.0
Mallard	30	-	-	17	-	-	47	23.5
Northern Pintail	0	-	-	2	-	-	2	1.0
Northern Shoveler	0	-	-	10	-	-	10	5.0
Pied-billed Grebe	5	-	-	13	-	-	18	9.0
Red-necked Grebe	0	-	-	1	-	-	1	0.5
Ring-billed Gull	36	-	-	74	-	-	110	55.0
Spotted Sandpiper	0	-	-	3	-	-	3	1.5
Western Grebe	410	-	-	378	-	-	788	394.0

Table 25. Number of individual waterbirds per species at Bartlett Reservoir, 2007-2012.

Species	2007	2008	2009	2010	2011	2012	Total	Average/Year
American Coot	-	10	-	-	0	-	10	5.0
American Wigeon	-	16	-	-	0	-	16	8.0
Bald Eagle	-	1	-	-	1	-	2	1.0
Belted Kingfisher	-	3	-	-	1	-	4	2.0
Canada Goose	-	41	-	-	0	-	41	20.5
Common Merganser	-	17	-	-	6	-	23	11.5
Double-crested Cormorant	-	2	-	-	0	-	2	1.0
Eared Grebe	-	75	-	-	74	-	149	74.5
Gadwall	-	7	-	-	0	-	7	3.5
Great Blue Heron	-	15	-	-	22	-	37	18.5
Great Egret	-	2	-	-	0	-	2	1.0
Green-winged Teal	-	194	-	-	0	-	194	97.0
Hooded Merganser	-	3	-	-	0	-	3	1.5
Horned Grebe	-	1	-	-	1	-	2	1.0
Killdeer	-	0	-	-	2	-	2	1.0
Mallard	-	21	-	-	0	-	21	10.5
Pied-billed Grebe	-	8	-	-	15	-	23	11.5
Red-breasted Merganser	-	0	-	-	1	-	1	0.5
Redhead	-	1	-	-	0	-	1	0.5
Ring-billed Gull	-	5	-	-	1	-	6	3.0
Ring-necked Duck	-	62	-	-	0	-	62	31.0
Ruddy Duck	-	0	-	-	2	-	2	1.0
Spotted Sandpiper	-	2	-	-	1	-	3	1.5
Western Grebe	-	73	-	-	24	-	97	48.5
Wood Duck	-	3	-	-	0	-	3	1.5

Table 26. Number of individual waterbirds per species at Apache Lake, 2007-2012.

Species	2007	2008	2009	2010	2011	2012	Total	Average/Year
American Coot	-	59	-	-	-	296	355	177.5
Belted Kingfisher	-	2	-	-	-	2	4	2.0
Clark's Grebe	-	1	-	-	-	1	2	1.0
Common Merganser	-	45	-	-	-	93	138	69.0
Double-crested Cormorant	-	7	-	-	-	13	20	10.0
Eared Grebe	-	205	-	-	-	949	1154	577.0
Gadwall	-	0	-	-	-	52	52	26.0
Great Blue Heron	-	6	-	-	-	1	7	3.5
Green-winged Teal	-	5	-	-	-	0	5	2.5
Hooded Merganser	-	3	-	-	-	0	3	1.5
Northern Shoveler	-	6	-	-	-	0	6	3.0
Pied-billed Grebe	-	21	-	-	-	21	42	21.0
Red-breasted Merganser	-	8	-	-	-	0	8	4.0
Redhead	-	0	-	-	-	8	8	4.0
Ring-billed Gull	-	9	-	-	-	45	54	27.0
Ring-necked Duck	-	0	-	-	-	6	6	3.0
Spotted Sandpiper	-	3	-	-	-	1	4	2.0
Western Grebe	-	218	-	-	-	355	573	286.5

Table 27. Number of individual waterbirds per species at Canyon Lake, 2007-2012.

Species	2007	2008	2009	2010	2011	2012	Total	Average/Year
American Coot	-	-	121	-	-	310	431	215.5
Bald Eagle	-	-	0	-	-	2	2	1.0
Black-crowned Night-Heron	-	-	0	-	-	3	3	1.5
Bufflehead	-	-	0	-	-	2	2	1.0
Common Merganser	-	-	43	-	-	62	105	52.5
Double-crested Cormorant	-	-	2	-	-	14	16	8.0
Eared Grebe	-	-	21	-	-	148	169	84.5
Great Blue Heron	-	-	4	-	-	5	9	4.5
Horned Grebe	-	-	0	-	-	4	4	2.0
Mallard	-	-	0	-	-	20	20	10.0
Osprey	-	-	0	-	-	1	1	0.5
Pied-billed Grebe	-	-	13	-	-	25	38	19.0
Redhead	-	-	0	-	-	1	1	0.5
Ring-billed Gull	-	-	0	-	-	2	2	1.0
Ruddy Duck	-	-	0	-	-	2	2	1.0
Spotted Sandpiper	-	-	1	-	-	0	1	0.5
Western Grebe	-	-	36	-	-	8	44	22.0