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HISTORY, CURRENT DISTRIBUTION, AND STATUS OF THE EGYPTIAN GOOSE (*ALOPOCHEN AEGYPTIACA*) IN THE CONTIGUOUS UNITED STATES

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Abstract—We summarize the history, current distribution, and status of Egyptian geese (*Alopochen aegyptiaca*) in the contiguous United States, using published records and the eBird database of bird observations. The area of occupancy for the Egyptian goose has increased throughout the contiguous United States. The species has three populations that appear to be strongholds throughout the United States: Florida, California, and Texas. The potential ecological and economic consequences of an apparent increase in the United States warrant further research on a number of aspects of Egyptian goose biology.

Resumen—Resumimos la historia, la distribución actual y el estado de los gansos del nilo *Alopochen aegyptiaca* en los estados contiguos de los Estados Unidos, utilizando registros publicados y las observaciones de aves de la base de datos eBird. El territorio ocupado por el ganso del nilo ha aumentado en los estados contiguos de los Estados Unidos. La especie tiene tres poblaciones que parecen ser bastiones en los Estados Unidos: Florida, California y Texas. Las posibles consecuencias ecológicas y económicas del aumento del número de gansos en los Estados Unidos merecen más investigación en varios aspectos de la biología del ganso del nilo.

The Egyptian goose (*Alopochen aegyptiaca*) is native to Africa (Brown et al., 1982; Maclean, 1988; Davies, 2005), where it is common and widespread south of the Sahara (Maclean, 1997). Egyptian geese are naturalized in Europe (Sutherland and Allport, 1991; Delany, 1993; Lensink, 1999; Rehfisch et al., 2010; Gyimesi and Lensink, 2012) and are considered one of the most rapidly spreading invasive species there (Gyimesi and Lensink, 2012). In the United States, Egyptian geese occur regularly in Florida, Texas, and California, among other states (Braun, 2004; Pranty and Garrett, 2011; Pranty and Ponzo, 2014; Callaghan and Brooks, 2016; eBird, 2016). Although population biology of the Egyptian goose has been described at the local level (e.g., Pranty and Ponzo, 2014; Callaghan and Brooks, 2016), state and especially nationwide analyses are lacking. In this note, we collate historical information and use eBird data (Sullivan et al., 2014) to present current distribution and current trends of Egyptian geese in the contiguous United States. The purpose of this note is to draw attention to an introduced species in North America that is demonstrating an exceptional increase, especially in recent years.

Akhurst (1877) and Kirkwood (1900) provide the earliest known records of Egyptian geese in North America. Both authors believed the records to be of wild specimens, but the birds were most likely escapees (Baird et al., 1884; American Ornithologists' Union, 1901). Phillips (1928) commented that the Egyptian goose was *commonly* kept and that *many* were imported since 1904 (our emphasis). The birds remained common in avicultural collections and likely accounted for various records throughout North America (Wilbur and Yocom, 1971). Breeding outside of captivity was first reported from California in 1967 (Renwick, 1968). This was followed by breeding in Florida in 1985 (Pranty and Ponzo, 2014) and Arkansas in 2008 (Smith and James, 2012). There now appear to be established populations in Florida, California, Texas, and possibly Arkansas. Recent published information on Egyptian geese in North America is limited to the status and distribution of populations in Arkansas (Smith and James, 2012; Chesbro, 2015), Florida (Pranty and Ponzo, 2014), California (Pranty and Garrett, 2011), and Texas (Callaghan and Brooks, 2016).

We used the eBird database (Sullivan et al., 2014) in order to summarize the current distribution and status of the Egyptian goose in North America. Given the unique look of Egyptian geese compared with other North American avifauna, there is little reason to believe that misidentifications would skew results. All Egyptian goose

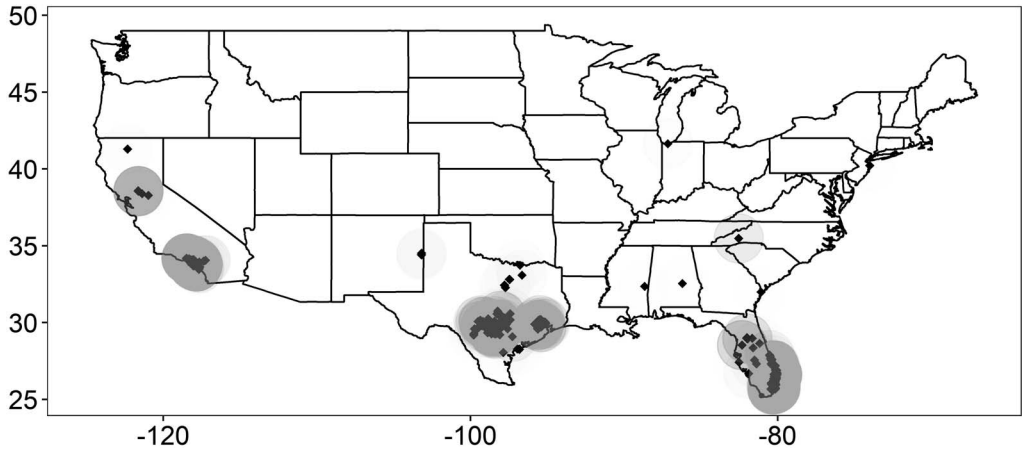

FIG. 1—The current distribution of the Egyptian goose throughout the continental United States. Maps are made using Program R statistical software, eBird data from January 2016 to December 2016 ($N = 2{,}221$ observations). Each eBird occurrence during this time frame is plotted, using a "jitter" approach, which introduces a small amount of variation to the points to avoid overplotting. The circle represents the "jittering." Minimal transparency indicates minimal points plotted on top of each other, while the darker areas indicate many points plotted on top of each other.

records in the eBird database were included, whether they were validated or invalidated by reviewers. We acknowledge that observers might not submit exotic bird sightings at the same frequency in which they submit native avifauna records, but unless there are statewide or regional reporting biases, this only biases our analyses in a conservative manner.

We investigated Egyptian goose records in the eBird database between January 2016 and December 2016 ($N = 2{,}221$ observations; 95% validated), and plotted these to visualize the current distribution of Egyptian geese in the contiguous United States (Fig. 1). The 1-year date range helped to minimize the role escapees would have on the current distribution. The species has three populations that appear to be strongholds throughout North America: Florida, California, and Texas. Overall, the most records (42%, 35%, and 20%, respectively) in the eBird database originate from these three states (Table 1). There are a number of records in the northeastern United States that likely represent isolated escapees. There are records from a number of other states (Table 1), but questions of provenance surround many of these birds. We speculate that records within the southeastern United States could represent dispersing individuals from the Florida population; however, based on the database used, it is difficult to surmise. Table 1 represents the number of records (i.e., occurrence—observation of an Egyptian goose, regardless of abundance) for each state between 2006 and 2016 in the eBird database. There were 17,447 observations in the database, of which 93% were validated. In order to represent sampling effort, the number of eBird checklists per state and the years in which Egyptian geese have been recorded are also included in the table.

We used eBird data from January 2006 to December 2016 (Sullivan et al., 2014) and the grid cell method, in ArcMap v10.2 (Environmental Systems Research Institute, Redlands, California), to calculate the area of occupancy (International Union for Conservation of Nature, 2001; Klemann and Vieira, 2013) of Egyptian geese throughout the contiguous United States. We calculated the area of occupancy by overlaying eBird observations on a grid, counted the grid cells in which at least one observation took place on an annual basis, and summed these, which provided a value in square kilometers per year. We used a 10-km^2 cell size, given the capable flight ability of Egyptian geese and in order to ensure the same individual geese were not being counted multiple times. To account for increasing effort of the eBird database, we standardized eBird data by dividing the area of occupancy in a given year by the number of checklists submitted in that year, for each respective location (i.e., United States, Florida, California, Texas). The trends make this species worthy of future investigations because they demonstrate a substantial increase in the area of occupancy of Egyptian geese (Fig. 2) throughout the contiguous United States, and especially Texas, where there appears to be the greatest rate of spread.

Egyptian geese are one of the most rapidly spreading invasive species in Europe and are considered a significant problem, in several ways (Lensink, 1998; Gyimesi and Lensink, 2012). They have been documented hybridizing with other waterfowl (Lensink, 1996; Harrop, 1998; Banks et al., 2008; Callaghan and Brooks, 2016); have had a negative effect on black sparrowhawk (*Accipiter melanoleucus*) nest success (Curtis et al., 2007); and in their native South Africa, Egyptian geese caused US$70,000 worth of crop damage at only one representative site (Mangnall and Crowe, 2002). Other ecological and economic consequences could include eutrophication of water bodies due to prevalence of geese on golf courses (Little

TABLE 1—The number of observations in the eBird database of Egyptian geese in the United States, 2006–2016. Percentage of Egyptian goose observations represents the percentage of all checklists submitted including Egyptian geese. These data do not represent population size, but only observations.

State	Number of observations	Years reported	Number of checklists	Percentage of Egyptian goose observations
Florida	7,323	2006–2016	881,957	0.8303
California	6,058	2006–2016	1,829,264	0.3312
Texas	3,573	2006–2016	1,137,199	0.3142
Arkansas	88	2006, 2008, 2010–2016	91,913	0.0957
North Carolina	68	2012, 2014–2016	330,960	0.0205
New Jersey	57	2008–2011, 2013–2016	521,620	0.0109
Massachusetts	53	2013–2015	661,154	0.0080
Arizona	31	2007, 2010, 2013–2016	553,691	0.0056
Pennsylvania	27	2007–2009, 2011–2014	774,997	0.0035
Michigan	26	2012, 2013, 2015	618,696	0.0042
New Mexico	25	2007, 2010, 2013–2016	212,990	0.0117
West Virginia	13	2012–2014	90,639	0.0143
Alabama	10	2013–2016	102,229	0.0098
Indiana	10	2006, 2011, 2016	224,964	0.0044
Maryland	10	2006, 2015	550,116	0.0018
New York	9	2007, 2008, 2012, 2015	1,174,641	0.0008
Missouri	8	2016	240,597	0.0033
Louisiana	7	2009–2012, 2014, 2015	143,002	0.0049
Tennessee	7	2012–2015	211,938	0.0033
Ohio	6	2009, 2015, 2016	530,035	0.0011
Georgia	5	2008, 2011, 2015, 2016	335,079	0.0015
Illinois	5	2009, 2016	513,744	0.0010
Oklahoma	4	2013, 2014, 2016	96,637	0.0041
Utah	4	2010, 2014–2016	197,074	0.0020
District of Columbia	3	2015	38,229	0.0078
Oregon	3	2008–2010	539,265	0.0006
Virginia	3	2012, 2015	469,404	0.0006
Connecticut	2	2013, 2015	310,196	0.0006
Delaware	2	2010	100,538	0.0020
Iowa	2	2008, 2012	92,590	0.0022
Maine	1	2016	259,810	0.0004
Mississippi	1	2016	49,083	0.0020
Rhode Island	1	2009	56,546	0.0018
South Dakota	1	2006	58,090	0.0017
Washington	1	2015	587,068	0.0002

and Sutton, 2013), aggression of geese toward native species, and goose–aircraft collisions (Rehfisch et al., 2010; A. Gyimesi and R. Lensink, in litt.).

Our analysis confirms that the distribution strongholds of Egyptian geese appear to be limited to Florida, Texas, and California. Further, there appears to be an increase in area of occupancy within Texas and the contiguous United States as a whole. Florida and California could indicate a population stability (Fig. 2). However, it is possible that the trends in Fig. 2 could be an artifact of the eBird database and the varying usage of it throughout the Egyptian goose range in the United States.

Without prudent research on Egyptian geese and the ecological or economic problems they may cause, Egyptian geese could establish themselves as permanent fixtures in the continental United States avifauna. We acknowledge that they are predominantly human-commensal at present (Pranty and Ponzo, 2014), which could limit their potential spread somewhat.

Specific questions that should be addressed in future studies include (1) What limits their population? (2) What negative effects, if any, do Egyptian geese have on native flora and fauna in the United States? (3) What habitat features do Egyptian geese require? This note highlights the spread of an introduced bird species, which has the potential to become a threat, ecologically and economically, in the United States.

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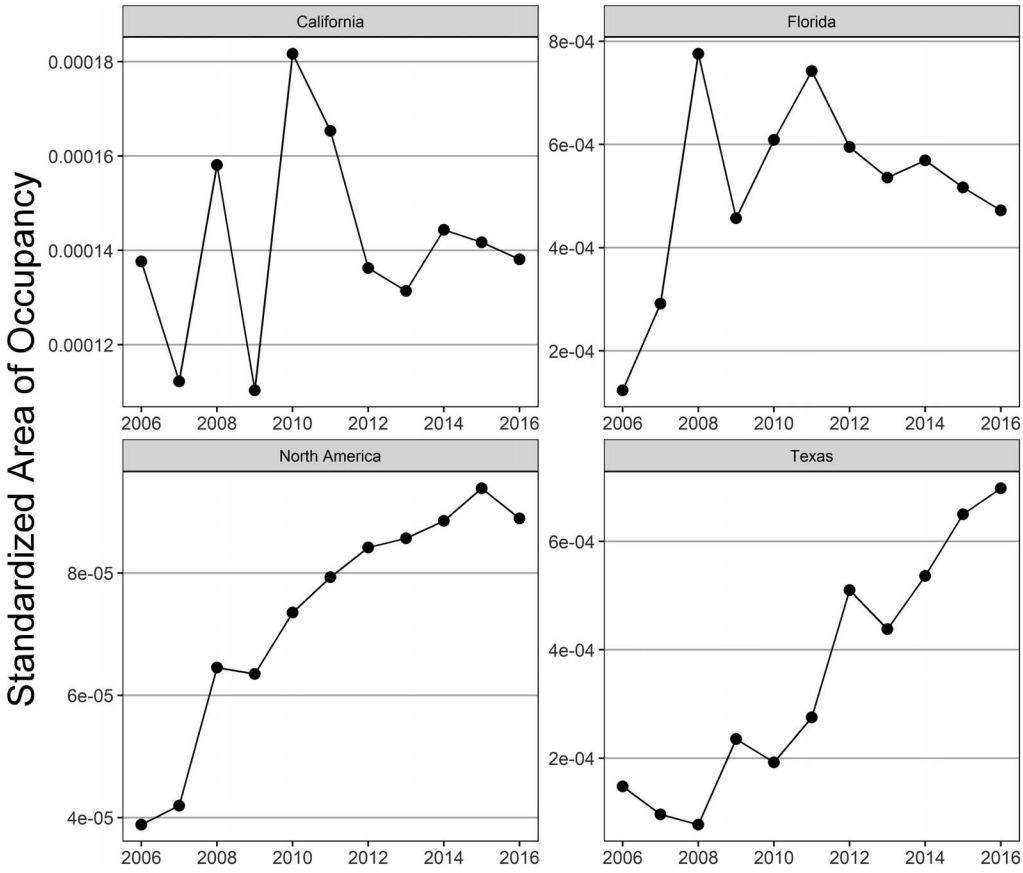

Fig. 2—The standardized area of occupancy of Egyptian geese in the contiguous United States 2006–2016. The *y* axis represents the area of occupancy (i.e., the number of 10-km^2 grid cells occupied in a given year) divided by the number of checklists in that given geographic location (as a measure of effort). Note the different *y* axes scales, which reflect the different number of checklists used to standardize the data, in order to account for effort.

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