Petition to Evaluate Species Status of American Flamingo (*Phoenicopterus ruber*) in Florida

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TO:
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Introduction

The American Flamingo (*Phoenicopterus ruber*) is a cultural icon of Florida and the only flamingo species native to the United States. Large flocks (hundreds or thousands) of American Flamingos formerly foraged through Florida Bay and the Florida Keys (Audubon 1839, Wurdemann 1860, Scott 1890, Ingraham 1893, Howe 1902) and along the western coast of the Florida peninsula – perhaps as far north as Hillsborough Bay (Williams 1837, Ward 1914). The best available evidence indicates that Florida's historic flamingo population not only foraged, but also nested within Florida (Whitfield et al. 2018) – though this topic has been controversial for decades (Sprunt 1937, Allen 1954, Stevenson and Anderson 1994, Whitfield et al. 2018). Flamingos were heavily hunted for food in the mid-1800s (Wurdemann 1860), hunted for plumes in the late 1800s (Scott 1890, Pierce 1962), and **Florida's flamingos were almost completely extirpated under anthropogenic hunting pressure by the beginning of the 20th century** (Bailey 1925, Howell 1932, Sprunt 1954, Allen 1956, Whitfield et al. 2018).

Through most of the 20th century, flamingos in Florida were extremely rare (Sprunt 1954, Allen 1956, Stevenson and Anderson 1994, Whitfield et al. 2018), and occasional sightings of individual flamingos or small groups were considered by most ornithologists to be escapees from captive colonies rather than wild birds (Bailey 1928, 1932, Allen 1956, Stevenson and Anderson 1994). However, first in 2002 and again in 2010, wild flamingos banded as chicks in the Yucatan of Mexico have appeared in Florida Bay or Everglades National Park (Galvez et al. 2016, Whitfield et al. 2018)– clear evidence that at least some of **Florida's flamingos are wild birds – not escaped birds from captive colonies**.

Despite strong anthropogenic hunting pressure as a clear driver of population decline, **American Flamingos have never been considered as a focal species for conservation, management, or monitoring within the state of Florida**. While American Flamingos are listed among native species under the Migratory Bird Treaty Act of 1918, to our knowledge the Florida Fish and Wildlife Conservation Commission ("FWC") has never conducted a Biological Status Review ("BSR") for the species, and American Flamingos are not mentioned in FWC's State Wildlife Action Plan (FWC 2012). FWC apparently has followed the historic consensus among ornithologists that flamingos are non-native to Florida, as American Flamingos were not included in a quantitative ranking review of all native Florida species for determining inclusion under state threatened and endangered species laws (Millsap et al. 1990). However, prevailing evidence now suggests that flamingos in Florida are not primarily escaped individuals, but rather are wild birds within their native, historic range (Whitfield et al. 2018). Consequently, FWC's consideration of the conservation status of flamingos may warrant attention.

As one of Florida's most iconic animal species, American Flamingos have been a target of conservation interest intermittently since the late 19th century. Early naturalists cautioned that unregulated harvesting of flamingos (and other bird species) would lead to population collapses – eventually resulting in legal protections for wild birds (Scott 1890, Ingraham 1893, Brodhead 1910, Ward 1914). Establishment of captive colonies of flamingos in Florida in the early 20th century was in some instances undertaken with an intention of reintroducing the species to Florida (Simpson 1920), and Daniel Beard (first director of Everglades National Park) discussed reintroduction of

flamingos shortly after the establishment of Everglades National Park (Beard 1938). **The re-emerging view that flamingos are a native species that was extirpated by human pressures has led to increasing calls for conservation efforts directed towards the species.** For example, a recent report of wading bird conservation priorities for the southeastern United States by the US Fish and Wildlife Service ("USFWS") concluded that American Flamingos are a species of "Regional Concern" and in need of "Critical Recovery attention" (Hunter et al. 2006). However, **any conservation efforts for American Flamingos will require clarification from wildlife regulatory agencies regarding the status of the species.**

We hereby request that Florida's Fish and Wildlife Conservation Commission conduct a status evaluation for American Flamingos (*Phoenicopterus ruber*). In this petition, we aim to provide the best available information to evaluate whether American Flamingos warrant status review by FWC by addressing in detail the "Biological Variables" posed in Millsap et al. (1990) as governed under governed by Rule 68A-27.0012 of the Florida Administrative Code and described by FWC at http://myfwc.com/wildlifehabitats/imperiled/listing-process/. We explicitly address one key scientific uncertainty for the listing process – the nature of population structure for American Flamingos. Finally, in this petition we aim to provide the best available information to evaluate either a Florida population or Pan-Caribbean population of flamingos, and information to evaluate whether a Florida population or Pan-Caribbean population is a valid unit for consideration.

Defining "Population" for American Flamingos in Florida

There may be substantial biological uncertainties regarding the nature of the Florida population of American Flamingos relevant to FWC's listing process and review. A historical population of flamingos that apparently nested within the state was extirpated or nearly extirpated by ~1900 under heavy hunting pressures (Wurdemann 1860, Scott 1890, Ingraham 1893, Howe 1902, Pierce 1962, Whitfield et al. 2018). For this historical population, it is not currently possible to estimate the extent of connectivity with nearby nesting colonies in The Bahamas (including now-extirpated nesting colonies in Abaco and Andros), Cuba, and the Yucatan Peninsula of Mexico. Early naturalists who described the historical population differed in their interpretations of whether the historic population was connected to populations in Cuba or the Bahamas (Audubon 1839, Wurdemann 1860, Scott 1890, Ingraham 1893, Allen 1956), but none of them had data to support their claims.

The number of flamingo observations in Florida has apparently increased over the past 70 years (Whitfield et al. 2018), likely the result of increased dispersal from nearby nesting colonies in The Bahamas, Cuba, or Mexico, as populations in these regions have all recovered following legal protections and species management. In two cases, individual birds banded in the Yucatan of Mexico have been identified in Florida - providing solid evidence that at least some individuals disperse from Mexico to Florida (Galvez et al. 2016, Whitfield et al. 2018). Plausibly, since nesting locations in Cuba and Inagua, Bahamas are closer than the Yucatan, there is also some connection to these breeding sites as well. Banding records have clearly shown that flamingos can travel long distances (Sprunt 1975, Galvez et al. 2016).

However, it is also evident that dispersal has been insufficient to result in a "rescue effect" of a flamingo population within Florida. Typically, colonial nesting birds such as flamingos show considerable site fidelity to their natal nesting colonies (Balkiz et al. 2010). Further, the strong colonial nesting behaviors of flamingos require a critical minimum number of individuals to initiate nesting activities (Pickering et al. 1992), and groups of less than 10 pairs are extremely unlikely to nest – prohibiting rescue effects into Florida from nearby Caribbean colonies. Banding studies do show that long-distance dispersal does occur, yet it is relatively rare (Sprunt 1975, Galvez et al. 2016). Clearly, while flamingos may disperse long distances, the rarity of these long-distance movements, high nesting site fidelity, and requirement of multiple pairs to onset nesting clearly lead to infrequent re-colonization of historic breeding locations.

Population genetic studies may inform the population structure of American Flamingos, though detailed studies are not currently available. Frias-Soler et al (2014) demonstrates that there is distinction between Cuban populations of *P. ruber* and populations in the Galapagos; while this indicates that there exists at least some degree of genetic differentiation among population units, it is not particularly informative for a Florida population. The Galapagos population is separated by ~2,500 km any other nesting area, and there is no evidence of movement between the Galapagos and Caribbean populations. For a similar species of Old World flamingo, *P. roseus* shows no distinct population structure across the Mediterranean – a significant portion of its range (Geraci et al. 2012). Zaccara et al. (2008) also show that populations of Lesser Flamingos (*Phoenicopterus minor*) between southern and eastern Africa are not genetically isolated.

Because of the uncertainty of how to define a Florida population of American Flamingos, for each of the Millsap et al. (1990 Biological Variables 1-5, we present evidence for both a "Florida Population" and a "Pan-Caribbean population." Our "Pan-Caribbean population" as here defined includes Florida, The Bahamas, the Greater and Lesser Antilles, a single nesting and foraging area in the Yucatan Peninsula of Mexico, and the northern coast of South America (particularly Venezuela) – but excludes nesting colonies in the Galapagos. For questions on Biological Variables 6 and 7, the same answers should apply to either a Florida or Pan-Caribbean population.

Review of Millsap et al. (1990) Biological Variables

Here, we provide a detailed review of Biological Variables described in Millsap et al. (1990). We aim in this review of the Biological Variables to provide the best available scientific information available on the biology and population status of American Flamingos (*Phoenicopterus ruber*). Further, when data deficits exist, we take efforts to identify these deficits and explicitly clarify assumptions that we make in producing the best answers available for the Biological Variables. We hope that the detailed discussion and review of the Biological Variables will make the Biological Score we produce herein entirely transparent, and will facilitate the processing of this request for staff at FWC (and if warranted, a Biological Review Group).

Table 1. Summary of Biological Variables in Millsap et al (1990) for American Flamingos, including two considerations of population units – a Florida-specific population, and Pan-Caribbean population (all populations within the Caribbean, but excluding a disjunct population in the Galapagos).

Biological Variable	Florida Population Best Answer	Florida Population Points	Pan-Caribbean Population Best Answer	Pan-Caribbean Population Points
1. Population size	(a) 0-500 individuals	10	(f) >50,000 individuals	0
2. Population trend	(c) Population experienced serious declines but is presently stable or increasing	6	(c) Population experienced serious declines but is presently stable or increasing	6
3. Range size	(a) <100km^2	10	(c) 1,001- 40,000 km^2 or up to ¼ the size of Florida	7
4. Distribution trend	(a) Area occupied has declined by 90-100%	10	(c) Area occupied has declined by 25-74%	5
5. Population concentration	(b) Concentrates at 1-25 locations	6	(b) Concentrates at 1-25 locations	6
6A. Average number of eggs or live young produced/adult female/yr	(a) <1 offsping/female/yr	5	(a) <1 offsping/female/yr	5
6B. Minimum age at which females typically first reproduce	(b) 4-8 yr	3	(b) 4-8 yr	3
7A. Dietary Specialization	(b) Substantial shift in diet with little change in no. of individuals	0	Substantial shift in diet with little change in no. of individuals	0
7B. Reproductive Specialization	(a) No. of individuals or no. of breeding attempts declines but no substantial shift to other breeding sites	3.3	(a) No. of individuals or no. of breeding attempts declines but no substantial shift to other breeding sites	3.3
7C. Other specialization	(b) Moderately specialized	1.7	(b) Moderately specialized	1.7
Biological Score		**55**		**37**

BIOLOGICAL VARIABLE 1: POPULATION SIZE

The estimated no. of adults throughout the range of the taxon

(a) 0-500 individuals (10 points)
(b) 501-1,000 individuals, or population size is unknown but suspected to be small (8 points)
(c) 1,001 - 3000 individuals (6 points)
(d) 3,001 - 10,000 individuals (4 points)
(e) 10, 001 - 50,000 individuals, or size is unknown but suspected to be large (2 points)
(f) >50,000 individuals (0 points)

FLORIDA POPULATION BEST ANSWER:

(A) 0-500 INDIVIDUALS

Within Florida, the number of American Flamingos has apparently at no time exceeded 500 individuals between 1903 and 2015 (Whitfield et al. 2018). The largest group of individuals recorded in Florida since 1902 was a flock of 147 individuals that appeared in Stormwater Treatment Area 2 (Palm Beach County) between 4 April and 5 May 2014 (Whitfield et al. 2018). The greatest number of individual flamingos in Florida Bay was a flock of 65 sighted January 1998 (Whitfield et al. 2018). While these reports probably approximate highest estimates for number of flamingos within Florida, it is currently more difficult to estimate a minimum number of individual flamingos in Florida. Many habitats used by flamingos are remote or have low detection probability, and no monitoring efforts have targeted the species within Florida. While large flocks are currently unlikely to reside in Florida year-round, the single flamingo banded in Florida and equipped with a satellite transmitter (band number US01, USGS 1148-90551), resided in Florida Bay continuously for a minimum of 24 months (between release and transmitter failure) - apparently indicating some flamingos may still be year-round residents (F. Ridgley, unpublished data).

Pan-Caribbean Population Best Answer:

(f) >50,000 individuals

Across the Caribbean, the IUCN Red List estimates the total number of individuals between 260,000 and 330,000 (Bird Life International 2016). However, for individual nesting colonies, recent population size estimates are typically not available, and in some cases population size estimates are decades-old. Available data suggests that the largest nesting colonies are in Cuba and Great Inagua in The Bahamas. Smaller yet important nesting colonies occur in Yucatan Peninsula of Mexico (Baldassarre and Arengo 2000, Brown and Boylan 2001, Galvez et al. 2016), Venezuela (Arengo and Childress 2004, Childress et al. 2009) and Bonaire (Rooth 1965, de Vries et al. 2017). There are minor nesting populations in Anegada and Necker Island (each <100 individuals) which resulted from re-introduction efforts.

The Great Inauga (Bahamas) population was estimated at 8,654 nesting pairs in 2006 and 8,064 nesting pairs in 2008 (Childress et al. 2008), and we are aware of no more recent population estimates for Great Inagua. The Cuban population was estimated at 100,000 individuals in 2000 (FSG 2000) and 157,000 individuals in 2004 – spread across six wetlands (Arengo and Childress 2004). The largest nesting area in Cuba, at Humedal Rio Maximo Cagüey (hereafter, "Rio Maximo") was used by between 22,000 and 51,600 nesting pairs annually between 1998 and 2008 – when Hurricane Ike impacted the nesting site, killed chicks and nesting adults, and destroyed the

research center from which flamingo censuses were conducted (Childress et al. 2005, 2008). We are aware of no more recent population estimates for Rio Maximo. The nesting colony in Yucatan, Mexico was estimated at 27,000 individuals in 1998 (Baldassarre and Arengo 2000), and between 3,500 and 12,500 nesting pairs used this site annually from 1999-2010 (Johnson and Arengo 2000, Arengo and Childress 2004, Childress et al. 2005, 2008, 2009, Clum 2006, Lee et al. 2011), and we are aware of no more recent population estimates for Mexico. Up to 37,110 individuals have been reported in coastal Venezuela, and between 200 and 10,900 pairs have nested there annually between 1998 and 2010 (Casler et al. 1994, Espinoza et al. 2000, Pirela 2000, Lee et al. 2011). The population in Bonaire (Netherlands Antilles) was recently estimated at 7,000 breeding adults (de Vries et al. 2017). Possibly up to 1,000 individuals reside in Hispaniola, and while intermittent nesting attempts have been documented there, there is no evidence of successful nesting there since 1928 (Paulino et al. 2011). Two small nesting populations in the British Virgin Islands (Necker Island and Anegada, each <100 individuals) are the result of reintroduction programs (Lazell 2001).

BIOLOGICAL VARIABLE 2: POPULATION TREND

Overall trend in no. of individuals throughout the taxon's range over the last 2 decades (or other appropriate time interval considering taxon's generation time). If population trend is unknown, consider trends in the availability and condition of the taxon's habitat as indicative of population trend.

(a) Population size known to be decreasing (10 points)
(b) Trend unknown but population size suspected to be decreasing (8 points)
(c) Population formerly experienced serious declines but is presently stable or increasing (6 points)
(d) Population size stable or suspected to be stable or increasing (2 points)
(e) Population size known to be increasing (0 points)

FLORIDA POPULATION BEST ANSWER:

(C) POPULATION FORMERLY EXPERIENCED SERIOUS DECLINES BUT IS PRESENTLY STABLE OR INCREASING

Historical accounts from early naturalists indicate that past flock sizes in Florida Bay and the Florida Keys ranged 500 to 2500 individuals in the late 1800s (Audubon 1839, Wurdemann 1860, Scott 1890, Ingraham 1893, Howe 1902, Pierce 1962). While these may be minimum estimates for historical flock size, it is not possible to gauge whether these are estimates of an entire Florida population or historically flamingos would have formed more than one flock within Florida. Undoubtedly, flamingos were historically far more abundant in the 19th century than they are today.

Citizen science data from Florida between 1950 and 2016 show directional increases in observation frequency and maximum group size for flamingos within Florida (Whitfield et al. 2018). These citizen science data are limited, but in the absence of monitoring efforts these data are the best available estimates for number of individuals in Florida.

PAN-CARIBBEAN POPULATION BEST ANSWER:

(C) POPULATION FORMERLY EXPERIENCED SERIOUS DECLINES BUT IS PRESENTLY STABLE OR INCREASING

The Pan-Caribbean population experienced major declines because of anthropogenic hunting

pressure in the 19th and early 20th centuries, though many nesting colonies have grown through the mid- to late- 20th century as the species has received legal protections and management in parts of its range.

There are no historical estimates (before ~1900) for population size for the Pan-Caribbean population in terms of number of individuals. Allen (1956) estimated that for the year 1955, the total population across the Caribbean is ~21,500 individuals (14,000 in Inagua, 4,500 in Yucatan, 2,400 in Bonaire, 300 in Abaco, and 300 in Galapagos). Sprunt (1975) estimated that for 1972, the pan-Caribbean population was 57,410-65,610 individuals (~12,000 in the Yucatan; 20,000-25,000 in Inagua; 15,000 – 18,000 in Cuba; 10,000 in Bonaire; and 300-500 in Galapagos).

While population estimates for the Pan-Caribbean are not available before ~1950, the number of extant nesting colonies also provides a metric for abundance for the species. Allen (Allen 1956) states that there were ~50 historical nesting colonies and that only four survived by the mid-1900s. Kahl (1975) also estimated that there were only four nesting colonies in 1975. While the number of individuals through the Pan-Caribbean appears to have grown considerably since the late 20th century, the number of nesting colonies has only recovered slightly. To our knowledge, there are currently seven significant active nesting colonies (Table 2).

BIOLOGICAL VARIABLE 3: RANGE SIZE

The size of the area over which the taxon is distributed during the season when the distribution is most restricted (e.g., for a species that nests over 1,000 km² in Michigan and winters over 10,000 km² on the Gulf Coast, use the breeding range)

(a) <100 km² (10 points)
(b) 101-1,000 km² (9 points)
(c) 1,001 – 40,000 km² or up to ¼ the size of Florida (7 points)
(d) 40,001 – 100,000 km² or about ¼ to ¾ the size of Florida (4 points)
(e) 100,000 – 2,000,000 km², or about ¾ the size of Florida to ¼ of the area of continental U.S. (1 point)
(f) >2,000,000 km² (0 points)

Accurate estimates of range size for American Flamingos (either for Florida and Pan-Caribbean population units) are challenging to produce because of limited data on current distribution and because of dramatic differences in area between breeding range and foraging range. We assume here that breeding distribution best fits the Millsap et al. (1990) criteria of "the season when distribution is most restricted." American Flamingos aggregate in a small number of spatially-confined nesting colonies, and nesting distribution is likely orders of magnitude smaller than foraging distribution. There are currently very limited high-resolution data available on nesting locations for American Flamingos. A "nesting colony" as we define here may either include a single aggregation of nest mounds, or a number of nests within close proximity (i.e., within the same wetland or reserve).

FLORIDA POPULATION BEST ANSWER:

(A) <100 KM²

American Flamingos are not known to have nested in Florida for more than a century; we

therefore assume that the current breeding range for a Florida population is effectively 0 km^2. Foraging range within Florida likely represents up to ¼ of the area of the state of Florida. Current sites at least occasionally occupied in Florida include all of the Florida Keys and Florida Bay, Biscayne Bay and coastal environments as far north as Hillsborough Bay on the Gulf Coast and Brevard County on the Atlantic Coast.

PAN-CARIBBEAN POPULATION BEST ANSWER:
(C) 1,001 – 40,000KM^2 OR UP TO ¼ THE SIZE OF FLORIDA

Existing range estimates are problematic

The challenge of producing accurate range size estimates is reflected in the IUCN Red List's range size estimate for American Flamingos (http://maps.iucnredlist.org/map.html?id=22729706), which contains several inaccuracies and internal inconsistencies. The IUCN's estimated Extent of Occurrence (EOO) is 5,200,000 km^2. While spatial data for the EOO used by IUCN is not available, it is likely that this estimate is from a convex hull spanning the Galapagos Islands (Ecuador) to the Yucatan Peninsula (Mexico), through The Bahamas, the Greater Antilles, and much of the northern coast of Venezuela. The vast majority of this area (>90%) is open ocean, and only a small portion of land and near coastal areas would comprise estuarine or coastal environments appropriate for either foraging or nesting for flamingos.

IUCN's distribution map contains several inaccuracies in the classification of breeding and non-breeding ranges that we are unable to account for given available data. For example, IUCN's distribution map includes the entirety of Cuba, the entirety of Hispaniola, and a large portion of the Caribbean coast of South America as a part of the breeding range for American Flamingos. However, there are only three known nesting colonies with Cuba (Mugica et al. 2012), and inclusion of the entirety of Cuba (including montane environments, agricultural areas, etc.) would vastly overestimate the breeding distribution. Further, the best available information indicates that there may have been no successful nesting in Hispaniola since 1928 (Wiley 1979, Garrido et al. 2010, Paulino et al. 2011). Additionally, only a single nesting location is known from mainland South America (Casler and Esté 2000, Espinoza et al. 2000, Esté et al. 2012), which is outside of the range distribution produced by the IUCN. Finally, the IUCN's range map includes the entirety of Jamaica and Puerto Rico as non-breeding habitat, though in both areas flamingo observations are rare.

Further, a significant internal inconsistency in IUCN's distribution data arises from differential treatment of Mexican breeding and non-breeding ranges from breeding and non-breeding ranges of other areas. IUCN's distribution data for American Flamingos in Yucatan (Mexico) provides a foraging range of ~29,700 km^2, and a nesting range of 97 km^2. However, IUCN's distribution data suggests that the entirety of Cuba and Hispaniola are within the breeding range for American Flamingos, though nesting is colonial in Cuba and Hispaniola as in Mexico. We are unable to account for the differing treatments of breeding and non-breeding ranges in IUCN's data, though data from Mexico effectively illustrate more than two orders of magnitude difference between foraging range and breeding range.

Estimating breeding range

To approximate the current nesting range for American Flamingos, we compile approximations of the extent of nesting areas that have been in use for the past two decades using

detailed searches of available peer-reviewed literature. Area of nesting colonies is undoubtedly orders of magnitude smaller than the EOO produced by the IUCN Red List for American Flamingos. However, area of nesting colonies is consistent with Millsap et al. (1990)'s "season when the distribution is most restricted" and with IUCN's estimation for Area of Occupancy, which states, "In some cases (e.g. irreplaceable colonial nesting sites, crucial feeding sites for migratory taxa) the area of occupancy is the smallest area essential at any stage to the survival of existing populations of a taxon."

Given limitations of the IUCN estimation for breeding range identified above, we attempted to produce a quantitative estimate for nesting range *de novo* to address Biological Variable 3: Range Size for a Pan-Caribbean population. For Caribbean islands exclusive of the Greater Antilles, we used the land area of the entire island (i.e., Bonaire, Great Inagua). For major estuaries through the Greater Antilles or mainland American continents, we used the size of either the Biosphere Reserve or RAMSAR Site where nesting occurs (all major nesting areas had received RAMSAR designations, Table 2). Cumulatively, this estimate yields a nesting range size of 5,803 km^2 (Table 2). We argue that this is a cautious estimate of nesting range – but should not be taken as an Area of Occurrence (AOO) or a quantitative analysis of nesting range.

Table 2. Major nesting sites and estimated nesting range of American Flamingos through the Caribbean.

Country	Location	Area (km^2)	Method of Area Estimation
Bahamas	Inagua National Park	1,679	Island area - Great Inagua
Mexico	Ria Lagartos Biosphere Reserve	603	Area of Ria Lagartos Biosphere Reserve
Cuba	Humedal Rio Maximo Cagüey	220	Area of RAMSAR site
Cuba	Gran Humedal del Norte de Ciego de Avila	2,269	Area of RAMSAR site
Cuba	Humedal Delta del Cauto	478	Area of RAMSAR site
Bonaire	Pekelmeer Flamingo Sanctuary	294	Island area - Bonaire
Venezuela	Refugio de Fauna Silvestre y Reserva de Pesca Cienaga de los Olivitos	260	Area of RAMSAR site
Total		**5,803 km^2**	

We believe it is important that we identify several caveats that could impact our estimate for range size. First, our estimate plausibly exaggerates true nesting range because much less than the entire wetland area or island area would be used for nesting sites. While any nesting location may have one or more spatially constricted aggregations of nest mounds, it is unlikely that nest mounds are evenly distributed through a protected area or wetland. Second, our estimate also excludes areas where small numbers of flamingos have attempted to nest, but where nesting failed – a small number of sites in Hispaniola (Wiley 1979, Paulino et al. 2011), and La Restinga National Park on Margarita Island in Venezuela (Childress et al. 2008). Our estimate also excludes two small nesting localities in the British Virgin Islands (Necker Island and Anegada) which are the result of re-introduction programs – neither population consists of more than 100 individuals, and both sites

are very small (Necker Island is 0.3 km^2, and Anegada is 38 km^2).

BIOLOGICAL VARIABLE 4: DISTRIBUTION TREND

% change (since European settlement) in area occupied by the taxon. (This is an estimate of change in the portion of the total range that is occupied or utilized; it may not equal the change in total range.)

(a) Area occupied has declined by 90-100%
(b) Area occupied has declined by 75-89%
(c) Area occupied has declined by 25-74%
(d) Area occupied has declined by 1-24%
(e) Area occupied is stable or has increased

FLORIDA POPULATION BEST ANSWER:

(A) AREA OCCUPIED HAS DECLINED BY 90-100%

Best available data suggest that the breeding habitat for American Flamingos in Florida has declined by 100%. The majority of evidence suggests that flamingos did nest in Florida in at least one nesting colony prior to ~1900, though to our knowledge there has been no nesting of flamingos in Florida since ~1902 (Whitfield et al. 2018).

However, there are a number of assumptions that require consideration in addressing this question. First, there is no evidence for nesting of wild American Flamingos in Florida since 1902 (Whitfield et al. 2018), and we assume that there has been no breeding since then. However, it is plausible that nesting has occurred but has not been reported. Second, we assume that the historic Florida population did nest within the state and that there was a single nesting area. For more than a century, ornithologists have discussed whether or not flamingos nested with Florida, and this topic has long been controversial (Wurdemann 1860, Scott 1890, Ingraham 1893, Sprunt 1937, Allen 1956, Stevenson and Anderson 1994, Whitfield et al. 2018). A detailed review of evidence for nesting of flamingos in Florida identified four egg specimens collected in the 1880s (Whitfield et al. 2018) and one plausible eye-witness account of nesting on Sugarloaf Key (Sprunt 1937). Three egg specimens indicate a locality "Florida Keys", and one "near Tampa." While none of the three egg specimens from the Florida Keys is accompanied by notes from the collector, a series of egg specimens in separate years and separate collectors in the same locality is much stronger evidence for nesting than has been presented previously. However, the collection locality for the egg specimen "near Tampa" has been questioned, and the collector of this specimen apparently often included erroneous information (Stevenson and Anderson 1994). We assume herein that there existed one nesting site within the Florida Keys, and believe this represents a conservative best estimate for number of nesting colonies in Florida. Regardless of the exact number of historic nesting sites or extent of area formerly used as breeding habitats, absence of nesting since ~1900 yields a decline of 100% in nesting range within Florida.

PAN-CARIBBEAN POPULATION BEST ANSWER:
(C) AREA OCCUPIED HAS DECLINED BY 25-74%

Proportion of nesting areas lost

The most intuitive metric for gauging lost nesting area is by calculating the number of extant nesting colonies out of all historic nesting locations. To our knowledge, seven nesting colonies have been used repeatedly since ~2000 (Table 2). Allen (1956) provides the best evaluation of historical nesting sites, and the nesting sites he describes are summarized in Table 3. The operational definition for "nesting area" we use here differs from that of Allen (1956), as we collapse several distinct nesting colonies described by Allen (1956) into a single nesting area. For example, Allen (1956) lists 12 nesting sites between North Andros and South Andros, which we re-classify as a single nesting area. Given the approach above, data indicate loss of 78.7% of nesting areas since ~1900.

Area of breeding range lost

While proportion of nesting areas lost is an easy metric for gauging distribution trend, some nesting areas are clearly larger and more important than others. As with nesting distribution for extant nesting areas, we constructed *de novo* estimates of nesting area using historical nesting areas compiled by Allen (1956). For 33 historic nesting locations (Table 3), we attempted to estimate range of nesting area using available resources. As for Biological Variable 3: Range Size, we used either island area for entire islands in the Bahamas, or wetland area for former nesting sites now protected as RAMSAR sites. This method of estimating historic nesting area yields a historic nesting area of 18,599 km^2, and with our estimate for current nesting range of 5,803 km^2, results in an estimated loss of 68.8% loss of nesting distribution since ~1900.

There are a number of caveats to this estimation of distribution change that we seek to specifically identify here. First, for seven of the 33 nesting locations described by Allen (1956), we can produce no estimate for area. In each case, the location names provided by Allen (1956) are not sufficiently specific to determine a specific locality, estuary, or wetland. However, as these areas are not included within our calculations of historic nesting area – and as a consequence should lead to conservative estimates of decline in area occupied. As with our estimations for Biological Variable 3: Range Size, these area estimates historic nesting locations are likely overestimations of actual areas used by nesting colonies, though because the same methods were used to estimate area, the results should be directly comparable. As with our estimations for Biological Variable 3: Range Size, these rough approximations should not be taken as actual estimates of Area of Occupancy (AOO) for the species – which are likely much smaller for nesting areas of American Flamingos.

Table 3. Major historic nesting sites and estimated historic nesting range of American Flamingos through the Caribbean. Historic nesting sites are derived from Allen (1956).

Country	Site	Area (km²)	Method of Area Estimation
Bahamas	Abaco	2,009	Island area - Abacos
Bahamas	Andros	5,957	Island area - Andros
Bahamas	Rum Cay	78	Island area – Rum Cay
Bahamas	Exuma Cays	250	Island area – Great Exuma
Bahamas	Long Island	596	Island area – Long Island
Bahamas	Ragged Island	23	Island area – Ragged Island
Bahamas	Acklins	389	Island area - Acklins
Bahamas	Horse Cay	Unknown	
Bahamas	Long Cay	21	Island area – Long Cay
Bahamas	Mayaguana	280	Island area - Mayaguana
Bahamas	Inagua National Park	1,679	Island area - Inagua
Turks and Caicos	Caicos Islands	116	Island area – Caicos Islands
Cuba	Humedal Rio Maximo Cagüey	220	Area of Humedal Rio Maximo Cagüey RAMSAR site
Cuba	Gran Humedal del Norte de Ciego de Avila	2,269	Area Gran Humedal del norte de Ciego de Avila RAMSAR site
Cuba	Humedal Delta del Cauto	478	Area of Humedal Delta del Cauto RAMSAR site
Cuba	Isla de la Juventud	2,419	Island area – Isla de la Juventud
Cuba	"(near) Cienfuegos"	Unknown	
Haiti	Ile de la Gonave	689	Island area – Ile de la Gonave
Haiti	"(near) Gonaives"	Unknown	
Haiti	Ile a Vache	52	Island area – Ile a Vache
Haiti	Etang Saumatre	170	Lake area – Etange Saumatre
Dominican Republic	Lago Enriquillo National Park	200	Lago Enriquillo National Park
Bonaire	Pekelmeer Flamingo Sanctuary	294	Area of entire island of Bonaire
Venezuela	Blanquilla	64	Island area - Blanquilla
Venezuela	Los Roques	41	Archipelago area – Los Roques
Venezuela	Isla Aves	<1	Island area – Isla Aves
Venezuela	Isla Orchila	44	Island area – Isla Orchila
Venezuela	Refugio de Fauna Silvestre y Reserva de Pesca Cienaga de los Olivitos	260	Area of Refugio de Fauna Silvestre y Reserva de Pesca Cienaga de los Olivitos RAMSAR site
Guyana	Waini Creek	Unknown	
Suriname	Suriname River	Unknown	
Suriname	Hermina Bank	Unknown	
French Guyana	Cayenne	Unknown	
Mexico	Ria Lagartos Biosphere Reserve	603	Area of Ria Lagartos Biosphere Reserve
Total		**18,599 km²**	

BIOLOGICAL VARIABLE 5: POPULATION CONCENTRATION

Degree to which individuals within populations congregate or aggregate seasonally (e.g. at hibernacula, breeding sites, migration focal points) or daily (e.g., communal roosts) at specific locations. Implies a regular temporal compression of the distribution independent of factors considered in variables 3 and 4.

(a) Majority concentrates at single location (10 points)
(b) Concentrates at 1-25 locations (6 points)
(c) Concentrates at >25 locations (2 points)
(d) Does not concentrate (0 points)

American Flamingos are gregarious by nature and concentrate both in nesting colonies during the breeding season and in foraging aggregations during the non-breeding season (Schmitz and Baldassarre 1992, Arengo and Baldassarre 1995). While both foraging aggregations and nesting colonies may number thousands or tens of thousands of individuals, the breeding season represents the most restricted temporal compression for the species since most individuals are within nesting colonies.

FLORIDA POPULATION BEST ANSWER:

(B) CONCENTRATES AT 1-25 LOCATIONS

Foraging individuals in Florida also often aggregate in fewer than 25 locations. For example, the majority of a Florida population may appear in Stormwater Treatment Area 2 (Palm Beach County) in spring (Whitfield *et al.* 2018). In many years, aggregations of a up to 68 flamingos have been present in Florida Bay (Whitfield *et al.* 2018). Any of these observations would be indicative of the majority of a modern Florida population aggregating in a single location.

PAN-CARIBBEAN POPULATION BEST ANSWER:

(B) CONCENTRATES AT 1-25 LOCATIONS

The Pan-Caribbean population concentrates in seven colonial nesting sites (Table 2), and even outside of nesting aggregations flamingos congregate in large foraging flocks (Arengo and Baldassarre 1995, Casler and Esté 2000). This aggregation in a very small number of sites makes reproductive events, and even survival of adults, highly susceptible to stochastic disturbances. Very often, drought at nesting sites will preclude breeding for a year, or flooding will flood nests and cause near total reproductive failure (Rooth 1965, Sprunt 1975, Baldassarre and Arengo 2000, Childress et al. 2009). Extreme weather events can even cause high adult mortality. For example, the largest nesting colony in recent decades (Rio Maximo in northern Cuba) was severely impacted by Hurricane Ike in 2008 during a nesting event, killing a large number of chicks and nesting adults (Childress et al. 2008). The largest nesting site within the Yucatan was destroyed by Hurricane Gilbert in 1988, though nesting resumed subsequently in a site nearby (Brown and Boylan 2001). Even foraging aggregations are susceptible to environmental disturbances. In 2010, an oil terminal adjacent to a major foraging area in Bonaire area caught fire, and large quantities of firefighting foam were used to extinguish the fire (de Vries et al. 2017). Toxic compounds in the firefighting foam caused major declines in prey items, and flamingo abundance at this site dropped to near zero (de Vries et al. 2017).

BIOLOGICAL VARIABLE 6. REPRODUCTIVE POTENTIAL FOR RECOVERY

Ability of the taxon to recover from serious declines in population size

BIOLOGICAL VARIABLE 6A: AVERAGE NUMBER OF EGGS OR LIVE YOUNG PRODUCED/ADULT FEMALE/YEAR

(a) <1 offspring/female/year (5 points)
(b) 1-9 offspring/female/year (3 points)
(c) 10-100 offspring/female/year (1 point)
(d) >100 offspring/female/year (0 points)

FLORIDA AND PAN-CARIBBEAN POPULATIONS BEST ANSWER:

(A) <1 OFFSPRING/FEMALE/YEAR

All available evidence indicates that females produce on average < 1 offspring per year. We discuss below three ecological factors that affect number of offspring produced per female per year: average clutch size, proportion of females nesting in a given year, and colony nesting success in a given year.

Average clutch size

The average clutch size is one egg, and laying multiple eggs by a single female in a nest is very rare. Maynard (1888) counted eggs at the now-extirpated nesting colony at Porpoise Creek, Andros, Bahamas. He noted that of 2000 nest mounds, 1949 contained a single egg, 50 contained two eggs, and one nest contained three eggs. Chapman (1905) examined nearly 2000 flamingo nests in Andros, Bahamas, of which only two contained 2 eggs, and the rest either one egg or one young bird. Hernandez and Garcia B (1976) studied reproductive biology of *P. ruber* in Yucatan, Mexico in 1975, and report that of 1,771 nests constructed in that year, 22.5% contained no eggs, and 74.2% contained a single egg, 2.9% contained two eggs, and 0.3% contained three eggs. For *ex situ* flamingo colonies in zoos across North America, 97.35% (1764 of 1812) of clutches contained a single egg (Lyngle-Cowland and Lynch 2017). While the number of eggs within a nest is a convenient metric for number of eggs per female, Johnson and Cezilly (2007) state that for the closely related Greater Flamingo (*Phoenicopterus roseus*), two eggs in a nest is more likely one egg each from two females than two eggs from a single female. Struder-Thiersch (1975) state that for captive flamingos, two eggs were present in a nest when two females were paired with a single male.

Proportion of females laying in a given year

In any given year, not all females will nest. Few direct field data exist on the proportion of females laying in a given year for *P. ruber*. Hernandez and Garcia (1976) estimated that of 11,000 adult flamingos in the Yucatan in 1975, there were only 1,750 nesting pairs.

In many years, entire nesting colonies will fail to produce nests because nesting sites are flooded or are too dry for nest construction. Rooth (1965) monitored nesting of *P. ruber* in Bonaire between 1950 and 1961, an found that in at least two years (1953 and 1954), no nesting was attempted. Sprunt (1975) monitored nesting success of *P. ruber* in Inagua, Bahamas, between 1952 and 1972 and found that in one year no nesting was attempted because of drought. More recently, For Rio Maximo between 1998 and 2008, nesting was attempted in eight years and no breeding occurred in two years (Childress et al. 2005, 2008, Clum 2006, Lee et al. 2011). No breeding

occurred in the Bahamas for at least five of the nesting seasons between 2002 and 2010 (Childress et al. 2005, 2008, 2009, Lee et al. 2011). For mainland Venezuela, there was no nesting for at least 10 of the nesting seasons between 1989 and 2010 (Johnson and Arengo 2000, Lee et al. 2011).

Colony nesting success in a given year

Climatic factors, including drought, extreme rainfall, or tropical storm activity, can heavily influence nesting success in *P. ruber*. In many years, entire nesting colonies have zero recruitment. Sprunt (1975) states that breeding success from 1952-1974 in Inagua (Bahamas), there was at least some successful nesting in 16 years, and zero nesting success in four years - all because of flooding of nest mounds. Rooth (Rooth 1965) monitored nesting of *P. ruber* in Bonaire between 1950 and 1961, an found that in at least two years (1953 and 1954), no nesting was attempted and in at least one year flooding washed away eggs and young completely. Johnson and Cezilly (2007) review information for colony success of *P. roseus* at a well-studied population in the Camargue (France) between 1950 and 2000. They indicate in three years there was complete colony failure, in two years no nesting was attempted, and in the remaining years hatching success ranged 9.6% to 87.5%. Flooding and hurricanes can have major impact to nesting colonies, as with Hurricane Ike in Cuba in 2008 (Childress et al. 2008). Between 1999 and 2010 in Mexico, flooding caused major mortality to nesting in 2001 and 2006 (Johnson and Arengo 2001, Childress et al. 2006).

BIOLOGICAL VARIABLE 6B. MINIMUM AGE AT WHICH FEMALES TYPICALLY FIRST REPRODUCE

(a) >8 yr (5 points)
(b) 4-8 yr (3 points)
(c) 2-3 yr (1 point)
(d) <2 yr (0 points)

FLORIDA AND PAN-CARIBBEAN POPULATIONS BEST ANSWER:

(B) 4-8 YR

Few direct data are available for wild populations of *P. ruber* to address the minimum age at which females typically reproduce. Rooth (1965) assumes 5-6 years age at reproductive maturity, and Sprunt (1975) assumes an age of first reproduction at five years for a population in Inagua, Bahamas – however, neither of these studies produce data on minimum age at first reproduction.

For captive populations of American Flamingos in zoos and aquariums, the median age of females at first reproduction is 10.086 years and the mean age is 12.915 years (Lyngle-Cowland and Lynch 2017), although some individuals have bred at one year of age. Data from captive populations should be viewed cautiously. While captive animals may have greater food supply and prescribed nutrition (which perhaps allows faster maturity under ideal conditions), reproduction in *ex situ* environments is less regular than for most wild populations, (perhaps artificially increasing the median age at reproduction).

Field data are available for the closely-related species *Phoenicoperus roseus*, which has been studied in greater detail than *P. ruber*. Johnson and Cezilly (2007), indicate that of 2,688 *P. roseus* banded in the Camargue (France) between 1982 and 2000 most birds bred for the first time between four and eight years of age, that none bred at two years of age, and only one male and

seven females bred at three years of age. An extensive demographic study of *P. roseus* in the Camargue (France) analyzed the capture histories of 983 females ringed between 1983 and 1996, and indicated that most females breed for the first time between 5 and 6 years of age, though they may reach sexual maturity by the third year (Tavecchia et al. 2001). They explain that early breeding in females comes at a cost to annual survival, which may explain the delay of first reproduction beyond attaining sexual maturity.

BIOLOGICAL VARIABLE 7: ECOLOGICAL SPECIALIZATION

Degree to which the taxon is dependent upon certain environmental factors

BIOLOGICAL VARIABLE 7A: DIETARY SPECIALIZATION

Choices below relate to the primary way in which local populations respond to decreases in availability of preferred food type (a species or guild within an order or class)

(a) No. of individuals declines, no substantial shift in diet (3.3 points)

(b) Substantial shift in diet with little change in no. of individuals (0 points)

FLORIDA AND PAN-CARIBBEAN POPULATIONS BEST ANSWER:

(B) SUBSTANTIAL SHIFT IN DIET WITH LITTLE CHANGE IN NO. OF INDIVIDUALS

American Flamingos are highly specialized filter feeders that consume large quantities of small food items with a bill specially adapted for filter feeding. Flamingos can consume a wide taxonomic range of small food items including macroalgae (i.e., *Chara* oogonia and bulbils), plants (i.e., *Ruppia* and *Salicornia* seeds), zooplankton, gastropods, polychaetes, crustaceans (*Artemia*), insects (*Ephydra* larvae and chrysalids), and "organic ooze" (sediments containing food items) (Rooth 1965, Arengo and Baldassarre 1995).

Arengo and Baldassare (1995) show that for the Celestun Estuary in Mexico, the number of foraging flamingos declines in response to reductions in prey availability. They suggested that flamingo foraging follows predictions of the ideal free distribution model – that flamingos can track availability of food in the environment and the density of foraging individuals tracks availability of food resources. However, the reduction in the number of foraging individuals reflects movement to nearby foraging sites rather than the change in number of individuals from births and deaths.

While the best evidence indicates that flamingos will leave a site in response to decreased food availability, there is a broad range in food types (multiple guilds, orders, and classes). There is no available evidence that flamingos would become less abundant with reduction in a certain prey type, rather that they may switch to more abundant types of food.

BIOLOGICAL VARIABLE 7B: REPRODUCTIVE SPECIALIZATION

Choices below relate to the primary way in which local populations respond to decreases in availability of preferred breeding sites (e.g., tree or snag species or size class)

(a) No. of individuals or no. of breeding attempts declines but no substantial shift to other breeding sites (3.3 points)

(b) Substantial shift to alternate breeding sites with little change in number of individuals (0 points)

FLORIDA AND PAN-CARIBBEAN POPULATIONS BEST ANSWER:

(A) NO. OF INDIVIDUALS OR NO. OF BREEDING ATTEMPTS DECLINES BUT NO SUBSTANTIAL SHIFT TO OTHER BREEDING SITES

American Flamingos require specialized habitats for nesting, where they construct volcano-shaped nest mounds from muddy or sandy substrate. Nesting colonies form either in lagoons or shallow mud flats in coastal or estuarine areas (Allen 1956, Rooth 1965, Casler et al. 1994, Baldassarre and Arengo 2000). Because nesting environments require specific sediments and specific hydrology, they are very limited in distribution in South Florida. While many such habitats within Florida are protected within Everglades National Park, coastal development (particularly in the Florida Keys), may have reduced the availability of historic nesting sites.

Further, weather and hydrology are important variables that may determine suitability of nesting areas. Drought or flooding can prevent nesting for entire colonies - and failure to nest appears to be the predominant response to decreased availability of breeding sites (Rooth 1965, Sprunt 1975, Arengo and Childress 2004). Typically, flamingos show strong fidelity to natal environments and will not typically nest in new environments if their natal nesting colonies are unfit for nesting in a given year. Studies of *P. roseus* show high fidelity to natal sites – more than would be expected for "nomadic" species (Balkiz et al. 2010). Further, they show that more experienced breeding birds show higher site fidelity to nesting sites, and that individuals are most likely to seek new breeding sites when their natal sites become "saturated."

In few cases, anecdotes suggest that large nesting aggregations will occasionally shift to other breeding sites when typical nesting sites are unsuitable. For example, Sprunt (1975) conjectured that an exceptionally large breeding aggregation of flamingos in Inagua in 1961 was the result of birds that typically nest in Rio Maximo (Cuba) nesting in Inagua during that year because of unusual conditions of flooding in Cuba – however ultimately this remains anecdotal.

BIOLOGICAL VARIABLE 7C: OTHER SPECIALIZATIONS

Ecological or behavioral specializations not covered in variables 7A or 7B (e.g. strict requirements for hibernacula, narrow ambient temperature limits, or specific roosting structures.)

(a) Highly specialized (3.3 points)
(b) Moderately specialized (1.7 points)
(c) Not specialized (0 points)

FLORIDA AND PAN-CARIBBEAN POPULATIONS BEST ANSWER:

(B) MODERATELY SPECIALIZED

American Flamingos have a number of ecological and behavioral specializations that warrant consideration. Foraging habitats are restricted to shallow lagoons and estuarine environments. These habitats are rather restricted in availability, particularly within Florida. American Flamingos are ecologically restricted to subtropical and tropical locations within the Americas. Nesting occurs at low altitudes and in coastal locations with appropriate nest building substrates. Behavior usually favors isolated locations with little human or predator disturbance.

The gregarious social structure of flamingos is also important for the ecology and conservation

of the species. Large groups of individuals are required for the establishment of nesting colonies, and pairs within the flock synchronize nest construction and egg laying. Typically, nesting will not occur unless hundreds or thousands of individuals or present, though in captive colonies nesting has been successful with as few as 20 individuals (Pickering et al. 1992). Flightless chicks gather in large creches on the breeding grounds where they are very vulnerable to hunting and disturbance (Wetmore 1965, Terres 1980, del Hoyo *et al* 1992).

Concluding Remarks

The information we compile here, using the best available scientific data, yields biological scores for the Florida population of 55 points, and for the Pan-Caribbean population of 37 points. By either definition of population, the biological scores we produce surpass FWC's threshold biological score of 27 to warrant further evaluation by FWC for inclusion as a threatened species or species of special concern. Through discussion of each of the Millsap et al. (1990) variables, we have aimed to provide sufficient references to primary literature to facilitate FWC's own review of the biological scores produced in this petition and to make entirely transparent the methods we use to calculate these scores.

We encourage FWC to give close consideration to this petition. As a cultural icon of Florida and an important component of Florida's natural heritage, we expect there is broad public support for conservation of American Flamingos. Though the Florida population of flamingos was nearly extirpated by hunting pressure more than a century ago, the rise in observations in recent decades likely represents initial signs of population recovery. At this crucial stage, management actions and regulatory decisions by FWC could have a major impact on future population trends – either positive or negative. FWC's historic designation of American Flamingos as a non-native species would likely preclude any conservation action for population recovery. However, protection of American Flamingos under Florida's threatened species laws and inclusion of American Flamingos in monitoring or management plans for native species would lay a strong initial foundation for the conservation of one of Florida's most iconic birds.

Literature Cited

Allen. 1954. Comments on the status of the flamingo in Florida. *Everglades Natural History* **2**:115–118.

Allen, R. P. 1956. The flamingos: Their life history and survival. National Audubon Society Research Report 5.

Arengo, F., and G. A. Baldassarre. 1995. Effects of food density on the behavior and distribution of nonbreeding American Flamingos in Yucatan, Mexico. *The Condor* **97**:325–334.

Arengo, F., and B. Childress. 2004. News from the regions 2004, New World. *Flamingo Specialist Group Newsletter* 12:20.

Audubon, J. J. 1839. Ornithological Biography, or an Account of the Habits of the Birds of the United States of America. Edinburgh, Adam Black. Edinburgh.

Bailey, H. 1928. Regarding a late Florida record of the flamingo. *The Wilson Bulletin* 40:197–198.

Bailey, H. H. 1925. Birds of Florida. Williams & Wilkins Company, Baltimore.
Bailey, H. H. 1932. Nature faking in Florida. *Oologist* **49**:69.
Baldassarre, G. A., and F. Arengo. 2000. A Review of the ecology and conservation of Caribbean Flamingos in Yucatán, Mexico. *Waterbirds* **23**:70–79.
Balkiz, Ö., A. Béchet, L. Rouan, R. Choquet, C. Germain, J. A. Amat, M. Rendòn-Martos, N. Baccetti, S. Nissardi, U. Özesmi, and R. Pradel. 2010. Experience-dependent natal philopatry of breeding greater flamingos. *Journal of Animal Ecology* **79**:1045–1056.
Beard, D. B. 1938. Everglades National Park project wildlife reconnaissance. Report to US Department of Interior.
Bird Life International. 2016. *Phoenicopterus ruber*. The IUCN Red List of Threatened Species 2016: e.T22729706A95020920. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22729706A95020920.en. Downloaded on 11 June 2018.
Brodhead, L. 1910. Notes on birds in the Florida Keys. *Bird Lore* **12**:189–190.
Brown, C., and J. Boylan. 2001. An overview of the conservation of the Caribbean Flamingos *Phoenicopterus ruber ruber* in Mexico. *Flamingo Specialist Group Newsletter* 11:21–23.
Casler, C. L., and E. E. Esté. 2000. Caribbean Flamingo feeding at a new solar saltworks in western Venezuela. *Waterbirds* **23**:95–102.
Casler, C. L., E. E. Esté, and H. M. Pardo. 1994. Breeding of the greater flamingo in western Venezuela. Colonial *Waterbirds* **17**:28–34.
Chapman, F. M. 1905. A contribution to the life history of the American flamingo (*Phoenicopterus ruber*), with remarks upon specimens. *Bulletin of the American Museum of Natural History* **21**:53–77.
Childress, B., F. Arengo, and A. Bechet. 2008. Flamingo, Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group **16**:1–76.
Childress, B., F. Arengo, and A. Bechet. 2009. Flamingo, Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group, No. 17.
Childress, B., F. Arengo, A. Bechet, and N. Jarrett. 2006. Flamingo, Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group, No. 14. Slimbridge, UK.
Childress, B., A. Bechet, F. Arengo, and N. Jarrett. 2005. Flamingo, Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group, No. 13. Slimbridge, UK.
Clum, N. 2006. Bahamas (*P. ruber*). Flamingo: Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group 14:6.
Espinoza, F., L. Parra, J. Aranguren, A. Martino, M. Quijada, D. Pirela, R. Rivero, T. Gutierrez, N. Jimenez, S. Leal, and E. Leon. 2000. Numbers and distribution of the Caribbean Flamingo in Venezuela. *Waterbirds* **23**:80–86.
Esté, E., C. Casler, J. Reyes, M. Nava, J. Carruyo, A. Flores, and C. Pardo. 2012. Abundancia del Flamenco Caribeño (*Phoenicopterus ruber*) y su relación con las fuentes de alimento, en La Ciénaga De Los Olivitos, Venezuela. *Boletin del Centro de Investigaciones Biologicas* **46**:211–243.
Florida Fish and Wildlife Conservation Commission. 2012. Florida's Wildlife Legacy Initiative: Florida's State Wildlife Action Plan. Tallahassee, Florida, USA.
Frias-Soler, R., E. Tindle, G. E. Lopez, S. Blomberg, A. Studer-Thiersch, M. Wink, and R. Tindle. 2014. Genetic and phenotypic evidence supports evolutionary divergence of the American Flamingo (*Phoenicopterus ruber*) population in the Galápagos Islands. *Waterbirds* **37**:349–468.
Galvez, X., L. Guerrero, and R. Migoya. 2016. Evidencias fisicas de la estructura metapoblacional en el Flamenco Caribeño (*Phoenicopterus ruber ruber*) a partir de avistamientos de individuos anillados. *Revista Cubana de Ciencias Biologicas* **4**:93–98.
Garrido, E., Y. M. Leon, Y. Arias, and L. Perdomo. 2010. Nidificacion reciente del flamenco (*Phoenicopterus ruber*) en Republica Dominicana. *Journal of Caribbean Ornithology* **23**:50–51.
Geraci, J., A. Béchet, F. Cézilly, S. Ficheux, N. Baccetti, B. Samraoui, and R. Wattier. 2012. Greater

flamingo colonies around the Mediterranean form a single interbreeding population and share a common history. *Journal of Avian Biology* **43**:341–354.
Hernandez, M. A., and J. Garcia B. 1976. Estudio del flamenco en la peninsula de Yucatan. *Bosques y Fauna* **8**:3–14.
Howe, R. H. 1902. Notes on various Florida birds. *Contributions to North American Ornithology* **1**:25–32.
Howell, A. 1932. Florida Bird Life. J. J. Little and Ives Company, New York.
Hunter, W. C., W. Golder, and S. Melvin. 2006. Southeast United States Regional Waterbird Conservation Plan. Waterbird Conservation for the Americas, Washington, D.C.
Ingraham, D. P. 1893. Observations of the American Flamingo, *Phoenicopterus ruber*. Pages 59–69*in* E. I. Rood, editor. Papers Presented to the World's Congress on Ornithology. Charles H. Sergel Co., Chicago.
Johnson, A., and F. Arengo. 2000. Flamingo Specialist Group Newsletter 10.
Johnson, A., and F. Arengo. 2001. Flamingo Specialist Group Newsletter 11.
Johnson, A., and F. Cezilly. 2007. The Greater Flamingo. T & A.D. Poyser, London.
Lazell, J. 2001. Restoration of the greater flamingo (*Phoenicopterus ruber*) to Anegada, British Virgin Islands. *Pitirre* **14**:113–114.
Lee, R., F. Arengo, and A. Bechet. 2011. Flamingo, Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group, No. 18. Slimbridge, UK.
Lyngle-Cowland, K., and C. Lynch. 2017. Population Analysis & Breeding Transfer Plan, Caribbean Flamingo (*Pheonicopterus ruber*).
Maynard, C. J. 1888. Notes on the breeding habits of the American Flamingo. *Oologist* **5**:108–110.
Millsap, B., J. A. Gore, D. E. Runde, and S. I. Cerulean. 1990. Setting Priorities for the Conservation of Fish and Wildlife Species in Florida. *Wildlife Monographs* **111**:3–57.
Mugica, L., M. A. A. Costa, A. R. J. Iménez, A. N. R. Odríguez, F. De Biología, U. D. La Habana, and C. D. La Habana. 2012. Current knowledge and conservation of Cuban waterbirds and their habitats. *Journal of Caribbean Ornithology* **25**:64–76.
Paulino, M. M., D. A. Mejia, and S. C. Latta. 2011. A new review of the status of the Caribbean Flamingo *Phoenicopterus ruber* in the Dominican Republic and Haiti. *Flamingo: Bulletin of the IUCN-SSC/Wetlands International Flamingo Specialist Group* **18**:62–67.
Pickering, S., E. Creighton, and B. Stevens-Wood. 1992. Flock size and breeding success in flamingos. *Zoo Biology* **11**:229–234.
Pierce, C. W. 1962. Cruise of the Bonton. *Tequesta* **1**:3–63.
Pirela, D. E. 2000. Monitoring Caribbean Flamingos at Los Olivitos Wildlife Refuge, Western Venezuela. *Waterbirds* **23**:103–108.
Rooth, J. 1965. The Flamingos on Bonaire (Netherlands Antilles). Kemink & Zn, Utrecth.
Schmitz, R. A., and G. A. Baldassarre. 1992. Correlates of flock size and behavior of foraging American Flamingos following Hurricane Gilbert in Yucatan, Mexico. *Condor* 94:260–264.
Scott, W. E. D. 1890. An Account of flamingoes (*Phoenicopterus ruber*) observed in the vicinity of Cape Sable. *Auk* **7**:221–226.
Simpson, C. T. 1920. In Lower Florida Wilds. G. P. Putnam's Sons, New York.
Sprunt, A. 1937. Nesting of the Flamingo in the United States. *Auk* **54**:531–532.
Sprunt, A. 1954. Florida Bird Life. Coward-McCann, Inc and the National Audubon Society, New York.
Sprunt, A. 1975. The Caribbean. Pages 65–83*in* J. Kear and N. Duplaix-Hall, editors.Flamingos. T & A.D. Poyser, Berkhamsted.
Stevenson, H. M., and B. H. Anderson. 1994. The Birdlife of Florida. University of Florida Press, Gainesville.
Struder-Thiersch, A. 1975. Flamingos in captivity: Basle Zoo. Pages 121–130*in* J. Kear and N. Duplaix-Hall, editors. Flamingos. T & A.D. Poyser, Berkhamsted.

Tavecchia, G., R. Pradel, V. Boy, A. Johnson, and F. Cézilly. 2001. Sex- and age-related variation in survival probability and the cost of the first reproduction in breeding Greater Flamingos. *Ecology* **82**:165–174.

de Vries, P., D. M. E. Slijkerman, C. J. A. F. Kwadijk, M. J. J. Kotterman, L. Posthuma, D. de Zwart, A. J. Murk, and E. M. Foekema. 2017. The toxic exposure of flamingos to per- and Polyfluoroalkyl substances (PFAS) from firefighting foam applications in Bonaire. *Marine Pollution Bulletin* **124**:102–111.

Ward, C. W. 1914. Florida's wealth of bird life. Pages 283–324*in* G. M. Chapin, editor.Florida: Past, Present and Future. S. J. Clark, Chicago.

Whitfield, S. M., P. Frezza, F. N. Ridgley, A. Mauro, J. M. Patterson, A. Pernas, and J. J. Lorenz. 2018. Status and trends of American Flamingos (*Phoenicopterus ruber*) in Florida, USA. *Condor* **120**:291–304.

Wiley, J. W. 1979. Status of the American Flamingo in the Dominican Republic and Eastern Haiti. *Auk* **96**:615–619.

Williams, J. L. 1837. The Territory of Florida. A. T. Goodrich, New York.

Wurdemann, G. 1860. Letter relative to the obtaining of flamingos and other birds from south Florida. *Smithsonian Institution Annual Reports*: 426–430.

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