

CAHOW RECOVERY PROGRAM

Breeding Season Report for 2010



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BERMUDA GOVERNMENT



**DEPARTMENT OF CONSERVATION
SERVICES**

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**RECOVERY PROGRAM FOR THE CAHOW
(BEMUDA PETREL)
*Pterodroma cahow***

**Breeding Season Report
For the Nesting Season October 2009 to June 2010**

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EXECUTIVE SUMMARY:

Key Words: Cahow, Banding, Breeding success, Data logging, Nonsuch Island, Social attraction, Translocation.

The Cahow Recovery Project is a long-term management, research and recovery program aimed at reducing threats to the National Bird of Bermuda, the Cahow or Bermuda petrel (*Pterodroma cahow*). It also aims to promote the recovery of this endemic species, which is now one of the rarest seabirds on Earth and is completely unique to the island.

The Cahow, once thought to have numbered more than half a million birds, was catastrophically affected by the arrival of humans on the island in the early 1600s and by introduced mammal predators such as rats, cats, dogs and pigs. In less than 20 years of settlement, the Cahow declined to the point where it was thought extinct, a belief that persisted until the rediscovery of 18 remaining nesting pairs on four tiny offshore islets.

Since 1960, a conservation and recovery program has been in place that has addressed and controlled most threats, resulting in an accelerating increase in the population. This has increased from 18 pairs producing 8 fledged chicks annually in the 1960s to a record total of 92 pairs producing 52 successfully fledged chicks in the 2010 nesting season. New techniques and technology have enabled this program to record a number of recent achievements over the last year, which include the following:

- A new nesting colony of Cahows has been successfully established on Nonsuch Island Nature Reserve, by the techniques of Translocation of near-fledged chicks from the small nesting islets, to the much larger and more protected Nonsuch, and by use of a sound attraction system;
- Archival geolocational data loggers were attached to the legs of 12 nesting Cahows; 9 of these were recovered and the data downloaded, revealing the tracks taken by the birds when at sea for up to 12 months. For the first time, it was revealed that Cahows fly thousands of miles to Mid-Atlantic or Canadian waters near Newfoundland and Nova Scotia to get food for their chicks in Bermuda. The loggers also revealed that Cahows spend up to 5 months in waters around the Azores Islands or as far northeast as western European waters, travelling an amazing total of up to 80,000 miles in 12 months.
- A program to attach identification bands to the legs of adult and fledgling Cahows has resulted in almost three-quarters of the entire population being banded by 2010. This enables individual birds to be identified and followed for the rest of their breeding lifespan, and has been used to determine survival rates, breeding success and other aspects of breeding biology.

The Cahow Recovery Program is now recognized as one of the most successful restoration projects known for a critically endangered species, and was highlighted in the first World Seabird Conference in Victoria, British Columbia, in September, 2010. Future plans include the establishment of additional safer nesting colonies, and additional tracking of the birds to determine their oceanic range and feeding areas.

1. INTRODUCTION:

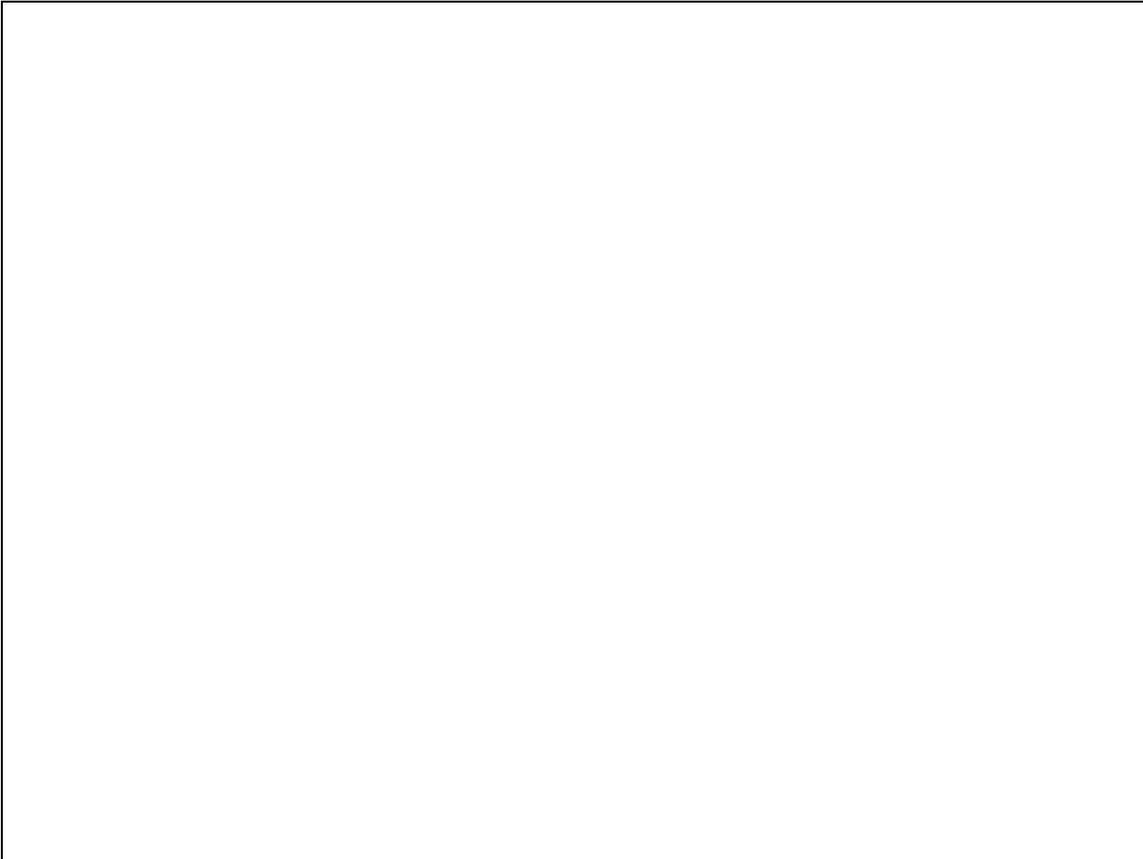


Fig. 2: Bermuda petrel (Cahow) nesting sites (strictly no public access)

1.1. A BRIEF HISTORY OF THE CAHOW:

The Cahow, or Bermuda petrel, occupies a very special place in Bermuda's history and biodiversity. A pelagic seabird that spends most of its life on the open ocean, usually hundreds of miles from the nearest land, the Cahow is endemic to Bermuda, nesting nowhere else on Earth. At the time of Bermuda's discovery by Spanish and Portuguese mariners in the early 1500s, the Cahow was thought to have numbered in the hundreds of thousands, nesting in soil burrows and rock crevices all over the islands. The noise made at night by the huge colonies of Cahows and other nocturnal seabirds, coupled with the stormy weather and dangerous reefs which surrounded the islands, convinced the Spanish that Bermuda was inhabited by devils and demons, and they never colonized what became known as "the devils isles, shunned by mariners above all other islands".

Although the Spanish never colonized Bermuda, they left a legacy of pigs behind on the island, intended to provide food for shipwrecked sailors. The pigs decimated Cahow populations on the main islands, rooting up and destroying burrows and eating eggs, chicks and adult birds. As on other island groups where pigs have been introduced, such as Hawaii and the Galapagos, they also undoubtedly caused immense environmental damage, both to other ground-nesting birds and plants with edible roots and tubers, and we will never know the full extent of the harm that they caused to Bermuda's

environment and the species which became extinct as a result. They were also the first of a long list of invasive species introduced by humans, which have replaced the indigenous flora and fauna to the point where over 95% of Bermuda's vegetation cover is now composed of introduced and largely invasive species, among the highest percentage of any location on the planet. The remaining population of Cahows still nesting on the larger islands in Castle Harbour, such as Coopers Island, were quickly affected following the English colonization of the islands between 1609 and 1612, both by predation from introduced Rats, Cats and Dogs and from hunting by the colonists. As a result, the remaining population declined so fast that by the 1620s the Cahow seemingly disappeared and was thought to be extinct, a belief that persisted for well over 300 years.

The Cahow was rediscovered in 1951, when a scientific expedition found a small number of nesting pairs surviving on several tiny islets near Castle Harbour. By 1960, the entire world population of the species was represented by only 18 nesting pairs, which were threatened by Rat predation, nest-site competition with other seabirds and a shortage of suitable nest sites. A conservation program was put in place to address these threats and to encourage the survival of the Cahow, which has since staged a remarkable recovery, recently bolstered by the establishment of a new nesting colony. Although the Cahow is still being one of the rarest seabirds on Earth, its future appears increasingly hopeful. The Recovery Program is looked upon in the international scientific community as one of the most successful recovery efforts known for a critically endangered species.

1.2. THREATS AFFECTING THE CAHOW:

The Cahow is subject to a number of threats and limiting factors, including the following:

- 1) The threat of introduced mammal predators, in particular Black and Norway Rats (*Rattus rattus* and *R. norvegicus*) swimming out to the nesting islands, where they can kill and eat the eggs, chicks or adult birds;
- 2) Nest site competition from the native White-tailed Tropicbird or Longtail (*Phaethon lepturus catsbyii*);
- 3) Predation by avian predators such as large Owls or Peregrine Falcons;
- 4) Disturbance or vandalism arising from unauthorized and illegal human visits to the protected nesting islands, which are strictly off-limits to public access;
- 5) Lack of available suitable nest burrows and habitat at the original tiny nesting islets, which have lost through erosion and storm activity almost all of the soil cover that the Cahow normally digs its burrows in;
- 6) The threat of erosion and damage to the breeding islets and nests by hurricane and storm surge and surf, which have overwashed and caused serious damage to the islets at least nine times over the last twenty years (see Fig. 3).

Much of the present management program for the species is focused on addressing and overcoming these various threats and issues, with a high degree of success. The near certainty of further major damage to the nesting islets from severe hurricanes and sea-level rise is now considered to be the greatest single threat to the continued survival of the Cahow. This threat cannot be fully addressed on the original tiny nesting islets, and so the establishment of new nesting colonies on larger and more elevated islands, which are managed to exclude mammal predators and have controlled human access, is considered to be a top priority.



Fig. 3: Flooding and erosion from hurricanes are a serious threat to the Cahow; nesting islet partly submerged by waves from hurricane Igor, Sept. 2010

2. OBJECTIVES OF CAHOW RECOVERY PROGRAM:

The Cahow Recovery Program was first initiated around 1960 by conservation officer David Wingate, to conserve the species and find methods to help the Cahow population recover. This program has continued under the present conservation officer since 2000. The short and long-term objectives of the program are covered in full in the Cahow Recovery Plan (Madeiros, 2005). Briefly put, they are outlined as follows:

- (1) To prevent nest competition with the White-tailed Tropicbird (Longtail) *Phaethon lepturus catsbyii* through the provision of ‘baffle’ plates fitted on the entrances of all Cahow burrows.
- (2) To regularly monitor all nesting and nearby islands for the presence of rats (*Rattus rattus* and *R. norvegicus*) and, when their presence is detected, to eradicate them by the use of anticoagulant rodenticide.

- (3) To learn more about the breeding biology of the Cahow through an ongoing banding program initiated in 2002 (see Fig. 4); also by a project carrying out growth studies of Cahow chicks from hatching until fledging to sea (a scientific paper describing the breeding success and population growth rate of the Cahow has been produced from the results).
- (4) To foster a increased understanding and knowledge of Bermuda's National Bird to the public through newspaper and magazine articles, public and school talks and lectures, and the publication of scientific articles and papers; also through carefully managed "Cahow encounters" at the new colony on Nonsuch Island during the nesting season.
- (5) To establish new breeding colonies of Cahow on larger, higher islands free of mammal predators which are safer from hurricane damage and erosion, and can support larger numbers of the birds. This is already underway on Nonsuch Island, using the translocation of near-fledged chicks and sound attraction.
- (6) To continue a program of building additional artificial concrete nest burrows to support ongoing increase in the Cahow breeding population.
- (7) To carry out studies of the oceanic range of the Cahow away from the nesting islets, using miniature archival geolocational data loggers which record daily position fixes, fitted to the legs of selected birds for periods of up to 2 years.

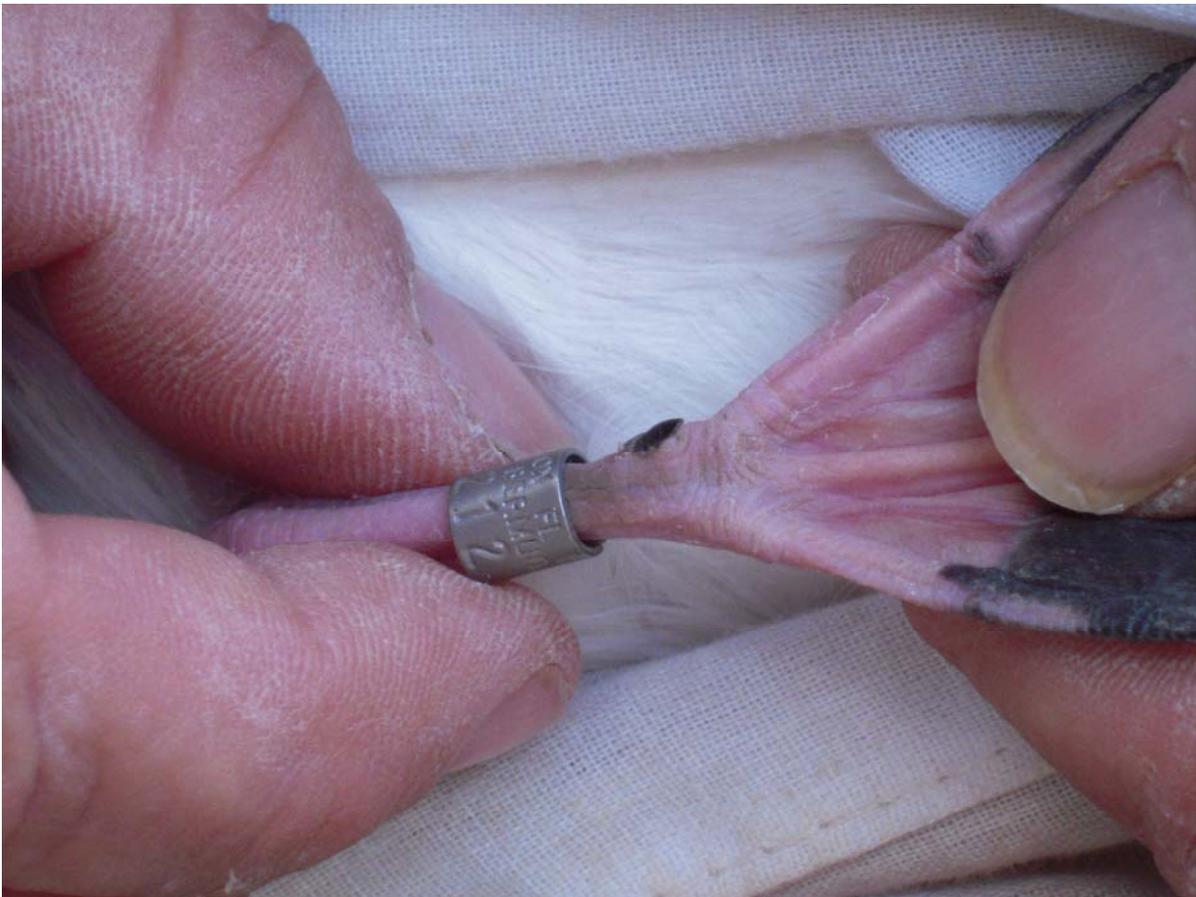


Fig. 4: Fitting "incoloy" identification band to leg of Cahow

3. SUMMARY OF 2010 CAHOW NESTING SEASON:



Fig. 5: 2-month old Cahow chick removed from burrow for measurement

The 2010 nesting season of Bermuda's national bird, the Bermuda petrel or Cahow (*Pterodroma cahow*) has seen the highest numbers of nesting pairs and successfully fledged chicks to be recorded in a nesting season since the rediscovery of the species in 1951 (see Fig. 5). The intensive Recovery and Management program for the species has enabled the Cahow to increase from a total breeding population of 18 pairs producing 8 chicks annually in 1960, to a new record high of 92 nesting pairs producing 52 successfully fledged chicks in 2010.

There were a number of highlights for this nesting season, which extended from mid-October 2009 with the first arrival of breeding adults on the nesting islets, until mid-June 2010 with the departure to sea of the last fledging Cahow chicks. These include the following:

- (1) New nesting pairs of Cahows established at three of the four original nesting islets, to the point where most available nest burrows have been occupied and it will be a priority to build new artificial nest burrows at one or more of these islands within the next year or two;

- (2) The project to establish a new nesting colony at the more storm-resistant Nonsuch Island Nature Reserve reached another milestone when the second chick from this colony hatched. The parents of this chick were originally translocated to Nonsuch as chicks and fledged to sea in 2005, and first returned to nest in 2008. This second chick, which became known as ‘Bermudiana’, developed normally and went on to fledge successfully to sea by June,2010 (see page 16);
- (3) Data was recovered from 9 archival geolocational data loggers that had been fitted to adult Cahows during 2009, greatly increasing the known foraging range of the species in the North Atlantic Ocean (see page 17).
- (4) A record number of 52 chicks successfully fledged from a total of 92 nest sites (see Fig. 7) with confirmed nesting activity (56.52 % breeding success). In addition, prospecting or pre-nesting activity was recorded at a total of 10 new nest sites, including 3 nest sites on Nonsuch Island.
- (5) A banding program for the Cahow has resulted in a total of over 300 birds being fitted with incoloy identification bands, including 32 Cahows being banded during the 2010 season (see section 7). Information provided by these bands has enabled a scientific paper to be produced on the breeding biology of the Cahow.

Following is a brief summary of the nesting season:

Total number of occupied nest sites with nesting activity confirmed:	92
Number of new nest sites with prospecting activity but no eggs/chick produced:	11
Total number of confirmed successfully fledging Cahow chicks:	52
Total number of active nest sites with unsuccessful nesting:	40
Number of confirmed failures from nest sites with observable nest chambers:	38

Breakdown of causes of breeding failure from nests where observation of nest chambers was possible:

Chick died hatching	2
Chick died later in development	7
Broken or pipped eggs	7
Non-hatching / infertile eggs	11
Egg buried / knocked off nest	8
Egg washed off nest by storm waves	1
Egg disappeared late in incubation; Land Hermit Crab predation?	2



Fig. 6: Adult Cahow on nesting island

4. Breakdown of Cahow Breeding Season Results by Nesting Island:

4.1. LONG ROCK

Active burrows with nesting confirmed (eggs laid and/or chicks hatched)	13
New nest burrows prospected by confirmed pairs	0
Nest burrows with successfully fledged chicks confirmed	9
Nest burrows with confirmed failed nesting (egg failed or chick died)	4

4.2. INNER PEAR ROCK

Active burrows with nesting confirmed (eggs laid and/or chicks hatched) 18
New nest burrows prospected by confirmed pairs 1
Nest burrows with successfully fledged chicks confirmed 10
Nest burrows with confirmed failed nesting (egg failed or chick died) 8

4.3. GREEN ISLAND

Active burrows with nesting confirmed (eggs laid and/or chicks hatched) 21
Nest burrows prospected by confirmed pairs 2
Nest burrows with successfully fledged chicks confirmed 12
Nest burrows with confirmed failed nesting (egg failed or chick died) 9

4.4. HORN ROCK

Active burrows with nesting confirmed (eggs laid and/or chicks hatched) 36
Nest burrows prospected by confirmed pairs 5
Nest burrows with successfully fledged chicks confirmed 20
Nest burrows with confirmed failed nesting (egg failed or chick died)16

4.5. NONSUCH ISLAND

Active burrow with nesting confirmed (eggs laid and/or chicks hatched) 4
Nest burrows prospected by confirmed pairs 3
Nest burrow with successfully fledged chick confirmed 1
Nest burrow with confirmed failed nesting (egg failed or chick died) 3

Number of Breeding Pairs and Reproductive Success of the Cahow from 1961 to 2010

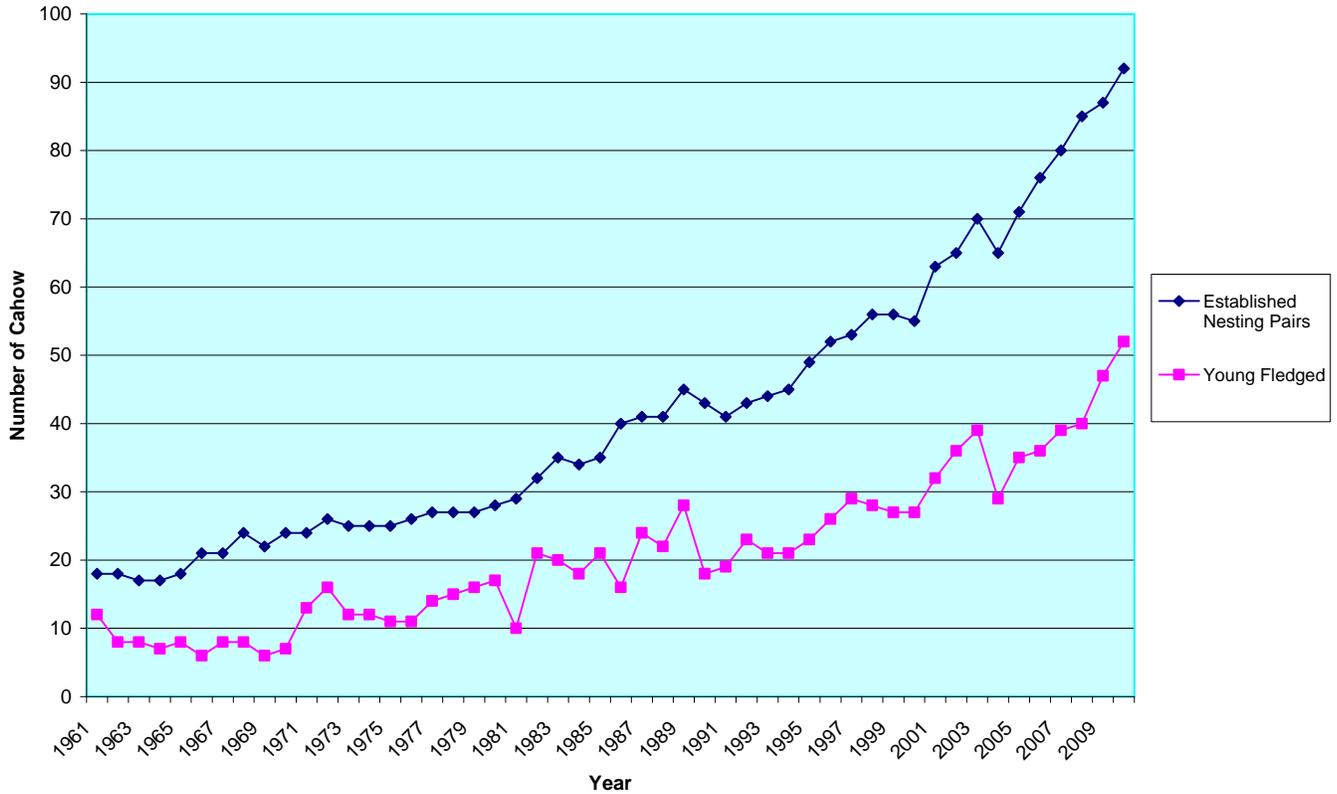


Fig. 7: Chart showing total numbers of breeding pairs and fledged chicks of Cahow from 1961 to 2010

(5) Report on Progress of New Nesting Colony at Nonsuch Island:

As previously stated, there has been an ongoing project since 2004 to establish a new breeding colony of Cahow on the Nonsuch Island Nature Reserve, which is larger and more elevated than the original tiny nesting islets that the Cahow had been confined to since its rediscovery in 1951. Between 2004 and 2008, a total of 105 Cahow chicks were translocated or moved from the nesting islands to a group of artificial nest burrows constructed on Nonsuch. They were then fed daily on fresh fish and squid (see Fig. 8) until mature, and then allowed to emerge at night to exercise and imprint on their surroundings until they fledged out to sea. A total of 102 Cahow chicks eventually fledged successfully out to sea.

There has been a project since 2002 to fit identification bands to most Cahow chicks while they are still in the nest so that individual birds can be followed through their lives after fledging. One of the findings of this project is that Cahow fledglings normally spend 3 to 5 years out at sea before they mature and return to the site that they had originally

fledged from. The first surviving translocated Cahows were therefore expected to return to the Nonsuch site around 2008, and in fact four birds translocated to Nonsuch in 2005 were recaptured back on Nonsuch as adults in 2008, prospecting in some of the same nest burrows that they had originally been moved to. By the 2009 nesting season, over 12 Cahows had been confirmed as returning to Nonsuch, with some of these birds forming breeding pairs in burrows. One of these pairs produced the first chick to hatch on Nonsuch since the 1620s. This chick, known as ‘Somers’, became the subject of national and international media interest before fledging successfully to sea in June, 2009.



Fig. 8: Translocated Cahow chick being fed fresh Anchovy on Nonsuch Is.

For the 2010 nesting season, the newly established nesting colony on Nonsuch Island has continued to grow as more of the Cahows originally translocated as chicks continue to return to Nonsuch Island as adults. By the end of this nesting season, a total of 18 Cahows had been confirmed as having returned to the new colony site on Nonsuch, of which 1 was translocated in the 2004 nesting season, 9 in the 2005 season, 6 in the 2006 season and 1 in the 2007 season. In addition, 1 non-translocated Cahow from the 2005 season paired up with a returned translocated bird in one of the nest burrows. During this year, a total of 7 nesting pairs have built nests in artificial burrows at this site. Four of these pairs produced eggs in 2010, and although only one egg hatched, this produced the second chick, called ‘Bermudiana’, to hatch on Nonsuch island since the 1620s (see Fig. 9). This chick fledged successfully to sea on the night of June 7, 2010.

The objective of establishing a new nesting colony of Cahows on the higher and larger Nonsuch Island Nature Reserve can therefore already be considered a success. With 7 pairs already establishing at the new colony and 2 chicks fledged from the site, the new colony already supports more Cahows than most of the original nesting islets did when management and recovery efforts began in the early 1960s. With more Cahows likely to return over the next few years from the later translocation Cohorts, it is very hopeful that this colony will continue to grow and provide the Cahow with a safe nesting habitat that is able to accommodate a growing population.



Fig. 9: “Bermudiana”, the second Cahow chick to hatch at new Nonsuch Island nesting colony, at 45 days of age (half-fledged).

6. Results from Oceanic Range Study of Cahow Using Archival Data Loggers:

Perhaps the most important development for the 2010 Cahow breeding season was the retrieval of data from the first year's deployment of archival geolocational data loggers or tags, which had first been fitted on selected Cahows during January to April 2009. These loggers are manufactured by Lotek Wireless of New Brunswick, Canada and are miniaturized units measuring 31.9mm long by 8.4mm wide and only 4.7 grams in weight. They are fitted to the legs of selected adult Cahows by means of small plastic 'zip-ties', fitted around low friction split-rings to prevent chaffing to the legs (see Fig. 11).

The Australian Seabird specialist Nicholas Carlile was invited to Bermuda for 15 days in late January, 2009 to instruct the Terrestrial Conservation Officer in the programming, installation, and downloading of these data loggers, as well as instructing staff in the use of a burrow-scope with which to visually check the deepest, previously inaccessible Cahow nest burrows (approximately 18 in number, making up about 20% of the breeding population). He also instructed the conservation officer in non-invasive methods of sexing Cahows, mainly by external cloacal examination of adult birds after the egg-laying period.



Fig. 10: Adult Cahow with archival geolocational data logger attached to leg.

By June, 2010, out of 12 data loggers originally deployed on individual Cahows, 10 had been recovered with 9 of these giving good information on the daily location of the birds for periods ranging from 6 weeks to well over 12 months. In addition to daily location, these units also provide information on water temperature every time the birds land on the water surface. Once the information has been downloaded into a laptop computer, the units can then be reset to free up their memory storage and continue gathering data, with each unit being good for up to 2 years. Accordingly, the terrestrial conservation officer was able to take his laptop computer out to the nesting islands in a Pelican waterproof carrying case to download data directly from the loggers without the need to remove them from the birds. Once the data was downloaded, the loggers were reset to continue gathering data from the same birds to determine the at-sea ranges and foraging areas of individual birds over more than one nesting season.

The location data recorded by these units was used by Ms. Mandy Shailer to make a series of maps showing the travels of individual Cahows around the North Atlantic Ocean during different phases of both their breeding and non-breeding seasons. The information recorded has completely revolutionized the understanding of the pelagic (at-sea) range of the Cahow and the distances that Cahows travel when foraging for food, both to feed the chicks and to provision themselves. It has also indicated several concentration points where a significant percentage of the population concentrates at different times of the year.



Fig. 11: Attaching Lotek LAT 2500 archival data logger to leg of Cahow.

Following are outlines of some of the new findings from the first year's use of data from the Lotek archival geolocational data loggers:

- Cahows appear to use strong winds around storm systems to 'slingshot' them to cover greater distances than they could efficiently achieve using their own energy, and in so doing, can travel distances of up to 400 – 500 miles in one day;
- Cahows regularly travel to, and apparently feed in, much cooler water temperatures than previously thought, especially in winter and early spring when they are feeding young chicks; some birds were recorded in water temperatures in the low 40s F, off the coasts of Newfoundland and Nova Scotia and even near the edge of pack ice in the St. Lawrence Seaway during January to March, 2009 (see Fig. 13).
- The shortest provisioning (food-gathering) trip recorded for a Cahow was about 1625 miles, lasting 8 days; the longest trip was over 10,000 miles, lasting 22 days;
- There seem to be three main concentration points where Cahows repeatedly gather to forage for food during the chick provisioning period, those being the waters off North Carolina and Cape Hatteras (see Fig. 12), the waters south and east of Nova Scotia and Newfoundland in Canada (see Fig. 13), and the central Atlantic northeast of Bermuda.
- Data was received from six data loggers during the non-breeding, summer season (June to October) which revealed that the Cahow appears to have two distinct foraging areas at this time. Two-thirds (4) of the birds tracked during this period spent part or all of their time in the vicinity of the Azores Islands (see Figs. 14, 15 and 16), over 2500 miles from Bermuda. In contrast, the other one-third (2) of the birds spent virtually their entire year west and north of Bermuda, never travelling more than 900 miles from the island.
- The total distances travelled by individual Cahows during the course of a year were spectacularly longer than originally thought. Of four birds which were tracked for periods of 12 or more months, the minimum distance travelled was 40,119 miles (64,566 Km), while the longest distance recorded was an amazing 81,559 miles (131,257 Km (see Table 1, and Fig. 16).

Each of the Lotek LAT 2500 data loggers have sufficient battery power to store up to two years worth of data; at the writing of this report, the loggers were just beginning to be recovered from birds for downloading of the second year of data. For the next, 2011 nesting season, it is planned to fit 12 new data loggers which are the updated LAT 2700 'Nano' model. This new logger is less than half the size and weight (only 2.2 g compared to the 4.7 g of the original loggers).

Table 1: summary of archival logger data during first year of tracking project

Lotek Tag Number	Cahow band #, sex & nest #	Track # 1 (dates of tracking period and total distance travelled)	Track # 2 (if applicable)
0769	Band # E0232 (female) Long D7	9/Jan/09 to 19/Jan/09; to North Carolina offshore waters; 1,625 miles (2,615 Km)	9/Jan/09 to Jan 2010; to Azores Islands non-breeding; Total distance travelled 81,559 miles (131,257 Km)
0770	Band # E0094 (female) Horn B3	14/Jan/09 to 23/Jan/09; north to area 200 miles east of Cape Cod; 2,057 miles (3,311 Km)	29/Mar/09 to 21/Oct/09; to West European waters & Azores non-breeding season; 40,119 miles (64,566 Km)
0772	Band # E0191 (female) Horn F3	15/Jan/09 to 25/Jan/09; northeast to area south of Nova Scotia; 2,908 miles (4,680 Km)	05/Feb/09 to 06/Mar/09; to offshore areas around Nova Scotia, Newfoundland & the Gulf of St. Lawrence; 3,898 miles (6,683 Km)
0773		25/Jan/09 to 07/Feb/09; (Incubation off-shift – to coastal North Carolina); 3,164 miles (5,092 Km)	
0775	Band # E0029 (male) Horn C11	29/Jan/09 to 04/Feb/09; Incubation off-shift; to north of Bda; 1,467 miles (2,361 Km)	19/Mar/09 to 06/Apr/09; Feeding trip to Grand Banks; 4,574 miles (7,362 Km)
0776	Band # E0130 (male) IPO D3	19/Jan/2009 to 16/Jan/2010; 12-month dataset; to Azores Islands non-breeding season; 62,047 miles (99,856 Km)	
0777	Band # E0131 Horn C22	27/Feb/2009 to 16/Jan/2010; 12-month dataset; bird spends breeding & non-breeding seasons to west and north of Bermuda; 54,607 miles (87,881 Km)	
0778	Band # E0096 (male) Horn C13	April 2009 to November 2009; 7-month dataset; briefly to Azores Is non-breeding, then northwest of Bermuda; 63,659 miles 102,450 Km	
0779	Band # E0040 Horn C15	Data not useable	
0780	Band # E0197 (female) Horn C13	Data not useable	

Post Egg-Laying Feeding Trips for 3 Female Bermuda Petrel (*Pterodroma cahow*)
January 2009

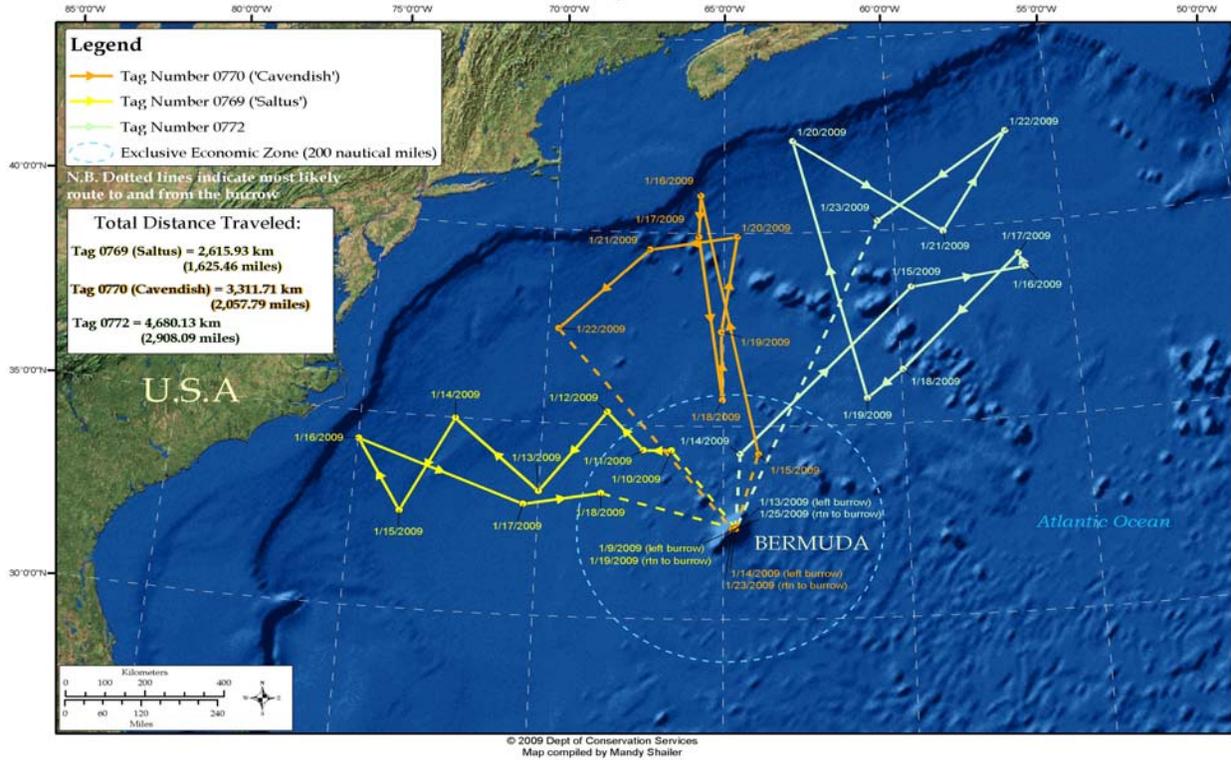


Fig. 12: “Off-shift” trips of 3 female Cahows during egg incubation period

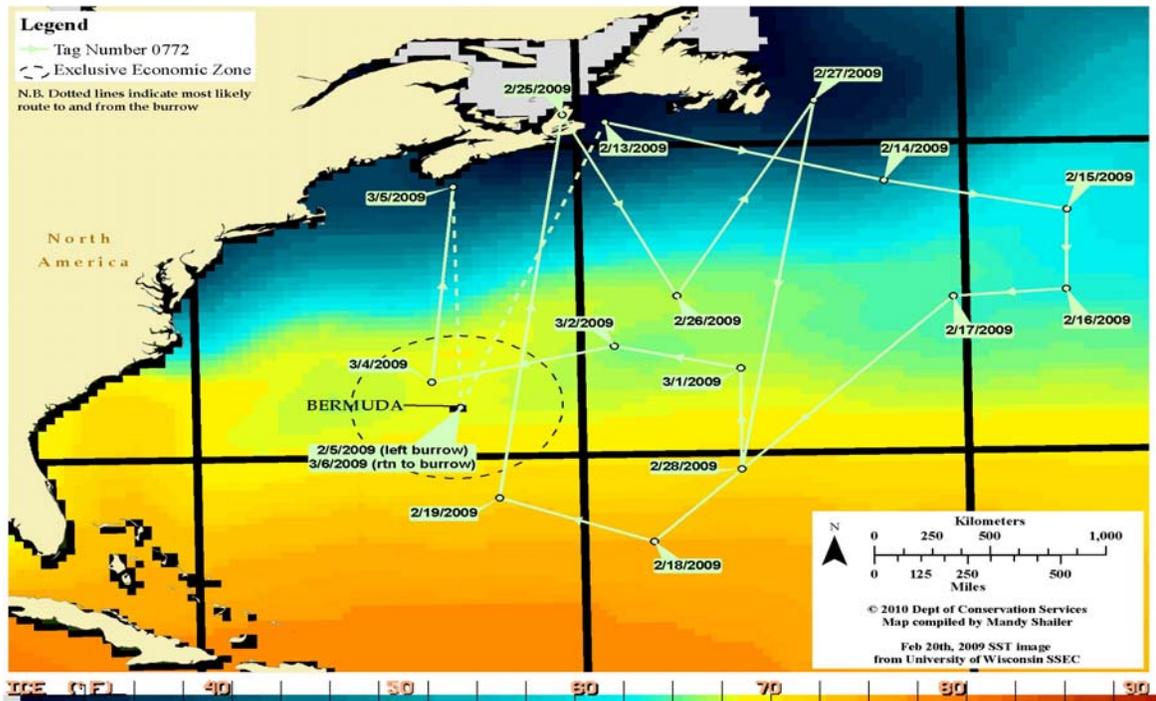


Fig. 13: Feeding trip of Cahow during egg incubation, showing sea temperatures

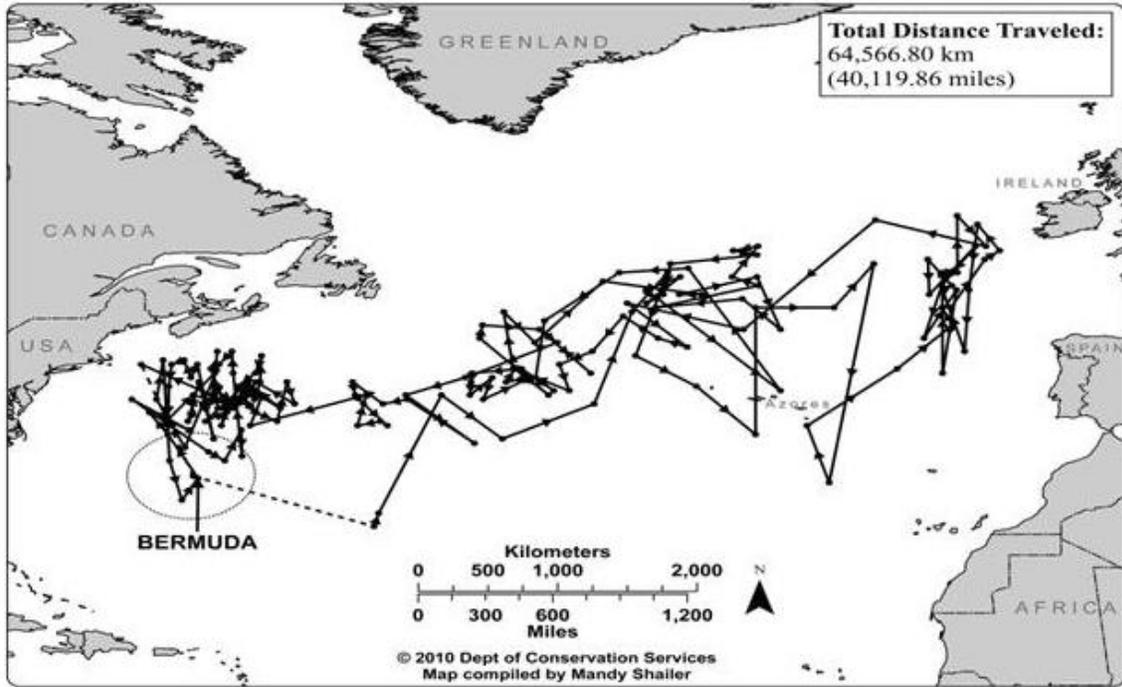
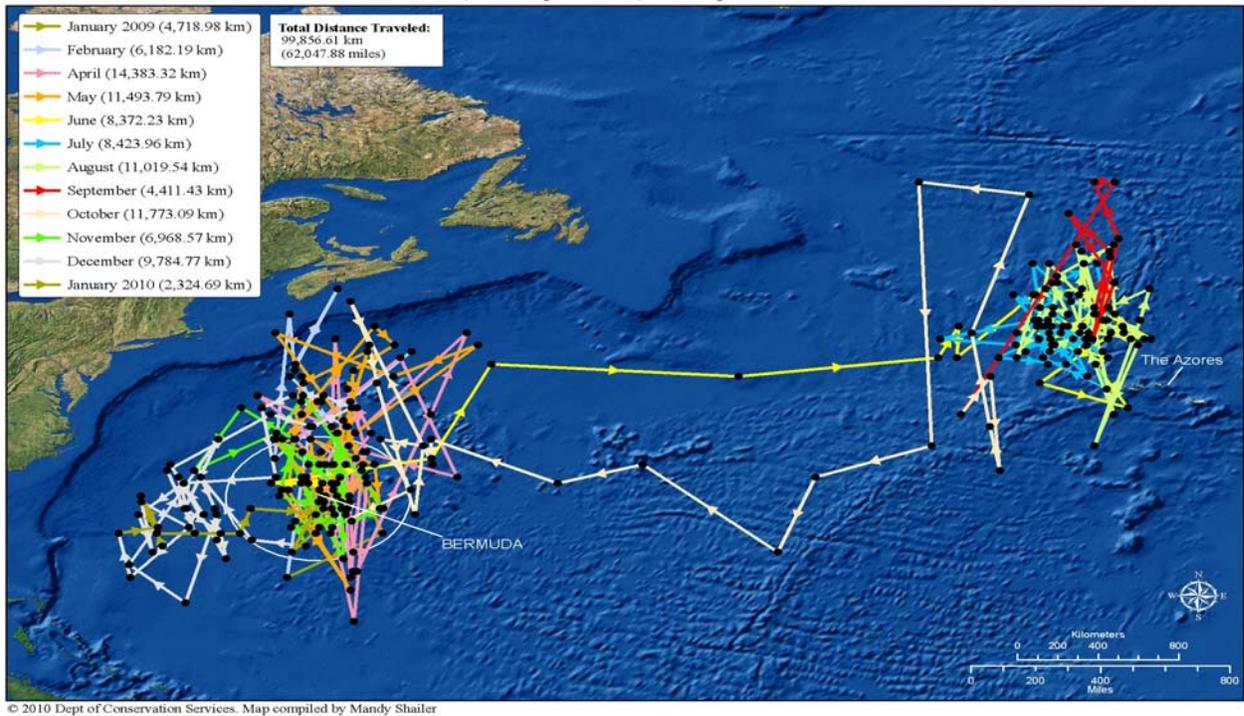


Fig. 14: Track recorded by 0769 logger on Cahow during summer period

**Geolocalational Data from Lotek 2500 0776 Tag
January 2009 - January 2010**



**Fig.15: Track followed by Cahow fitted with data logger over 12-month period
ery that this project has demanded.**

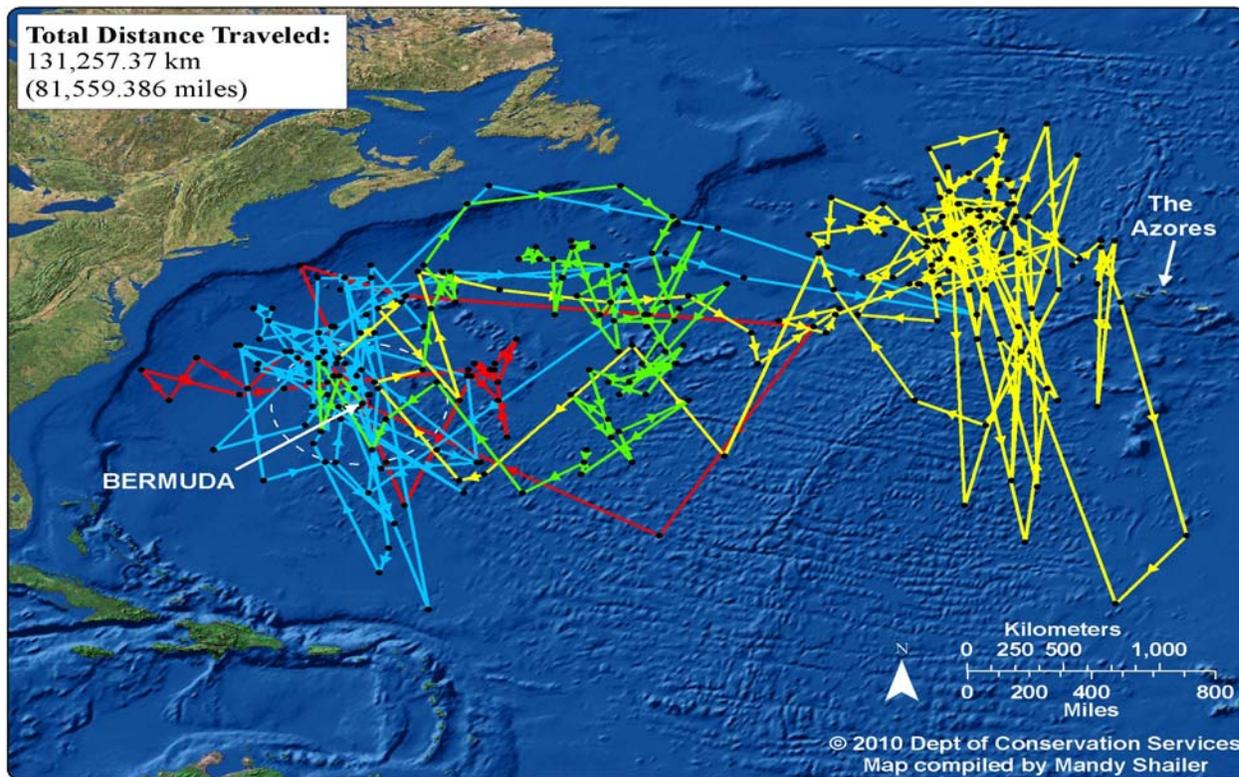


Fig. 16: Longest track recorded of Cahow by data logger # 0770 over 12-month period

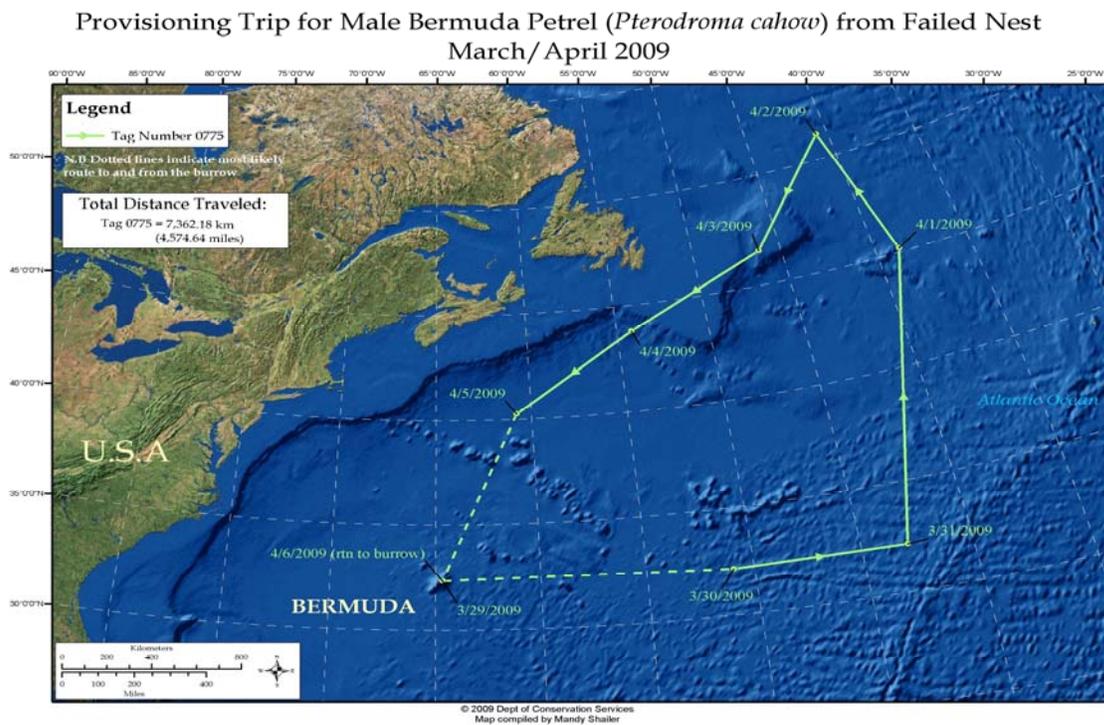


Fig. 17: Single feeding trip for male Cahow (Logger # 0775) to Grand Banks

7. UPDATE ON CAHOW BANDING PROGRAM - 2010

There has been a program in place since 2002 to fit identification bands or rings onto the legs of as many breeding adult Cahows as possible, and on a target figure of at least 75% of all fledglings produced by the population if possible. Birds are fitted with 5.5mm metal bands (see Fig. 4) made of a strong, corrosion-resistant alloy called incoloy, which can last in excess of 30 years, or most likely for the life of the birds. These bands were made especially for Bermuda by Porzana Ltd (U.K. Wetlands Trust affiliation) in the United Kingdom, who also provides the Terrestrial Conservation Division with bands for Tropicbirds, Common terns and Green Herons. Adult Cahows are fitted with bands on their right legs where their age is not known, and fledglings and other known-age birds are banded on their left legs for easy identification in the field.

These bands enable individual Cahows to be positively identified for the first time, and recaptures of the same birds over consecutive years enable them to be followed for essentially their entire breeding lifespan.

Some of the statistics and details of Cahow breeding biology revealed by this program are outlined as follows:

- For the nine years to date of this program, a total of 374 Cahows have been fitted with these identification bands, including 111 birds banded as breeding adults (over 57 % of the adult breeding population), and 263 birds banded as chicks still in their burrows. This is already providing very valuable information on the survival rates of Cahow chicks between the time they leave their burrows and fledge out to sea, to the time that they return as sexually mature young adult birds, and also at what age they return for the first time to choose mates and nest burrows.
- As a direct result of this program, we now know that Cahows first return to the nesting grounds at 3 to 5 years of age. Males tend to return first, at 3 to 4 years, although at least 2 have returned as early as 2 years after fledging, while females first return at 4 to 5 years of age.
- This information can be used to determine the survival rates of chicks from each breeding season. For example, a total of 170 chicks were banded up to 2007, and were old enough to return during the 2010 season. Out of these 170 birds, a total of 60 have been confirmed as returning to the various nesting islands, giving survival and return rates of between 28% to over 50% of chicks fledging in any particular year.
- Survival and return rates appear to be higher for chicks originating from some nesting islands than from others; for example, a consistently higher percentage of chicks fledging from Green Island and Inner Pear Rock survive to return as adults than from Horn Rock and Long Rock. The reason for this discrepancy is presently unknown.

9. FURTHER MANAGEMENT ACTIONS PLANNED FOR FUTURE:

At the writing of this report, the next, 2011 Cahow breeding season was well underway, with many birds already incubating recently laid eggs. Following are some of the ongoing management actions planned for the future for the Cahow recovery Program:

2011 Nesting Season:

- Recovery of second year of tracking data from Lotek LAT 2500 archival geolocational data tags; deployment of 12 smaller and more accurate LAT 2700 data tags on selected adult Cahows;
- Production of paper on results of data tags, for submission to peer-reviewed scientific journal;
- Construction of at least 15 new artificial Cahow nest burrows at second, “B” site on South Hill of Nonsuch Island, using proven translocation of near-fledged chicks and sound attraction techniques;
- Continue banding program, with goal of at least 75% of chicks produced being fitted with identification bands;
- Complete documentary of establishment of new Cahow colony on Nonsuch with LookTV television station;
- Start 5-year review of Cahow Recovery plan 2005;
- Continue monitoring of nesting islands for presence of rats; set out rodenticides when necessary;
- Install new artificial nest burrows for Cahows at nesting colonies where appropriate.

2012 Nesting Season:

- Start establishment efforts for second nesting colony on Nonsuch with planned translocation of 25 Cahow chicks to “B” colony site on South Hill;
- Retrieve and download data from Lotek LAT 2700 “NANO” archival data loggers fitted to 12 adult Cahows;
- Continue Cahow banding program;
- Continue monitoring nesting islands for rats; set out rodenticides when necessary;
- Continue installation of additional artificial nest burrows at nesting colonies.

2013 -15 Nesting Seasons:

- Continue translocations of near-fledged Cahow chicks from nesting islets to “B” colony site on Nonsuch Island, moving 25 – 30 chicks annually until a target figure of 75 to 90 chicks have been moved and have fledged from Nonsuch;
- Install 2nd Sound Attraction system at new “B” colony site on Nonsuch Island. And play disk of Cahow courtship calls during breeding season;

- Continue Cahow banding program;
- Continue monitoring nesting islands for rats; set out rodenticides when necessary;
- Continue installation of artificial nest burrows at nesting colony sites.

10. ACKNOWLEDGEMENTS:

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I am deeply indebted to the Terrestrial Conservation Crew for their work in building the artificial nest burrows for Cahows, both on Nonsuch Island and the smaller nesting islets, which have enabled the nesting population of Cahows to increase to the present extent. This labor-intensive and risky job has involved landing thousands of pounds of concrete on the isolated nesting islets in often rough conditions, and transporting it to the top of the cliffs on these islets. The Conservation Crew consists of Barry Smith (Foreman), Kiwon Furbert, Hillgrove Iris and Marvin Jones.

Much of the research work carried out for the Cahow Recovery Project has only been possible because of donations given by individual members of the public, businesses and organizations; in particular, the geolocational tracking project has been made possible entirely through donations. We are deeply grateful for the interest and generosity shown by all of these donors, who have made possible many of the advances in the understanding and conservation of Bermuda’s unique National Bird.

Finally, I would like to specially mention my wife, Leila Madeiros, and children Seth and Elizabeth for their support and patience over the last 10 years, with apologies for the amount of my time and energy that this project has demanded.