Cahow or Bermuda Petrel
(*Pterodroma cahow*)

5-Year Review:
Summary and Evaluation†

U.S. Fish and Wildlife Service
Southeast Region
Raleigh Ecological Services Field Office
Raleigh, North Carolina

† Please see Addendum 1 at the end of this, our original 5-year review document. The Addendum provides the limited new information we have gathered for our second 5-year review for this endangered bird that was initiated in the Federal Register (May 7, 2018, 83 FR 20092) and the analysis we have shared to explain the basis for continuing to recommend no change in status for this species.

5-YEAR REVIEW
Cahow or Bermuda Petrel (*Pterodroma cahow*)

I. GENERAL INFORMATION

A. Methodology used to complete the review: The U.S. Fish and Wildlife Service's Raleigh Field Office completed this review. All literature and documents used for this review are on file at the Raleigh Field Office and are cited in the References section. We used published literature; technical reports; data and information on the Internet; unpublished data; and personal communications with land managers, biologists and researchers. Public notice of this review was given in the *Federal Register* on September 21, 2007, with a 60-day public comment period (72 FR 54057). No public comments were received for this review. None of this review was contracted to outside parties. The draft of this document was distributed for peer review (see Appendix A) and comments received were evaluated and addressed as appropriate.

B. Reviewers

Lead Region: Southeast Region – Kelly Bibb, 404-679-7132

Lead Field Office: Raleigh (NC) Ecological Services – (originally David Rabon and subsequently completed by) John Hammond, 919-856-4520 x28

C. Background

1. **Federal Register Notice citation announcing initiation of this review:** 72 FR 54057, September 21, 2007

2. **Species status:** The overall population status of the cahow is unknown. The cahow is a pelagic seabird, and its range and distribution at sea make it very difficult to survey. The cahow is known to nest only on five small islets in Bermuda. Surveys are limited to the breeding grounds. The total population of the cahow is estimated as 101 breeding pairs (Madeiros 2012; Cahow Recovery Program 2011-2012 Breeding season report). We are not aware of any oceanic surveys to determine the status of this species, although the species is occasionally seen off the coast of North Carolina in the deep off shore waters. Since the time of listing, the number of breeding pairs has increased from about 24 nesting pairs to 85 pairs in 2008 to 101 pairs in 2012 (Madeiros 2012). However, the cahow continues to face threats from hurricane erosion of the breeding islands, sea level rise (Madeiros 2005) and physical constraints of the present nesting areas, and natural and introduced predators. While many of the serious land-based threats to the cahow (e.g., nest site competition from white-tailed tropic bird (*Phaethon lepturus*), nest predation by rats and avian predators) are now adequately controlled as part of Bermuda's conservation program for the species, the cahow remains vulnerable to other threats, not all of which can be reduced through management. The conclusion is that the population is generally improving, but the species'

overall status remains precarious. Recovery efforts should continue to be focused on preventing extinction by protecting the existing population and its habitat in Bermuda.

3. **Recovery achieved:** 1 (1= 0-25% species' recovery objectives achieved)

4. **Listing history:**
   Original listing:
   FR notice: 35 FR 8491
   Date listed: June 2, 1970
   Entity listed: species
   Classification: endangered

5. **Associated rulemakings:** None

6. **Review history:**

   Recovery Data Call – 2013, 2012, 2011, 2010, 2009, 2008, 2007, 2006, 2005, 2004.

7. **Species' Recovery Priority Number at start of review (48 FR 43098):** 1 (a monotypic species with high degree of threat and recovery potential).

8. **Recovery Plan or Outline**
   See II.B.1 below

II. REVIEW ANALYSIS

A. Application of the 1996 Distinct Population Segment (DPS) policy:

1. **Is the species under review listed as a DPS?** No.

2. **Is there relevant new information that would lead you to consider listing this species as a DPS in accordance with the 1996 policy?** No.

B. Recovery Criteria

1. **Does the species have a final, approved recovery plan containing objective, measurable criteria?** No. The cahow does not have a final, approved U.S. recovery plan. This bird species only known land habitat is under the jurisdiction of the Government of Bermuda. This animal is actually Bermuda's national bird. The Government of Bermuda developed a recovery plan with objective, measurable criteria for the cahow in 2005 (Madeiros 2012). Bermuda's recovery program for this small pelagic bird has grown and has had measurable success. Under Section IV, Recommendations for Future Actions, we have identified actions that we (the

Service) and our partners can cooperate with and potentially assist Bermuda with to continue to strengthen their established recovery program. We are looking for ways to strengthen our partnership with Bermuda to help find ways to further this bird's recovery.

C. Updated Information and Current Species Status

1. Biology and Habitat

The cahow (*Pterodroma cahow*; (Nichols and Mowbray, 1916)) is a nocturnal ground-nesting seabird endemic to the island of Bermuda, and is one of the world's rarest seabirds. The cahow is a medium-sized gadfly petrel (Brinkley 2012) with a body length of 38 centimeters (cm) and a wingspan of 89 cm (Madeiros, 2005). Body weight ranges from 280 grams to 499 grams. The cahow's upper body, wings and tail are dark to medium brownish-gray with a crescent-shaped white band across the rump (this latter feature is not always obvious). The undersides of the body and wings are white with dark edges and wingtips. There is a distinctive dark spot or carpal "thumbprint" on the outer third of the underside of the wing. Both sexes are virtually identical although the males may be slightly larger and heavier.

Adults typically have crowns darker than the back and the gray of the back continues onto the sides of the breast. Plumage surrounding the bill is narrowly whitish. Plumage surrounding the eye is darker than the back, more like the very dark gray of the crown (or darker). In some individuals there is a narrow whitish supercilium that segregates the dark eyepatch from the dark crown (Brinkley, 2012).

The cahow's breeding season begins in late October and ends in mid-June (Wingate 1973). Cahows lay a single white egg in January, hatch in late February to early March, and young birds fledge in late May to early June (Murphy and Mowbray 1951, Wingate 1978). Incubation ranges from 51 to 53 days and is carried out by both sexes. Like other species of the genus, cahow adults often cease tending their chick long before they are able to fly, since the fat accumulation by the fledglings can provide enough energy to reach fledging condition.

Cahows originally burrowed their nests into the soft soils of Bermuda, but predation by introduced mammals (beginning in the early 17th Century: pigs, dogs, feral cats, and rats) exterminated them everywhere except on the smallest islets where soil cover was too sparse to permit burrowing. Cahows shifted nesting to occupy natural erosion crevices in the cliffs and cliff talus, but these breeding habitats are already used by the more aggressive tropicbirds (Wingate 1978). As part of the management program, a large number of artificial burrows made out of cement have been constructed on the nesting islands. This was necessary to supplement the small number of natural nest sites that met the requirements of the cahow and to enable the tiny remnant population to increase. Approximately 80% of cahow breeding pairs now use these artificial burrows (Carlile et al. 2012).

Cahows are believed to range widely on the open ocean, returning to land only to breed (Wingate 1973). On the western edge of the Gulf Stream interaction with the cooler coastal waters creates mixing zones and upwelling that brings nutrients to the surface and creates concentrations of prey species. It is likely that the cahow travels to and feeds in the offshore deep waters off of North Carolina, South Carolina, and Georgia along the edge of the warm Gulf Stream current, up into areas north and northwest of Bermuda. It is also possible that the cahow may feed in and around giant eddies which regularly break away from the eastern edge of the Gulf Stream. These eddies can be hundreds of miles across and create local upwelling and mixing, which also concentrates prey animals. These eddies can occur over a huge area of ocean between the Gulf Stream and Bermuda. The cahow's food is believed to consist primarily of cephalopods (small squid) and lesser amounts of shrimp and probably small fish (Wingate 1972). They take food with their bill from the water surface.

Additional information on the cahow's biology and habitat can be found on BirdLife International's website at http://www.birdlife.org.

a. Abundance, population trends, demographic features, or demographic trends: The cahow was once abundant throughout the Bermudas and possibly occurred in the Bahamas (Wetmore 1938, Olson and Hilgartner 1982) and the Azores (Bried and Magalhães, 2004). Until recently, little was known about the oceanic range of the cahow. During the 1990s, there were an increasing number of sightings off North Carolina by deep sea pelagic birding tours operating from Cape Hatteras (Patterson and Brinkley 2004). There are over 20 records of cahow observations off the North Carolina coast (LeGrand 2012). North Carolina records are from the Gulf Stream off Oregon and Hatteras Inlets. All but one of these individuals was observed between late May and mid-August. The species was considered extinct after 1621, having been exploited by early colonists for food, until it was rediscovered by a single specimen in 1906. In 1951, 19 pairs were rediscovered breeding on five islets near Castle Harbour at the eastern end of Bermuda (Murphy and Mowbray 1951, Wingate 1985). One of these islets (Outer Pear Rock) supported 2 nesting pairs of cahow which were destroyed by an infestation of brown rats (*Rattus norvegicus*), that swam across from nearby Coopers Island in 1967. Outer Pear Rock was never re-colonized following the loss of all breeding adults. Over 60 years of intensive management has resulted in slow but steady increases in the population of this species, but total numbers remain extremely small. The present status of the cahow can be summarized as follows:

- The total population of the cahow is estimated as 250-275 individuals. This is based on the adult breeding population (170 individuals in 2008), non-breeding adults estimated from capture/recaptures of non-breeding adults on nesting islands at night (20-30 individuals), and juvenile and immature birds not yet breeding (based on known survival rates of banded, fledged young returning after 3 to 5 year of 36% to 39% of the young fledging to sea each year). The number of immature and non-breeding adults is

unknown, but anecdotal evidence suggests that the population has increased markedly in recent years. Numbers of young fledging each year are accurately known as all existing nest sites are under regular surveillance during the nesting season and at departure time for the chicks.

- The breeding population of the cahow has increased from 18 nesting pairs in 1961 to 85 pairs in 2008 and to 101 pairs in 2012 (Madeiros 2012).
- The total number of active, occupied nesting burrows reached a new record high of 101 during 2012, up from 98 in 2011 and 92 in 2010.
- A total of 57 cahow chicks successfully fledged in 2012 meeting a target for the Bermuda recovery program, compared to 56 cahow chicks successfully fledged in 2011, 52 chicks in 2010. This is a consistent increase from 8 chicks fledged in 1962 when the program began.
- The breeding success of the cahow has improved considerably, with an average of 50 percent success or greater since 1970 (56.4% in 2012; 57.14% in 2011; and 56.52% in 2010), compared with an average 37 percent success rate over the first decade of management, 1960-1970.
- At the end of the 2008 nesting season, 102 cahow chicks that were translocated from the other nesting islands to Nonsuch Island had successfully fledged. In 2009, a pair of the previously translocated birds returned and produced the first chick to fledge from Nonsuch Island as a result of the efforts to establish the new nesting colony. Fifteen of the young birds moved to Nonsuch Island from the other four nesting islands between 2004 and 2008 were observed on Nonsuch in the 2008/2009 breeding season. In 2010, four cahow breeding pairs laid eggs, although only one pair was able to produce a fledgling. The total number of returning birds recaptured on Nonsuch Island that had been translocated as chicks rose to 17. In 2011, researchers confirmed that Nonsuch Island breeding pairs laid seven eggs. Four fledglings successfully left the island by June 17, 2011. Ten nesting pairs produced eggs on Nonsuch Island in 2012 with seven chicks hatching and returning to the sea. The nesting adults on Nonsuch Island included 26 individuals of the 102 originally translocated fledglings to Nonsuch between 2004 and 2008. Fifteen other returned birds were documented in nests on the other four nesting islets. Three non-translocated cahows were found among the nesting adults on Nonsuch Island in 2012.
- Nonsuch Island is much larger and more elevated than the present nesting islets, and is much more protected from hurricane or storm overwash and erosion.
- Despite 3 passing hurricanes during 2011, there appears to have little or no effect on breeding success (Madeiros 2012).
- At the beginning of each nesting season, efforts are made to repair any damages sustained by existing nesting burrows on the four islets. The rapid growth of the cahow population along with increased frequency of storm damage has made it progressively more difficult to ensure a sufficient number of nesting burrows are available on the original nesting sites. To promote sustained growth, the program continues to expand nest site

construction into new areas. Nine new artificial burrows were created in November 2011 in a second translocation site (Site B) on Nonsuch Island. The Department of Conservation Services (DCS) also plans to establish a new nesting colony on Southampton Island in the near future.

b. Genetics, genetic variation, or trends in genetic variation: The cahow is a member of the gadfly group of petrels, a widely distributed genus across tropical and subtropical seas. The cahow was identified as a valid species with its description by Nichols and Mowbray in 1916. Limited genetic studies indicate that the cahow is closely related to the Black-capped petrel (*Pterodroma hasitata*), and the Fea's petrel (*Pterodroma feae*) (Wingate in litt. 2008: Madeiros 2005). Continued study of the cahow will include blood sampling for DNA analysis to better understand the genetic relationships between this species and other North Atlantic gadfly petrels, gauge genetic diversity and variability within the population, check for possible inbreeding and lack of genetic variability and to confirm the sex of individual birds.

c. Taxonomic classification or changes in nomenclature: The Integrated Taxonomic Information System (www.itis.gov) was checked while conducting this review. The scientific name *Pterodroma cahow* (common names cahow [English], Bermuda petrel [English], and Pétrel des Bermudes [French]) is valid, and there are no proposed changes in the taxonomic classification or in nomenclature.

d. Spatial distribution, trends in spatial distribution or historic range: Cahows widely nested all over Bermuda's islets, and may have nested elsewhere. The only tangible evidence of the species away from its known breeding grounds in Bermuda, though, is that of fossil bones on Crooked Island, Bahamas (Wetmore 1938, Olson and Hilgartner 1982) and a male specimen taken from a burrow early in the breeding season in the Azores (Bried and Magalhães, 2004). Currently, known cahow breeding is restricted to four small, suboptimal rocky islets and the newly established nesting colony on Nonsuch Island in Castle Harbour, in east Bermuda. Prior to 2009, little was known about the cahow's range at sea during the non-breeding season, however, they were believed to range widely in the North Atlantic to the western edge of the Gulf Stream (Wingate 1973). Since the 1990s, cahows were seen annually near the offshore waters of the Atlantic Coast of the United States (Patterson and Brinkley 2004). Between 2009 and 2012, the Terrestrial Conservation Division used light-based geolocational data loggers placed on individual birds to gather information about the at-sea movements of cahows. Data collected from 11 recovered data loggers show that the overall range of cahow movements cover an area stretching from the eastern coast of North America to Western European waters (Madieros 2012).

e. Habitat: The cahow formerly excavated nesting burrows in sand or soft soils on the hillsides of Bermuda, but introduced predators preclude them from using this habitat. Cahow nesting is currently restricted to four small, rocky offshore islets

in Castle Harbour, in suboptimal eroded limestone crevices or artificial nesting burrows. The cahow competes for the natural cliff and cliff talus sites with the more aggressive white-tailed tropicbird (*Phaeton lepturus*) and would suffer >70% annual breeding failure without human intervention (Madeiros 2005).

2. Five-Factor Analysis

a. Present or threatened destruction, modification, or curtailment of its habitat or range:

Following the birds' rediscovery in 1951, the Government of Bermuda implemented a conservation program that has periodically eliminated rats, installed concrete nesting burrows, and placed wooden baffles over burrow entrances to keep out larger, competing white-tailed tropicbirds. These actions continue to be practiced as necessary. The Castle Harbor islands were designated as a Nature Preserve in accordance with the Bermuda National Parks Act of 1986 (Bermuda 1986: 45) and are listed as Class (A) Protected Areas pursuant to section 3 of the National Parks Act. Management activities that benefit the cahow are performed in accordance with Part II Section 5 of the National Parks Act.

The current primary threat to the cahow is the continuing damage and substantial attrition to the nesting islets caused by severe hurricanes and storms, along with sea level rise. Between the early 1950s and late 1980s, weather and sea-level related impacts to cahow nesting habitat was comparatively minimal. In contrast, at least ten major storms visited the nesting islets between 1989 and 2011. The effects of these hurricanes included undermining and collapse of large sections of the islands, breaking off of limestone and cliff faces and inundation of the smaller islets. This has led to complete destruction of some cahow nesting burrows, and occlusion of others by rocks and debris.

Following large storms and peak tidal surges, the Department of Conservation Services undertakes substantial actions to re-construct and recondition damaged nesting burrows on affected nesting islands. Failure to carry out nest site management after such events could have demographic and reproductive consequences, e.g., a reduction in the number of available nest sites is likely to cause long-established pairs to break up. Several years may be required for returning adult cahows to re-establish new nests with new mates.

To minimize the nesting population’s vulnerability to hurricanes, sea-level rise and other events, the Department of Conservation Services’ recovery program includes key objectives to restore ecological function and establish new nesting colonies on islands that are both larger and more elevated than the original tiny nesting islets, each of which are only about a half an acre in area each. A new colony, which included 12 active nest burrows, was established on 16.5-acre Nonsuch Island. Efforts are now underway to establish a second colony on

Nonsuch Island as well as a new colony on Southampton Island, approximately 100 meters southwest of the currently existing nesting colony on Horn Rock.

The Department of Conservation Services' recovery program for the cahow has made steady progress in expanding the cahow's nesting range. As described in the current recovery plan for the cahow (Madieros 2005), the geographic extent of the nesting area is just over 2.2 kilometers. The potential effects of major hurricanes (wind, rain and tidal surge) often extend dozens of miles from the storm's center. While the recovery strategy for the cahow strives to grow the population to 1,000 breeding pairs, it is likely that loss of nesting sites and possibly nesting cahows will continue to be threats due to the limited distribution of nesting habitat.

b. Overutilization for commercial, recreational, scientific, or educational purposes: The cahow was extensively hunted for its meat and eggs, nearly to the point of extinction, when colonists arrived in Bermuda in the 16th Century. However, since the rediscovery of a single specimen in 1906 and a breeding colony on Castle Harbour in 1951, the species has been protected under various laws and regulations. Overutilization for commercial, recreational, scientific, or educational purposes was not known as a threat to recovery of the cahow at the time of listing and is not a threat at present.

c. Disease or predation: Cahows originally burrowed their nests into the soft soils of Bermuda, but predation by introduced mammals (pigs, dogs, feral cats, and rats) exterminated them everywhere except on the smallest islets. In 1967, two pairs of nesting cahow were destroyed by an infestation of brown rats that swam from a nearby island. This breeding population has never returned. In 2008, four newly hatched cahow chicks were killed by a single black rat (*Rattus rattus*) that swam to one of the nesting islands. This rat was destroyed before affecting any of the breeding adults, but highlighted the threat rats continues to pose to the cahow. As a result, more frequent baiting of the nesting islets with anticoagulation rodenticide has been implemented. Cahows that occupy natural erosion crevices in the cliffs and cliff talus are in direct competition with the more aggressive white-tailed tropicbirds which also use these habitats for breeding (Wingate 1978; Wingate and Talbot 2003). Predation has been confirmed from avian predators as well, including peregrine falcons (*Falco peregrinus*), and snowy owl (*Bubo* (=*Nyctea*) *scandiaca*), and possibly other large raptors (Madeiros 2005). A rare, but potential threat is that of wild European honeybees (*Apis melifera*) colonizing cahow nesting burrows (Madeiros 2005). Documentation indicates that predation remains a threat to the cahow.

d. Inadequacy of existing regulatory mechanisms: In addition to the Endangered Species Act of 1973, as amended, the cahow is protected under the Bermuda Protected Species Act of 2003 (Bermuda 2003: 15); Bermuda Protected Species Amendment Act of 2011 (Bermuda 2011: 40) and Bermuda Protected Species Order 2012 (Bermuda BR 7 / 2012), as amended. The Ministry of the

Environment of Bermuda prepared a Recovery Plan for the Bermuda Petrel (cahow) in 2005 (Madeiros 2005).

Bermuda is also included in the United Kingdom's ratification of the following international agreements:

- Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention)
- Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)

The Government of Bermuda has a comprehensive system for protection of remnant areas of natural habitat, with various legal measures in place, that may benefit the cahow, including:

- The Bermuda National Parks Act 1986. The enabling legislation for the designation of national parks and reserves, which may be areas of land or water. Currently, 12 nature reserves covering some 48 ha, and 63 parks ranging in size from 0.04 ha to 38 ha are listed under the Act. The nature reserves listed include a number of those already declared under statutory instruments arising from the Protection of Birds Act (Bermuda 1975: 52). The Castle Harbor Islands are also listed as Class (A) Protected areas under the Act. The sections of the Act which apply to the cahow are detailed as follows:

  Bermuda National Parks Act 1986: Part II, Section 5 – Objective of Protected Areas

  a. to safeguard and maintain plants and animals as well as geological features and Ecosystems of national and international significance where strict protection is required and human use is generally limited to scientific research and educational purposes in order to protect and preserve these special or fragile natural resources.

- Protection of Birds Act 1975. The first legislation to provide for nature reserves was the 1949 Protection of Birds Act, under which the first reserve was declared at Castle Harbour Islands following the rediscovery of the cahow in 1951. That Act was superseded by the Protection of Birds Act 1975, which similarly provided for reserves to be declared by the Minister on land appearing to be "especially suited for the feeding and nesting of protected birds, or otherwise important for their preservation."

Enforceable restrictions in reserves relate to access control by permits or to designated access areas.

Planning legislation in Bermuda also has provisions giving precedence to the conservation of natural areas, which may benefit the cahow.

- The Development and Planning Act 1974 (Bermuda 1975: 51). A 1983 amendment included an additional provision for "overlay zoning" of "Environmental Conservation Areas", within which the preservation of open space and the natural environment takes precedence over other planning considerations.
- "Bermuda 2000": The Bermuda Plan 1992. Three goals of the plan are to: (1) conserve open space and promote a high quality environment; (2) provide sufficient development potential to meet the community's needs; and (3) encourage a more efficient use and development of land.

[The preceding information was taken from the Joint Nature Conservation Committee website at: http://www.jncc.gov.uk/pdf/OT_Bermuda.pdf.]

Both the Endangered Species Act of 1973, as amended and the Migratory Bird Treaty Act of 1918 apply to the protection of seabirds such as the cahow. However, except for section 7 review of potential impacts of other federal agencies' actions, the Service's role in conserving the cahow at sea is relatively limited. However, the National Marine Fisheries Service (NMFS) recognizes its role in protecting migratory birds including seabirds (NOAA 2013). NMFS has established a goal to work "…with avian scientists, regional fishery management councils, other agencies, such as U.S. Fish and Wildlife Service, and various stakeholders, to foster and sustain seabird and migratory bird populations."

e. Other natural or manmade factors affecting its continued existence: One of the many threats to the cahow is catastrophic weather events, hurricanes or other strong storm systems that cause extreme high water events on the nesting areas. Storm surges can partially or completely inundate nesting burrows. For example, the Category-3 Hurricane Fabian in 2003 overwashed three of the four breeding islets, damaging or destroying a significant number of nest burrows (Madeiros 2005). Three hurricanes passing over Bermuda in 2011 apparently had little or no effect on cahow breeding success. Fortunately, the majority of the species' breeding season occurs when hurricanes are unlikely to form. However, the effects of hurricanes and other strong storms on the cahow when it is at sea are unknown.

Given the small size of the cahow's breeding islets, the threat of sea-level rise and increased storm activity owing to anticipated global warming and climate change is of potential great concern. There were at least five major floods affecting burrows in the 1990s, after 25 years without significant problems from flooding. Long-term climate change will continue to affect the nesting burrows available to

cahows (Madeiros 2005). Habitat managers working to maintain cahow nesting sites acknowledge the potential for the annual number of stronger than average hurricanes to actually increase in the next few decades (Madeiros 2012). Light pollution from a nearby airport and NASA tracking station adversely affects nocturnal aerial courtship. Negotiations with the relevant authorities to reduce, redirect, or shield lighting affecting the nesting islands have so far been moderately successful, but this situation will require continued, constant attention. Residues of DDT found in the oceanic food chain once contributed to a decline in reproduction of the cahow (Wurster and Wingate 1968). Contaminants may still be contributing to reduced egg success in the species (Madeiros 2005).

Seabirds in general are susceptible to oil spills (NOAA 2013). Oil spills both directly and indirectly affect seabird survival. Oil laden birds have difficulty flying and foraging; oil can interrupt the insulative properties of their down feathers, making them unable to regulate body temperature and often leading to death by hypothermia. There is relatively little information regarding the potential risks to seabirds associated with human activities. However, in the fisheries industry, statistics may be derived as bycatch data are gathered from records of observed fishing gear. In reference to records of bycatch that included seabirds from 1989 to 2005, over 2,000 individuals from 11 avian families were recorded. Taxa representing Procellaridae (shearwaters and petrels) were the most frequently observed species (NMFS 2013).

The continued survival the cahow would not be possible without the efforts of the Department of Conservation Services. In the development of the program's recovery program, DCS has identified and responded to predation, nest site competition, human disturbance and other factors. The DCS has implemented steps to expand the nesting population and has plans to monitor and adjust management as local conditions change. Despite substantial progress, the cahow remains vulnerable to other threats, not all of which can be addressed through management.

D. Synthesis

The degree of threat to the cahow's persistence remains high. It is a species with a high level of taxonomic distinctness, and its potential for recovery is low due to its very limited population size and limited nesting range in Bermuda. The restricted distribution of the cahow makes it a risk to catastrophic loss from hurricanes and other storm events that can completely inundate the species' habitat. Hurricanes and other severe storm events are a natural factor affecting the cahow's continued existence. However, given its very limited nesting range in Bermuda, a hurricane or strong storm event could cause a catastrophic decline of this species due to its possible impact to fledglings if they are still present or if fledglings have left to nesting burrows.

Overutilization for commercial, recreational, scientific, or educational purposes is not

known as a threat to recovery. Disease is not known to be a threat to recovery, but mammalian and avian predators continue to be limiting factors to recovery. Competition with the white-tailed tropicbird for nesting areas will continue to be a major threat without continuous human intervention.

Regulatory mechanisms are in place to aid in minimizing impacts from development on lands that the species uses for nesting. However, few regulatory mechanisms are available that may protect the species when at sea.

Most of the land-based threats to the cahow are now adequately controlled as part of the conservation program for the species. The cahow however remains vulnerable to other threats, not all of which can be reduced through management.

In summary, the cahow continues to be in danger of extinction throughout all or a significant portion of its range due to its very small nesting distribution and the threat from hurricanes and other storm events, introduced and nonnative predators, and competition for nesting habitats form other native species. Therefore, we believe the cahow continues to meet the definition of an endangered species.

III. RESULTS

A. Recommended Classification: No change in status.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

1. Assist in studies to determine aspects of the cahow's ecology at sea, including identifying movements, feeding grounds, and issues related to prey availability, and potential off-shore threats to the species or its foraging habitats. (The following recommendations are primarily taken from The South Atlantic Migratory Bird Initiative Implementation Plan, 2005 and the Southeast United States Regional Waterbird Conservation Plan, 2006):

    - Use updated spatial data on the cahow to identify important foraging, migrating, and wintering cahow areas. Key marine habitats and/or focus areas should be identified. The value of sargassum to the cahow, and the effects of sargassum harvest to seabird habitat and populations should be determined.
    - Establish interagency collaboration between NMFS, Service, and State and Provincial conservation agencies to develop strategies to gain a better understanding of threats to seabirds and establish an approach to implementing conservation measures to address risks to the conservation of the cahow and other declining seabirds.
    - Conservation efforts should develop partnerships with fishery industries and sport anglers. Interactions of the cahow with commercial fishing operations should be further evaluated, and the role of commercial fisheries in cahow mortality should be determined. Impacts to the cahow from offshore and inshore fisheries should be addressed in all future fishery plans. Monitoring of bycatch should be

increased, and the policy of elimination of bycatch in fisheries should be embraced by all fisheries management entities. Dumping of debris, line, and nets should be prohibited and strictly enforced, and non-persistent lines, nets, and traps should be developed. Education and public awareness campaigns focused on the hazards of discarded fishing line, removing hooks from birds caught while fishing, and proper disposal of fishing line should be conducted in all coastal states. An assessment of the impact of gill nets and longlines on pelagic seabirds and other waterbirds should be conducted. The addition of streamer lines to longlines can substantially reduce seabird bycatch. Fisheries managers should implement policies and strategies to eliminate incidental mortality of cahow, and ensure long-term sustainability of prey species.

- Measures to minimize collisions with lighted offshore structures should be implemented. New oil/natural gas extraction structures proposed or being assessed for location in offshore waters of the southeastern or mid-Atlantic United States should be reviewed for their impacts on the cahow.
- Oil effects on the cahow should be minimized through increased enforcement of shipping activities, safe operational procedures, spill clean up, and rehabilitation of oiled birds. Population level effects of oil and hazardous materials on the cahow should be determined. Protection of cahow habitats should be included in all rapid response plans for oil spills.
- Death and morbidity of cahows should be monitored wherever it occurs. All dead or moribund cahow should be reported to the SeaNet program administered through Tufts University (http://www.tufts.edu/vet/seanet/).
- Seasonal population estimates, distribution, and abundance of seabirds are needed in the Southeast Continental Shelf. The extent of cahow use of foraging areas off Cape Hatteras, North Carolina should be determined. Beached seabird surveys in the South Atlantic region should be expanded to determine trends and causes of mortality.

2. Coordinate with the Government of Bermuda to assist in the recovery of the cahow, by conducting the following:

   a). Work with the Bermuda DCS to review recently accumulated telemetry data (gathered through the use of light-based geolocational archival tags) that needs to be analyzed to refine our understanding of how the species uses oceanic resources and enable us to protect the species from any as of yet unidentified threats (e.g., evolving fisheries techniques, power generation, etc).
   b). Assist in improving nest-burrow monitoring.
   c). Assist in the continuation of the project to establish new cahow nesting colonies using translocation and sound attraction techniques Investigate the potential for expanding the extent of cahow nesting sites beyond the Castle Harbor Islands Nature Reserve.

*****The use of trade names or mention of a commercial product in this document is not intended to imply endorsement.*****

V. REFERENCES

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Cahow or Bermuda Petrel (*Pterodroma cahow*)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review: No change in status

Review Conducted By: John Hammond, Raleigh Ecological Services Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date 9/26/13

REGIONAL OFFICE APPROVAL:

for
Lead Regional Director, Fish and Wildlife Service

Approve _____ Date 10-30-13

APPENDIX A
Summary of peer review for the 5-year review of
Cahow or Bermuda Petrel (*Pterodroma cahow*)

A. Peer Review Method: See B. below.

B. Peer Review Charge: On September 10, 2008, the following letter and Guidance for Peer Reviewers of Five-Year Status Reviews were sent via e-mail to potential reviewers requesting comments on the 5-year review for the cahow (*Pterodroma cahow*). Requests were sent to: Dr. David Wingate (former Conservation Officer, Department of Conservation Services, Ministry of the Environment, Bermuda), Mr. Jeremy Madeiros (Conservation Officer, Department of Conservation Services, Ministry of the Environment, Bermuda), and Ms. Susan Cameron (at that time Waterbird Coordinator, North Carolina Wildlife Resources Commission).

We request your assistance in serving as a peer reviewer of the U.S. Fish and Wildlife Service (Service) 5-year status review of the endangered cahow or Bermuda petrel (Pterodroma cahow). The 5-year review is required by section 4(c)(2) of the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 et seq.). A 5-year review is a periodic process conducted to ensure the listing classification of a species as threatened or endangered on the Federal List of Endangered and Threatened Wildlife and Plants is accurate. The initiation of the 5-year review for the cahow or Bermuda petrel was announced in the Federal Register on September 21, 2007, and the public comment period closed on November 20, 2007. No public comments were received for this status review.

The enclosed draft of the status review has been prepared by the Service pursuant to the Act. In keeping with Service directives for maintaining a high level of scientific integrity in the official documents our agency produces, we are seeking your assistance as a peer reviewer for this draft. Guidance for peer reviewers is enclosed with this email. If you are able to assist us, we request your comments be received in this office on or before September 22, 2008. Please send your comments to David Rabon via fax to (919) 856-4556 or by e-mail to david_rabon@fws.gov.

We appreciate your assistance in helping to ensure our decisions continue to be based on the best available science. If you have any questions or need additional information, please contact me at (919) 856-4520 extension 16. Thank you for your assistance.

Guidance for Peer Reviewers of Five-Year Status Reviews
U.S. Fish and Wildlife Service, Raleigh Ecological Services Office

As a peer reviewer, you are asked to adhere to the following guidance to ensure your review complies with Service policy.

Peer reviewers should:

1. *Review all materials provided by the Service.*

2. *Identify, review, and provide other relevant data apparently not used by the Service.*

3. *Not provide recommendations on the Endangered Species Act (ESA) classification (e.g., endangered, threatened) of the species.*

4. *Provide written comments on:*
- *Validity of any models, data, or analyses used or relied on in the review.*
- *Adequacy of the data (e.g., are the data sufficient to support the biological conclusions reached). If data are inadequate, identify additional data or studies that are needed to adequately justify biological conclusions.*
- *Oversights, omissions, and inconsistencies.*
- *Reasonableness of judgments made from the scientific evidence.*
- *Scientific uncertainties by ensuring that they are clearly identified and characterized, and that potential implications of uncertainties for the technical conclusions drawn are clear.*
- *Strengths and limitation of the overall product.*

5. *Keep in mind the requirement that we must use the best available scientific data in determining the species' status. This does not mean we must have statistically significant data on population trends or data from all known populations.*

All peer reviews and comments will be public documents, and portions may be incorporated verbatim into our final decision document with appropriate credit given to the author of the review.

Questions regarding this guidance, the peer review process, or other aspects of the Service's recovery planning process should be referred to David Rabon, U.S. Fish and Wildlife Service, at 919-856-4520 extension 16, email: david_rabon@fws.gov.

C. Summary of Peer Review Comments/Report

A summary of peer review comments from respondents is provided below. The complete set of comments is available at the Raleigh Ecological Services Field Office, U.S. Fish and Wildlife Service, 551-F Pylon Drive, Raleigh, North Carolina, 27606.

The Service accepted all minor edits from peer reviewers. Overall, the reviewers agreed the draft document adequately characterized the known information on the status and threats of the listed species. The following discussion is limited to the use of additional information that was provided.

Dr. David Wingate, Audubon Society Bermuda (former Conservation Officer, Department of Conservation Services, Ministry of the Environment): Dr. Wingate generally provided editorial comments and information regarding efforts to reduce nest site competition, as well as additional references for information cited in this document. His recommendations have been incorporated.

Mr. Jeremy Madeiros, Conservation Officer (Terrestrial), Department of Conservation Services, Ministry of the Environment: Mr. Madeiros generally provided updated information regarding the 2008 nesting season, and recommended additional future actions that include specific measures to assist in Bermuda's management of nesting cahows. His recommendations and updates, as well as annual nesting season and recovery program reports have been incorporated.

Ms. Susan Cameron, Waterbird Coordinator, North Carolina Wildlife Resources Commission): Ms. Cameron recommended that potential threats to the existence of the cahow during the non-breeding season, such as changes to food sources and supply from climate change, and commercial fisheries, and impacts from offshore energy development, be included in the assessment. She also recommended incorporating measures to conserve the cahow identified in the South Atlantic Migratory Bird Initiative Implementation Plan (2005) and the Southeast United States Regional Waterbird Conservation Plan (2006). Her recommendations have been incorporated.

D. Response to Peer Review – The Service agreed with all comments and suggestions provided by the peer reviewers. The draft five-year review was modified in accordance with the reviewers' suggestions.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Cahow or Bermuda Petrel (Pterodroma cahow)
2019

Nonsuch Expeditions 2017

Addendum 1. Summary of new information obtained since the 2013 5-year review.

The Federal Register notice announcing the initiation of this 5-year review was published on May 7, 2018 (83 FR 20092). No comments were received during the 60-day public comment period following the notice.

I. GENERAL INFORMATION

A. Reviewers

Lead Region: Southeast Region – Kelly Bibb, 404-679-7132

Lead Field Office: Raleigh, North Carolina (NC); Eastern, NC Ecological Services Sub-Office, Manteo, NC – Shaun Olson, 252-473-1132 x241

B. Background

1. **Federal Register Notice citation announcing initiation of this review:** 83 FR 20092, May 7, 2018

2. **Species status:** Overall population status is still unknown. The estimated breeding population is now 131 pairs and 73 chicks fledged on six separate islets in Bermuda (Madeiros 2019, pers. comm.). There are no known oceanic-based population surveys being conducted; known population surveys are limited to breeding grounds. An at-sea range study was conducted, starting during the 2009/10 breeding season and concluded in during the 2011/12 season. The results, which were fully published after the 2013 5-year review had been completed, indicate that there appears to be two major areas of foraging; northwest of the Azores and off the eastern shores of North America (Madeiros et al. 2014). A multi-year effort to further understand the petrel's at-sea range and foraging areas was launched in 2019 by the government of Bermuda, in collaboration with MARE-ISPA (Instituto Universitário de Ciências Psicológicas, Sociais e da Vida (University Institute of Psychological, Social, and Life Sciences))

and CE3C-FCUL (Centre for Ecology, Evolution and Environmental Changes of the University of Lisbon); they placed a number of short-duration GPS trackers on adult breeding birds to examine these questions (LookBermuda 2019). Threats facing the Cahow remain largely unchanged.

3. **Recovery achieved:** 1 (1=0-25% species' recovery objectives achieved) based on Bermuda's goal of 1000 breading pairs (Madeiros 2005)

4. **Listing history:**
   Original listing:
   FR notice: 35 FR 8491
   Date listed: June 2, 1970
   Entity listed: Species
   Classification: Endangered

5. **Review History:**
   5-year Review: 2013. In this 5-year review (presented just above this addendum), we recommended no change in status for the Bermuda petrel.

Each year, the Service reviews and updates listed species information for inclusion in the required Recovery Report to Congress. Through 2013, we did a recovery data call that included status recommendations such as "Unknown" for this bird. We continue to show that species status recommendation as part of our 5-year reviews. The most recent evaluation for this bird was completed in 2018.

II. REVIEW ANALYSIS

A. Updated Information and Current Species Status

1. Biology and Habitat

a. Abundance, population trends, demographic features, or demographic trends:

- The estimated total population at the end of the 2019 breeding season was 350 – 360 individuals (Madeiros 2019, pers. comm.). This number takes into account breeding pairs, immature and non-breeding birds. This is an increase from the estimated 250 – 275 individuals in 2008 as stated in the 2013 5-year review.
- Average annual growth rate of breeding pair population since 1961 has been 3.6% with an average fledging success rate of 49.4% (see Figure 1). Growth rate of breeding pair population and fledging success rate from 2009 – 2018 has been 3.9% and 53.6% respectively. Breeding success every year since 1971 has averaged over a 50% success rate and the latest data continues to illustrate that level of success.
- 2017 marked the fifth and final year for a second translocation project on Nonsuch Island. 70 fledglings from all four original nesting islets were

moved over the five-year period with 64 chicks successfully fledging. This represents a 91.43% success rate (Maderios 2018).

- The breeding pair population as of 2019 is 131. This is a marked increase from 18 pairs in the early 1960s (Madeiros 2019, pers. comm.).

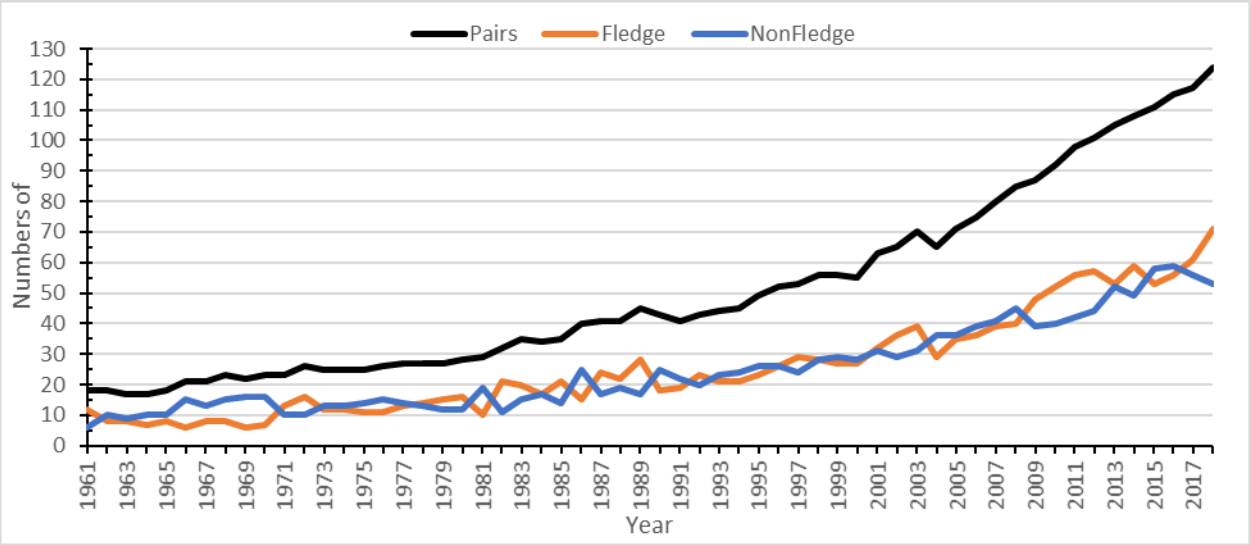

FIGURE 1. Relative numbers of Bermuda petrel breeding Pairs, Successful Fledge vs. Non-Fledging (assumes all pairs attempted breeding) from 1961 to 2018. Graph generated using data from Bermuda's breeding reports and papers (Madeiros et al. 2012, Madeiros 2006-2008, 2010-2017).

b. Spatial distribution, trends in spatial distribution or historic range:

Currently all nesting sites occur on 6 islets in Bermuda, totaling 22.26 acres (9 ha) in area; four of which are located in Castle Harbour, one in Long Bay and one in Turtle Bay. When recovery efforts first began in 1961, the petrel was only found breeding on four tiny islets, totaling only 3.4 acres (1.38 ha). An effort to promote the creation of new nesting sites on Nonsuch Island (area 16.5 acres/6.77 ha) in Castle Harbour began in 2004 with the translocation of 14 chicks pulled from the four original islets. This first effort was repeated every year until 2008. An additional, similar translocation effort began in 2013 and finished in 2017. These translocation efforts have proven successful and there are currently two nesting colony sites on Nonsuch Island, supporting a combined total of 22 breeding pairs in 2019 (Madeiros 2019, pers. comm.). On August 6, 2012, a survey of nearby Southampton Island (area 2.36 acres/0.96 ha) in Castle Harbour discovered the carcass of a nearly full-fledged petrel on the top of the island indicating one of two possibilities; a predator brought the chick over from nearby Horn Rock to feed or the presence of an unknown nest. Subsequent night surveys conducted in January and February of 2013 yielded observations of adults flying over the northwest side of the island. Consequently, three nests were discovered. This natural recolonization of Southampton was most likely aided by the close proximity of Horn Rock, which contains the largest nesting concentration of petrels. (Madeiros 2013)

While much is still unknown about the at-sea distribution of the petrel, the recovery team conducted a study using Lotek data-loggers to monitor and track the petrel's at-sea movements. The monitoring project began in 2009 and ended during the 2011/12 season. The study found that during chick rearing, adults primarily spent time in the central Atlantic waters northwest of Bermuda, off the coast of North Carolina and the waters south and east of Nova Scotia. The data further suggests that during the nonbreeding season there are two distinct areas utilized: the waters well to the northeast of Bermuda and the waters north and west of the Azores and occasionally off the coasts of Ireland and Spain, and the area east of North Carolina north to Massachusetts and south of Nova Scotia (see Figure 2) (Madeiros 2012, Madeiros et al. 2014).

During the 2018/19 breeding season, the government of Bermuda, in conjunction with MARE-IPSA and CE3C-FCUL, started using GPS tracking units to accurately map foraging area use. Each GPS unit will last up to 5 weeks and does not process or calculate location in real-time. Instead, the units will record the time taken to contact the GPS satellites, which in turn is used to determine location when downloaded (LookBermuda 2019).

c. Ongoing research:

The Government of Bermuda is currently collecting and analyzing blood and feather samples to investigate the following:

- Identify the trophic niche of adult birds during the breeding season, by Stable Isotope Analysis of blood & feathers
- To investigate whether birds are exposed to Persistent Organic Pollutants integrated with diet (analyzing blood samples to determine levels of DDT, PFOs, PCP, etc.);
- Understand whether the relatively high proportion of infertile/failed eggs is related to the concentration of bio-accumulated contaminants (e.g. DDT/DD has toxic effects causing eggshell thinning) and/or to bird breeding experience (i.e. relatively high percentage of younger, inexperienced breeding adults).

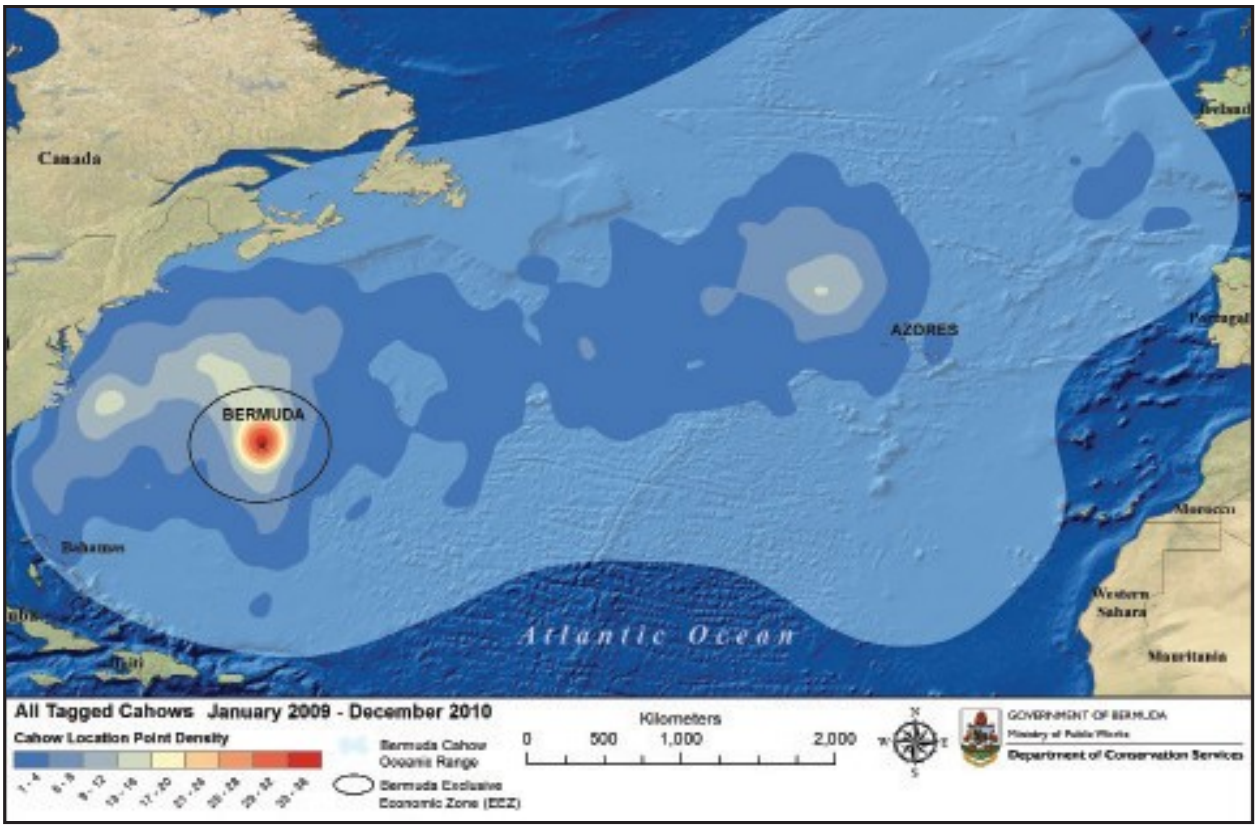

FIGURE 2. Spatial distribution of Bermuda petrel foraging forays during chick rearing and non-chick rearing seasons (Madeiros et al. 2014).

2. Five-factor Analysis or Threats

The Bermuda petrel continues to be threatened throughout all or a significant portion of its range due to its very small nesting distribution and the threat from hurricanes and other storm event, as well as sea level rise, predators and competition for limited nesting habitats with other native species. Regarding hurricanes and other storm events, since publication of the previous 5-year review in 2013, there have been 11 named hurricanes and tropical storms that have caused various levels of impacts to Bermuda and potential damage to nesting habitat. Additionally, while there appears to be no evidence in the literature that plastic ingestion is a known issue for the Bermuda petrel, the increasing impacts of plastic pollution on seabird species, including other petrel species, makes this a potential threat to recovery and efforts should be made to monitor for possible impacts due to plastic pollution on the Bermuda petrel.

B. Synthesis

The threats to the species remain largely the same; combined with low population numbers and limited breeding habitat availability, this species still faces possible extinction due to man-made and stochastic events. While the Bermuda government, in conjunction with its many partners, are making considerable progress and achieving measurable success in recovering this species (e.g., from 24 nesting pairs at the time of

listing in 1970 to 131 nesting pairs in 2019), the Bermuda petrel continues to meet the criteria to remain in an endangered species status.

III. RESULTS

A. Recommended Classification: No change in status.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

1. Continue to follow recommendations in the 2013 5-year review. In line with those recommendations:
    a. Efforts should be made to assist with, and conduct studies to further examine and determine the at sea range and foraging habitats to see where the Bermuda petrel's life history intersects with pollution (e.g. light, plastic) and offshore resource development (e.g. oil, gas, wind) and evaluate the potential impacts.
    b. Continue to communicate with the Government of Bermuda to look for ways to assist in recovery efforts for the Bermuda petrel, as resources allow, including data sharing such as providing North Carolina off shore sighting data, when available.
    c. Necropsies performed on dead Bermuda petrels should evaluate stomach contents to determine levels of plastic ingestion, as noted as a potential threat to other seabird species.

V. REFERENCES

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW addendum of Cahow or Bermuda Petrel (*Pterodroma cahow*)
2019

Current Classification: Endangered

Recommendation resulting from the 5-Year Review: No change in status

Review Conducted By: Shaun Olson, Raleigh, North Carolina (NC); Eastern, NC Ecological Services Sub-Office, Manteo, NC

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve PETER BENJAMIN Digitally signed by PETER BENJAMIN Date: 2019.08.20 15:58:21 -04'00' Date_____

REGIONAL OFFICE APPROVAL:

Lead Regional Director, Fish and Wildlife Service

Approve_____Date_____