

**CAHOW RECOVERY PROGRAM
For Bermuda's Endangered National Bird
2016 – 2017 Breeding Season Report**



BERMUDA GOVERNMENT

**Compiled by: Jeremy Madeiros, Senior Conservation Officer
Terrestrial Conservation Division
Department of Environment and Natural Resources
*"To conserve and restore Bermuda's natural heritage"***

RECOVERY PROGRAM FOR THE CAHOW
(Bermuda Petrel) *Pterodroma cahow*

BREEDING SEASON REPORT
For the Nesting Season (October 2016 to June 2017)
Of Bermuda's Endangered National Bird



**Fig. 1: Pair of courting Bermuda petrels (Cahows) at sea off Nonsuch Island
(Kate Sutherland)**

Cover Photo: Adult Cahow in flight
At sea 5 miles southeast of Coopers Island
(Kate Sutherland)

2016 - 2017 Report on Cahow Recovery Program
Compiled by: Jeremy Madeiros
Senior Terrestrial Conservation Officer

CONTENTS:

Page No.

Section 1: Executive Summary:	5
Section 2:	
(2a) Management actions for 2016-2017 Cahow breeding season:	7
(2b) Cahow Recovery Program – summary of 2016/2017 breeding season:	11
(2c) Breakdown of breeding season results by nesting island:	12
Section 3:	
(3a) Update on original (A) breeding colony on Nonsuch Island:	14
(3b) Results for fifth year of 2nd translocation project on Nonsuch island:	17
(3c) Cahow Recovery Program – Public Outreach/Education:	20
Section 4:	
(4a) Future management actions and research:	23
(4b) Acknowledgements:	24
(4c) References:	25

List of Figures

Page no.

Cover photo: Adult Cahow in flight at sea 5 miles off Coopers Island:	(K. Sutherland)
Fig. 1: Pair of courting Cahows at sea off Nonsuch Island (K. Sutherland):	(2)
Fig. 2: 10-day old Cahow chick from Nonsuch R817 nest, March 2017:	(7)
Fig. 3: Cahow chicks on Nonsuch Island at 12 weeks of age and 1 week of age:	(9)
Fig. 4: Number of nesting pairs and fledged young over 56 - year period:	(10)
Fig. 5: Breeding adult Cahow being measured on Nonsuch Island (J. P. Rouja):	(14)
Table 1: Breeding results at new nesting colony on Nonsuch 2009-2016:	(15)
Table 2: Annual breeding success by nest at Cahow (A) nesting colony:	(16)
Table 3: Summary of 2017 Cahow Translocation Project Results:	(18)
Fig. 6: Translocated Cahow chick being fed with Anchovy by Lizzy Madeiros:	(19)
Fig. 7: Adult Cahow feeding chick in nest burrow, viewed on “Cahow-Cam”:	(20)
Fig. 8: Cahow presentation being given to Saltus Cavendish Primary 1 school group: ..	(22)
Fig. 9: School tour group viewing Cahow chick on Nonsuch island, April 2017:	(22)
Fig. 10: Translocated Horn Rock F7 Cahow chick being readied for feeding at B site: ..	(26)

- Cover photo & Fig.1 by Kate Sutherland; Fig. 2 by David Liittschwager; Fig. 4 by Leila Madeiros; Figs. 3, 5 & 7 by JP Rouja; Fig. 8 by Cynthia Barnes; Fig. 9 by Camilla Stringer; Figs 6 & 10 by Jeremy Madeiros

SECTION 1:

1(a): EXECUTIVE SUMMARY:

Key Words: Burrow-cam, Cahow, New Colony, Nonsuch Island, Translocation.

The Cahow Recovery Program is a long-term management, research and recovery program for Bermuda's National Bird, the critically endangered Cahow, or Bermuda petrel (*Pterodroma cahow*), which is one of the rarest seabirds on Earth. The primary objective of this program is to increase the Cahow's breeding population through control of threats to the species, construction of artificial nesting burrows, and the establishment of entirely new nesting colonies. A secondary objective is to promote public education and understanding of the importance of the Cahow to the history and environment of Bermuda.

The Cahow is endemic to the Islands of Bermuda and was originally abundant, possibly numbering more than half a million birds. It was catastrophically affected by the colonization of the island by English settlers in the early 1600s, due both to direct hunting by the settlers and by their introduction of invasive predators such as Rats, Cats, Dogs and Pigs. After less than 12 years of settlement, the Cahow by the 1620s was thought to be extinct, a belief that persisted for almost 350 years until the rediscovery in 1951 of a tiny remnant population on four small offshore islets (Murphy & Mowbray, 1951).

The recovery program has been in place since 1960 and has been successful in addressing most of the threats to the Cahow. This program was administered by Dr. David Wingate until his retirement in 2000, and has since been administered by the author of this report. This program has enabled the breeding population to increase from only 18 pairs producing a total of 8 chicks annually in the early 1960s to a record number of 117 breeding pairs in 2017, producing a record total of 61 successfully fledged chicks.

Major threats to the Cahow include erosion and flooding of the original nesting islets from hurricane activity, predation by invasive Rats swimming to the islets, insufficient habitat and suitable deep nest burrows or rock crevices, and nest-site competition with the Longtail or White-tailed Tropicbird *Phaethon lepturus catsbyii*.

Following are some of the highlights for the 2017 Cahow nesting season:

- **The new nesting colony of Cahows established on Nonsuch Island** by the translocation of chicks between 2004 and 2008 has continued to grow, with 16 pairs established in nest burrows and laying eggs. In 2017, 8 chicks hatched and successfully fledged out to sea, bringing the total number of chicks produced by this colony since 2009 to 54.
- **The total breeding population of the Cahow has increased to a record number of 117 nesting pairs** (pairs that produced an egg, whether it hatched or not), compared to 115 pairs in the 2015-2016 breeding season.

- **The number of successfully fledging chicks in 2017 increased to a record number of 61**, compared to 56 during the 2016 nesting season. This represents continued recovery from the loss of 5 established breeding pairs and widespread damage to nest burrows during hurricane “Gonzalo” on October 17th, 2014.
- **The second translocation of Cahow chicks to Nonsuch continued at the ‘B’ colony site**, approximately 200m east of the ‘A’ colony site. A total of 14 Cahow chicks were translocated from three of the original nesting islets to artificial nest burrows at the B site and hand-fed on fresh Anchovies. **13 of these chicks fledged successfully out to sea.** Coupled with 51 Cahow chicks already translocated to this site between 2013 and 2016, this makes a total of 64 Cahow chicks that have now fledged successfully from this site.
- **The infrared “Cahow-cam”** developed by JP Rouja of LookTV with financial assistance from the Ascendant Group of Companies has been a resounding public outreach success, and **was further improved in 2017 through a new partnership with the Cornell Bird Lab.** This involved the installation of a new infrared camera which gave much better views of the nesting birds, enabling school groups and the public to follow the nesting activities of Cahows in a underground burrow on Nonsuch Island, including the hatching of a Cahow chick on 4th March, 2017. The burrow-cam then followed the development of the chick until it fledged out to sea around June 6th. This website can be accessed at **www.nonsuchisland.com**

To summarize, the Cahow Recovery Program has continued to achieve both its primary objective of increasing the Cahow breeding population, and secondary objectives of establishing new nesting colonies and increasing public outreach and education. This is despite ongoing threats to the breeding population during the 2016-2017 nesting season, including a direct hit by hurricane “Nicole” in October 2016, and the invasion of Nonsuch Island by rats, a known predator on Cahow chicks. Regular annual monitoring of the entire breeding population has proved to be indispensable for rapid identification and management of threats as they arise.

Full details on the 2016 – 2017 breeding season are given in the following report, in addition to research and management proposals for the next two seasons.

Section 2(a): Management actions for 2017 Cahow breeding season:



Fig. 2: 10-day old Cahow chick from Nonsuch R817 nest burrow, March 2017 (D. Liittschwager)

Shortly before the start of the 2016-2017 Cahow nesting Season, Bermuda received a direct hit from Hurricane “Nicole” on October 13th 2016. Nicole approached Bermuda from the south-southwest with Category 4 winds sustained at 144-145 mph just 24 hours before hitting the island, but luckily lost strength rapidly before hitting the island with sustained winds of 103 mph, gusting to 136 mph.

Despite being a direct hit, with the calm “eye” of the hurricane passing directly over the island, the storm hit at extreme low tide, minimizing the impact on the Cahow nesting islands. Upon inspection, there was surprisingly little damage to most nesting islands, although both Green Island and Long Rock were partially submerged under large waves. Many the heavy concrete nest lids (that can be removed to permit inspection of the nest burrows and removal of the nesting birds for banding and measurement) were dislodged from the nests here, and several were washed overboard from Green Island. Most of these were recovered, but three new lids had to be made from poured concrete. Storm debris, rocks and mud swept in by the waves also had to be removed from burrows on the two islands. All other nesting islands were relatively unaffected by the hurricane, except for Inner Pear Rock, which lost a large section of cliff. This has made it very difficult to access several of the Cahow nest burrows on the island.

Following is a review of the events and management / research work carried out for the Cahow Recovery Program through the 2016-2017 breeding season:

- (1) The breeding season began with preparatory work for the upcoming Cahow nesting season in early October, including the setting out of rat bait on all nesting islands, unblocking of nest burrows, removal of entrance Tropicbird baffles etc. In addition, replacement of several nest lids washed off nests by large waves from hurricane “Nicole”, and clearing out of debris washed into burrows by the storm had to be carried out on some of the nesting islets.
- (2) The first Cahows were recorded returning from the open ocean to their nesting burrows on the 18th October 2016, with all back by the second week of November. During late October and November 2015, a total of 98 adult Cahows were removed briefly from nests to check band numbers, body condition and weight.
- (3) The first Cahows returned to the nesting islands from a one-month pre-egg laying exodus in January 2017, with the first eggs confirmed on the 2nd January. During the egg incubation period, which lasts about 53 days, an additional 57 of the incubating adults were checked to determine sex, weight and band numbers.
- (4) The first Cahow chick hatched by the 22nd February, 2016, with the last confirmed by the end of March. Some of these had to be confirmed in deeper natural nests by using an infra-red “burrow-scope.” Once all chicks had hatched, a sub-sample of 40 chicks were chosen which were then checked at least twice weekly, weather conditions permitting, for weight, wing chord length, and plumage development. This information is essential in identifying when chicks chosen for translocation, are at the optimal stage of development to be moved to their new nest sites.
- (5) All accessible chicks were fitted with identification bands on their left legs once their adult plumage covered more than half their body, usually at 70 days of age or older (adult birds whose ages are not known have their bands fitted to their right legs). During the 2015-2016 Cahow nesting season, a total of 39 chicks were fitted with identification bands, out of a total of 56 chicks which successfully fledged (70 % of all chicks).
- (6) The total number of active nesting pairs of Cahows increased to a record high of 117 pairs during the 2016/2017 nesting season, compared to 115 nesting pairs in the 2015/2016 season and 55 pairs in 2000/2001. A record total of 61 chicks successfully fledged from all nesting islands, the first time since the rediscovery of the Cahow that the number of fledged chicks has exceeded 60 (**See Fig. 4**).
- (7) The new nesting colony on Nonsuch Island, which was established by the translocation of near-fledged chicks and sound attraction techniques between 2004 and 2009, has continued to grow. For the 2016-2017 breeding season, 16 nesting pairs laid eggs at the Nonsuch colony; from these, eight chicks hatched, all of which fledged successfully out

to sea, while a new pair of prospecting adult Cahows has established themselves in one additional nest (**See section 3(a)** for full details).

- (8) During May and June, a total of fourteen Cahow chicks were translocated from all four of the original nesting islets to a second colony site on Nonsuch Island (**See Fig. 6**). Thirteen of these chicks eventually fledged successfully from this new site, termed the ‘B’ site. This makes a total of 64 translocated chicks that have fledged to sea successfully over the last four breeding seasons from the ‘B’ translocation site, out of 68 chicks that have been translocated (94.1 % fledging success rate) (**See section 3(b)**). The last Cahow chick to depart from Nonsuch fledged to sea on 19th June 2016.
- (9) One Cahow chick, which had been developing normally and was within a few days of fledging to sea, died in unusual circumstances after a swarm of European Honeybees invaded the nest burrow and stung the chick to death. The swarm was removed several days later by Agricultural Officer Thomas Sinclair. This is the first case of this happening in the history of the recovery program, although there was a case in the 1990s when a nest burrow on Horn Rock was occupied during summer by a swarm of bees, which was removed before the Cahows returned to nest.



Fig. 3: Cahow chicks on Nonsuch Island at twelve weeks of age (L) and 1 week of age (R) (photo courtesy of J.P. Rouja @ LookBermuda)

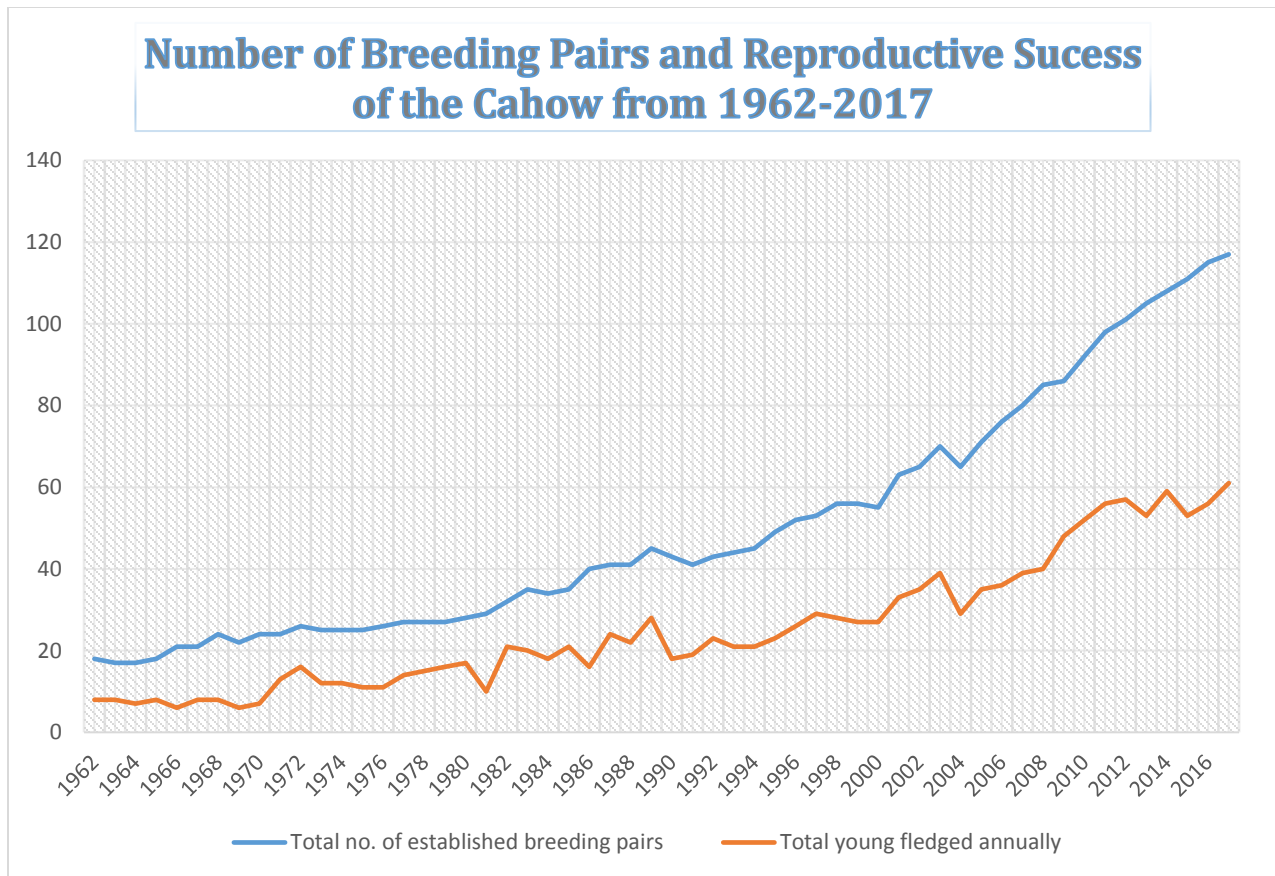


Fig. 4: No. of breeding pairs and fledged young of Cahow over 55-year period (Leila Madeiros)

Two additional events during this nesting season were of particular interest:

- 1) In early April 2014, Black Rats (*Rattus rattus*) were found to have invaded Nonsuch Island, most likely by swimming over from Coopers Island 300 metres to the northeast. Although efforts to eradicate the rats, using poison bait and traps, greatly reduced their numbers, complete eradication was not confirmed until November 2016, after setting out 75 bait boxes baited with anticoagulant rodenticide on a grid pattern around the island.
- 2) The first confirmed instance of one Cahow killing another was recorded on January 17th, 2017 when the resident adult female (identified by her band # E0030) was found freshly dead outside the C12 nest burrow on Horn Rock. This bird had bloody wounds on its head and tail area, which were unlike those typically caused by rats. A unbanded female Cahow, with minor wounds and feathers in its beak, was found in the burrow with the resident male bird. All evidence points to a fight occurring between the resident female and a new young female, which the older bird lost.

2(b): Summary of 2016 - 2017 Cahow Nesting Season:

The 2016-2017 Cahow nesting season has been highlighted by (a): an increase in the number of breeding pairs; (b): successfully fledging chicks increasing to 61 from last year's number of 56, and (c): by the continued growth of the new nesting colony that has been established on the Nonsuch Island Nature Reserve.

The Cahow population has increased to a new record high number of 117 breeding pairs, of which 61 produced successfully fledging chicks. This represents a breeding success rate of 52.1%, which is an improvement over the 48.7 % recorded in the 2015-2016 season. In addition, new prospecting or pre-breeding activity was recorded at a record number of 13 additional new nest sites, including 3 new nest sites on Nonsuch Island.

Following is a summary of the 2016-2017 nesting season results:

Total number of nest burrows with confirmed nesting activity:	117*
Number of new nest sites with prospecting activity:	13*
Total number of confirmed successfully fledged chicks:	61*
Total number of active nest sites with unsuccessful nesting:	56
Number of failures from nest sites with observable nest chambers:	48
Number of failures from nest sites with non-observable nest chambers:	8

Breakdown for causes of breeding failure from observable nest burrows:

Chick killed by bee swarm just before fledging:	1
Chick died in 1st month of development:	1
Chick died later in development:	2
Eggs broken or pipped:	19
Non-hatching / infertile eggs:	14
Egg buried or knocked off nest:	3
Egg disappeared (Land Hermit Crab predation?):	1
Tropicbird nest competition:	1
Egg destroyed after resident adult female killed by intruder Cahow:	1
Failure from unknown causes:	5

* Indicates record high numbers

2 (c): Breakdown of Breeding Season Results by Nesting Island:

Following is a breakdown of breeding results on all offshore Cahow nesting islands for the 2016/2017 nesting season. Some of the nesting islets had abnormally low breeding success. These included Green Island and Horn Rock, at 41.6 % and 48.8 % breeding success respectively. This may be due to heavy impacts to these particular islands from recent hurricanes. In contrast, other islands, such as Inner Pear Rock, Long Rock and Nonsuch Island had much higher breeding success rates of 65 %, 53.8 % and 53.3 % respectively.

LONG ROCK:

Active nest burrows with nesting confirmed (eggs laid and/or chick hatched): 13
New nest burrow prospected by confirmed pair: 2
Nest burrows with successfully fledged chicks (B, C, D1, D2, D3, D4, D5): 7
Nest burrows with confirmed failed nesting: 6
(A (cause unknown), D7– egg disappeared; Land hermit Crab predation?; D8- egg broken; E1 – egg infertile; E4-egg infertile and undersized, nest # 16-egg broken)

INNER PEAR ROCK:

Active nest burrows with nesting confirmed: 20
New nest burrows prospected by confirmed pairs: 2
Nest burrows with successfully fledged chicks: 13
(B1, B3, B7, B8, B10, C2, C4, C5, D1, D2, D3, D4, E1)
Nest burrows with confirmed failed nesting:7
(A1-egg broken; B2-egg rolled off nest; B4-egg broken, B6-young chick killed by Tropicbird; B9-egg infertile; C1-unknown causes; C3-egg knocked off nest.

GREEN ISLAND:

Active nest burrows with nesting confirmed: 24
New nest burrow prospected by confirmed pair: 2
Nest burrows with successfully fledged chicks: 10
(A1; D1; # 2; # 4; # 6; # 8; # 11; # 12; # 13; # 17)
Nest burrows with confirmed failed nesting:14
(E1- cause of failure unknown; F1 – cause of failure unknown; F2 - egg broken; # 3 - egg infertile; # 3-4 - egg broken; # 5 - egg infertile; # 5-6 - egg infertile, # 7- egg broken; # 9-egg cracked; # 10 - egg infertile; # 14 - egg knocked off nest; # 15 - egg broken)

HORN ROCK:

Active nest burrows with nesting confirmed: 43
 New nest burrows prospected by confirmed pairs: 3
 Nest burrows with confirmed successfully fledged chicks: 21
 (B6; B7; C4; C5; C7; C13, C14; C15; C21; C22; C23; C26; C28; C29; D1; D4; E2; F3; F6; F7; G3)
 Nest burrows with confirmed failed nesting:21
 (B3 - egg knocked off nest/buried; B5 – unknown causes; C6 – egg broken; C8 – egg broken; C9 – egg infertile; C10 – egg knocked off nest; C11 – chick died at 2 weeks; C12 - adult female died after fight with prospecting Cahow; C16 – egg broken; C17- egg buried in nest; C18 – egg infertile; C19 – egg cracked; C20 - egg knocked off nest; C24 - broken egg, C27 - egg crushed; D3 -unknown causes; E1 - unknown causes; F2 - egg infertile, F4 - egg knocked off nest; F5 - chick died at 2 months of age; F8 - egg cracked)

NONSUCH ISLAND:

Active nest burrows with nesting confirmed: 15
 New nest burrows prospected by confirmed pairs: 3
 Nest burrows with confirmed successfully fledged chicks: 8
 (R817; R818; R820; R821; R831; R832; R835; R836)
 Nest burrows with confirmed failed nesting: 7
 (R816-broken egg; R819- egg buried in nest material; R830 – infertile egg; R833 – infertile egg; R834 - infertile egg; R837- infertile egg; R838-egg broken)

SOUTHAMPTON ISLAND:

Active nest burrows with nesting confirmed: 5
 New nest burrows prospected: 1
 Nest burrows with successfully fledged chicks: 2
 (S3; S5)
 Nest burrows with failed nesting: 3
 (S1; - cause unknown; S2 - cause unknown, S4 - egg buried by sand collapse)

SECTION 3(a): Update on New Nonsuch Nesting Colony:



Fig. 5: Breeding adult Cahow being measured on Nonsuch Island (J. P. Rouja)

A primary objective of the Cahow Recovery project has been to establish new nesting colonies on larger, more elevated islands containing suitable habitat, that are less at risk from hurricane flooding and erosion than the original tiny nesting islets. It involves moving (translocating) Cahow chicks approximately 18 days before fledging, from nests on the original nesting islets, to artificial burrows constructed on the much larger and higher elevated Nonsuch Island.

Gadfly petrels such as the Cahow generally return when mature to the same area that they originally departed from as fledglings, a trait known as *site faithfulness*. Taking advantage of this tendency, a total of 105 Cahow chicks selected from all four of the original nesting islets were moved to a new group of artificial nest burrows on Nonsuch Island over a five-year period between 2004 and 2008. On Nonsuch, they were hand-fed daily on imported squid and locally sourced fresh Anchovies, and their weight, wing growth and plumage development recorded daily until they were fully developed. The chicks were fitted with identification bands, or rings, and monitored through their exercise period, when they emerge for several nights to exercise flight muscles and imprint on their surroundings.

At the end of this period, they fledge to sea on their own, hopefully to return when mature to the translocation site. A total of 102 translocated Cahow chicks fledged successfully from Nonsuch between 2004 - 2008 (**Carlile et al. 2012**).

By 2008, the first four translocated Cahows were recaptured back at the translocation site on Nonsuch, and their identities confirmed from their band numbers. The first real evidence that the effort to establish a new Cahow breeding colony on Nonsuch was succeeding occurred in **2009**, with the first pairs of Cahows nesting in burrows. This resulted in the first chick hatched on Nonsuch since the 1620s. In addition, a total of 15 returned translocated Cahows were re-captured at the translocation site by the end of this season.

Between 2010 and 2016, the number of established breeding pairs carrying out nesting activity at the new Nonsuch Island nesting colony rose from 4 to 15, with the number of successfully fledged chicks produced annually by this colony increasing from 1 chick in 2010 to 10 chicks in 2016. The total number of returning adult Cahows on Nonsuch that had been translocated to the island as chicks rose to 28, one from the 2004 translocation cohort, eight from the 2005 cohort, eight from the 2006 cohort, six from the 2007 cohort and five from the 2008 cohort (**Madeiros 2010, 2012, 2013 & 2014**). In addition, another 21 translocated chicks eventually returned to the four original nesting islets (Long Rock, Inner Pear Rock, Green Island and Horn Rock). The total number of confirmed returning translocated Cahow chicks was therefore 49, out of 102 that originally fledged from Nonsuch (representing a 48 % return rate).

For the most recent 2016/2017 breeding season, the total number of breeding pairs on Nonsuch is 15, of which 8 produced successfully fledging chicks (53.3% breeding success). The total number of Cahow chicks that have hatched and successfully fledged from the new Nonsuch nesting colony since 2009 has now risen to 54 (**See Tables 1 and 2**).

TABLE 1: Breeding results at new translocation colony on Nonsuch Island 2008/2009 to 2016/2017 breeding seasons		
Breeding season	No. of Breeding pairs	No. of fledged chicks
2008-2009	3	1
2009-2010	5	1
2010-2011	7	4
2011-2012	12	7
2012-2013	13	5
2013-2014	13	9
2014-2015	14	9
2015-2016	15	10
2016-2017	15	8

Overall, for the 2016-2017 Breeding Season, the first Cahow chick to fledge to sea at the (A) translocation colony site did so during the night of May 27, 2017, while the last one fledged out to sea on the night of June 20th, 2016.

Table 2: This table shows the breeding success of all active Cahow nest burrows at the Nonsuch “A” nesting colony between 2009, when the first pair of translocated birds returned to breed, and 2017, when the number of breeding pairs have increased to 15.

NONSUCH ISLAND	2009	2010	2011	2012	2013	2014	2015	2016	2017
Nest No.	Breeding Success (Chick fledged = 1, failed = 0)								
R816			0	1	1	1	1	1	0
R817			1	1	0	1	0	0	1
R818	1	1	1	1	0	1	1	0	1
R819						1	1	1	0
R820					0	0	1	1	1
R821							1	1	1
R830				1	0	0	0	1	0
R831		0	0	0	0	1	1	1	1
R832		0	1	1	1	0	1	1	1
R833				0	0	1	0	1	0
R834		0	0	0	0	1	0	0	0
R835					1	1	1	1	1
R836				1	1	1	1	1	1
R837			1	1	1	0	0	0	0
R838								0	0
Total no. of chicks/year	1	1	4	7	5	9	9	10	8

Annual Breeding Success of Cahow Pairs on Nonsuch Island and Pair Establishment

3 (b): 5th Year Results of 2nd Translocation Project on Nonsuch

2017 marked the fifth year of a second translocation project on Nonsuch Island. Following the success of the first translocation project, this project is aimed at establishing a second nesting colony site at a different location on Nonsuch. This would ensure that the Cahow would have two separate footholds on this much larger island, which offers improved nesting habitat and safety from hurricane erosion and flooding. To accomplish this, a new complex of artificial nest burrows were constructed about 200 meters to the east of the original colony site. A total of about 70 - 80 fledgling Cahows are to be moved over a 5-6-year period from nest burrows on all four of the original nesting islets to the new burrows, where they could be fed and monitored daily until they fledged out to sea. In this way, they hopefully imprint on the new site, returning when mature to choose their own nest burrows. The new burrow complex is located on top of a promontory formed by the south hill of Nonsuch, and is situated at 35' to 45' above sea level, well beyond the reach of hurricane waves and surge.

These new nest burrows were built with the assistance of volunteer groups from the Ascendant Group of Companies. Groups of volunteers from Ascendant came out to Nonsuch Island in 2012 and 2013 to assist in mixing and pouring concrete to make new Cahow nest burrows at the new translocation site. Additional nest burrows have since been constructed at this site by the terrestrial conservation crew and conservation officer.

Both the traditional concrete artificial burrows and the new design plastic burrows installed at this site have been readily accepted by the translocated chicks. For 2017, fourteen Cahow chicks were translocated to the "B" nest colony site from all four of the original nesting islets, with thirteen successfully fledging out to sea. Out of the successfully fledging chicks, 6 originated from nest burrows on Horn Rock (C4; C14; C21; C22; F6; F7), 3 from nests on Green Island (# 6; # 8; # 12), 3 from nests on Inner Pear Rock (D2, D3, D4), and 1 from a nest on Long Rock (D3).

One chick was unfortunately stung to death by a wild swarm of Honeybees (*Apis meliofolia*) which invaded its nest burrow just days before the chick was due to fledge.

The first Cahow chick (from the Long Rock D3 nest) was translocated to Nonsuch Island on the 9th May, 2017. This also became the first chick to successfully fledge out to sea, on the 25th May, after 16 days in its translocation burrow on Nonsuch. The final chick was not translocated until the 19th June, with the last chick fledging out to sea on 26th June. The median date for translocation of chicks was the 27th May, while the median date for fledging of chicks was the 12th June. The age of chicks at their translocation ranged from 71 to 104 days after hatching (mean age = 81.38 days), while their age at fledging ranged from 86 to 111 days after hatching (mean = 94.46 days). (See Table 3 for full translocation results and figures).

TABLE 3: 2017 Cahow Translocation Project Results

Date of Translocation of Bermuda Petrel Chicks to Nonsuch Island, Age at Translocation, Number of Feeds and Total Feed Weight, Period of Emergence to Fledging, Date of Fledging, and Age, Weight and Wing Chord (Length) at Fledging.

Individual	Translocation		Number of Feeds		Emergence to fledging (days) (Exercise period)	Fledging				
	(Origin – Island & nest No.)	Date moved (2016)	Age when moved (days)	No. of feeds after moving		Total Feed weight (grams)	Date fledged (2014)	Age from hatching (Days)	Weight (grams)	Wing Chord (mm)
LONG D3		9 May	72	6	260g	4	25 May	88	314g	259mm
GREEN 8		15 May	75	9	457g	5	1 June	92	304g	256mm
HORN F6		17 May	73	5	240g	2	29 May	86	267g	250mm
HORN C22		17 May	71	6	306g	3	1 June	86	282g	255mm
GREEN 6		19 May	78	5	236 g	2	31 May	90	269g	246mm
IPO D4		20 May	80	7	270g	4	1 June	92	228g	239mm
IPO D2		27 May	76	6	312g	2	12 June	92	278g	260mm
GREEN 12		31 May	76	8	339g	7	15 June	91	275g	263mm
HORN C4		1 June	77	8	231g	4	15 June	91	285g	263mm
IPO D3		6 June	85	8	265g	4	18 June	97	258g	258mm
HORN C21		8 June	97	6	246g	2	18 June	107	268g	255mm
HORN F7		8 June	94	6	237 g	3	19 June	105	265g	254mm
HORN C14		19 June	104	9	417 g	2	26 June	111	275g	253mm
Median		27 May					12 June			
Mean			81.38	6.84	293.5g	3.38		94.46	274.46g	254.7mm

At their translocation burrows, the chicks were hand-fed either every other day, or daily if the chick was considered below optimum weight. Food provided to the chicks consisted of oil-rich and highly nutritious Anchovy *Sardinella anchovia*. 2017 was the first year since 2013 that Anchovies had been present and available in any numbers in Bermuda’s waters, and Cahow chicks appear to thrive on them. The availability of Anchovies made it unnecessary to provide imported unfrozen squid, simplifying feeding and saving money.

The Anchovies were netted locally and provided by Mr. Chris Flook, who had also provided fish for the original translocation project from 2004 to 2008. A typical meal for one Cahow chick consisted of 5 to 7 Anchovies.



Fig. 6: Translocated Cahow chick being fed with fresh Anchovy by Elizabeth Madeiros

The number of meals given to each translocated Cahow chick before fledging ranged from 5 – 9 meals (mean = 6.84 meals), and individual meal weights usually ranged from 40 grams to 60 grams (extreme ranges 14 grams – 75 grams). The total combined amount of food from all meals given to each chick also varied widely from a low of 231 grams to a high of 457 grams (mean = 293.5grams).

The number of nights that the chicks emerged to exercise before fledging ranged from 2 to 7 nights (mean = 3.38 nights), with chicks fledging to sea between the 25th may and the 26th June (median fledging date = 12th June).

The weight of the chicks at fledging ranged from a high of 314 grams to a low of 228 grams, with the latter considered to be below the target weight of 250-280 grams. However, the mean fledging weight was 274.46 grams, which compares favorably with naturally fledging chicks. The wing chord (outer wing length from the wrist joint) of fledging chicks ranged from 239mm to 263mm (mean = 254.7 mm).

3 (c): Cahow Recovery Program – Public Outreach/Education:

One of the primary objectives of the Cahow recovery Program has been to increase public outreach and education about Bermuda’s National Bird and the broader conservation issues involved in its management. To help achieve this, a partnership was formed with Mr. J.P. Rouja of Look TV, who, funded by the Ascendant Group of Companies, developed an infrared “night vision” video camera. This was installed in a modified Cahow burrow, to provide video footage of the breeding activities of adult Cahows and the development of the single chick. This footage was available on-line mainly to local viewers.

This system was used successfully from 2013 – 2016, but the view from directly overhead was not ideal, and it was felt that there was a need to use a higher-quality camera with better distribution to international viewers. Accordingly, a new partnership was formed with the **Cornell Lab of Ornithology Bird Cams project**, with project manager Charles Eldermire visiting Bermuda in November 2016 to help set up the new camera and work out the details of the live-streaming system.



Fig. 7: Adult Cahow feeding chick in nest burrow, viewed by infrared “CahowCam”

A new video camera, fitted with military-grade infrared lights that are completely undetectable by humans or animals, was installed which gives a view into the nest chamber from the side, giving a much better vantage point to see the nesting Cahows (see above). This camera then live-streams video to the internet through the Cornell network, where it has been seen by viewers in over 100 countries.

This new partnership between the Bermuda Department of Environment and natural Resources, the Cornell lab of Ornithology and Nonsuch Expeditions has contributed greatly to the objective of increasing public outreach and education, resulting in 600,000 views for a total of 8.5 million minutes of video being viewed by scientists, students and followers from around the world, through the website www.nonsuchexpeditions.com.

Some of the highlights that the CahowCam revealed during 2016/2017 include:

- nest-building and courtship activity by the adult Cahows;
- the actual laying of the single egg on 11th January, 2017 by the female bird;
- incubation shifts and changeovers by the two adults;
- the hatching of the chick on 2nd March, 2017;
- feeding visits by both parents to the chick;
- a nest invasion by a prospecting young Cahow, which aggressively attacked the chick before leaving the nest (the chick survived the attack uninjured);
- the growth and maturing of the chick until it fledged out to sea on the 6th June 2017.

For the second consecutive year, a **Leach's Storm-petrel** (*Oceanodroma leucorhoa*) prospected in the Nonsuch Island nest burrow that the CahowCam was installed in, shortly after the Cahow chick's departure on the 6th June. This small seabird, although common well offshore during the winter and spring months, has never been recorded on land before 2016 on Bermuda. This bird, evidently a male, visited the burrow almost nightly, arranging nest material and calling loudly for hours at a time at the burrow entrance, trying to attract a mate. This Storm-petrel visited the nest almost nightly between the 6th June and 17th July, 2017. The CahowCam recorded encounters between the Storm-petrel and large Red Land Crabs (*Gecarcinus lateralis*), which it repelled aggressively from the burrow. Although this bird was again unsuccessful in attracting a mate, it will be very interesting to see if the same bird returns to this nest burrow in 2018.

The infrared CahowCam has proven to be an asset for the Recovery Program, revealing previously unknown behavior and enabling the public to follow the development and behavior of the chick and adult Cahows, revealing the private life of Bermuda's critically endangered National Bird to an international audience. In addition, the new partnership with the Cornell Lab of Ornithology is proving to be successful in highlighting the management efforts of the Bermuda dept. of Environment and natural resources.

Other public outreach efforts relating to the Cahow Recovery Project have included guided tours and "Cahow encounters" at Nonsuch, in addition to PowerPoint presentations at schools (see Figs. 8 & 9) and the Bermuda Zoological Society's Natural History Course. Warwick Academy and Saltus Cavendish School included the Cahow in their curriculum, with the latter again giving a very generous donation to the Recovery Project. A total of 21 tour groups, mostly from local middle and secondary schools and the Bermuda College, and totaling 334 people, were allowed to see Cahows at close range on Nonsuch Island being assessed and measured as part of the research program.



Fig.

8: Cahow Project talk being given to Saltus Cavendish Primary 1 group.



Fig. 9: Showing Cahow chick to school tour group on Nonsuch island, April 2017

Section 4 (a): Future Management Actions and Research:

A number of the projects and proposals recommended in past yearly Nesting Season Reports have now either been successfully completed or are well underway; following are the most important recommendations for the continuation of projects and management work already underway, or that are proposed for the next two nesting seasons:

2017 – 2018 Breeding Seasons:

- Carry out the final translocation of Cahow chicks from nesting islands to the “B” colony site on Nonsuch Island, with the goal of moving at least 9-10 chicks to reach a target figure of 75 chicks moved to and fledged from this second location;
- Continue banding program for adult and fledgling Cahows;
- Continue monitoring of nesting islands for the presence of rats; set out rodenticides when necessary;
- Continue installation of additional artificial nest burrows at nesting colonies, including at the new colony on Southampton Island.
- Investigate the potential deployment of extremely accurate GPS loggers on Cahows to more accurately determine oceanic range and important foraging areas for the species.

2018 – 2019 Breeding Seasons:

- Continue translocating near-fledged Cahow chicks from the original nesting islands to the “B” colony site on Nonsuch Island if needed. If target number of translocated chicks has been reached during previous year, switch from active translocation of chicks to monitoring of burrows at translocation site;
- Possibly start use of Sound Attraction System at “B” colony site on Nonsuch;
- Continue banding program for adult and fledgling Cahows;
- Continue the installation of additional artificial nest burrows for the Cahow on suitable nesting islands and locations;
- Carry out the deployment of extremely accurate GPS loggers on selected adult and fledgling Cahows.

Section 4 (b): Acknowledgements:

I would like to acknowledge with thanks the following Departmental staff, volunteers, organizations, schools and members of the public for their assistance in the Cahow Recovery Project during the 2015 – 2016 breeding season:

Mr. Peter Drew, Conservation Officer, Bermuda Biodiversity Officer Alison Copeland (Dept. of Conservation Services) as well as Camilla Stringer of the Bermuda Zoological Society and Lizzy Madeiros, for assistance in monitoring checks and feeding of translocated Cahow chicks; Ms. Mandy Shailer (GPS coordinator, Dept. of Conservation Services), who has provided maps of nesting islands and nest sites, and compiled locational data from the geolocational data loggers to make the tracking and oceanic range maps, Chris Flook, who agreed to once again provide fresh Anchovies and Herring for the translocated Cahow chicks, and JP Rouja of Nonsuch expeditions (designer/installer of the infrared “Cahow burrow-cam” and Charles Eldermire, manager of the Cornell Bird Lab web cam project, to enable unobtrusive study of the behavior of the birds inside nest burrows).

The excellent photos in this report were used with the kind permission of Kate Sutherland, David Liittschwager, J. P. Rouja, Cynthia Barnes, Leila Madeiros and Camilla Stringer.

As always, I am deeply thankful to the Terrestrial Conservation Crew for their hard work in building concrete nest burrows and assistance in managing nesting habitat for the Cahows on both Nonsuch Island and the original nesting islets. The Crew consists of Kiwon Furbert (Foreman), Llewellyn Rewan, and Marvin Jones. Also to recently retired foreman Barry Smith, who carried out much work on the project over a period of more than 20 years.

The research work carried out by the Cahow Recovery Program has been possible only because of donations by schools, businesses, organizations and members of the public. For example, the geolocational loggers which have revolutionized understanding of the oceanic range of the Cahow were purchased entirely through public donations, notably by Saltus Cavendish School and Paget Primary School. Mr. Robert (Bob) Flood of Scilly Pelagics, who is producing a series of multimedia seabird identification books in which the Cahow was prominently featured, and who also brings specialized birding groups to Bermuda specifically to see the Cahow, has also been an important supporter of the project. Special thanks also go out to the Ascendant Group of Companies, who have provided volunteers to construct new Cahow nest burrows and donated a new Boston Whaler boat and solar power system for the Cahow Recovery Project. We are deeply grateful for the interest and generosity shown by these and other donors.

Finally, I would like to thank Leila Madeiros and my children Seth and Elizabeth, whose support and patience have made this demanding project possible over the last 17 years.

Jeremy Madeiros,
Senior Terrestrial Conservation Officer
Dept. of Environment and Natural Resources

Section 4 (c): References:

Carlile, N., Priddel, D., & Madeiros, J. 2012. Establishment of a new, secure colony of Endangered Bermuda Petrel *Pterodroma cahow* by translocation of near-fledged nestlings. *Bird Conservation International*, available on Cambridge Journals Online
Doi: 10.1017/S0959270911000372.

Flood, R., & Fisher, A. Multimedia Identification Guide to North Atlantic Seabirds; *Pterodroma* Petrels. 2013. Pelagic Birds & Birding Multimedia Identification Guides in association with www.scillypelagics.com ISBN 978-0-9568867-1-2. 4edge Ltd, Hockley, Essex

Madeiras, J. 2005. *Recovery Plan for the Bermuda Petrel (Cahow) Pterodroma cahow*. Department of Conservation Services, Bermuda.

Madeiras, J. 2010. Cahow Recovery Program. *Establishment of a New Breeding Colony of Bermuda Petrel Pterodroma cahow on Nonsuch Island, Bermuda, by the Translocation of Near-fledged Chicks and Social Attraction*. Department of Conservation Services, Bermuda.

Madeiras, J. 2012. *Cahow Recovery Program: Breeding Season Report for 2011-2012*. Department of Conservation Services, Bermuda.

Madeiras, J., Carlile, N., & Priddel, D. 2012. Breeding biology and population increase of the endangered Bermuda Petrel *Pterodroma cahow*. *Bird Conservation International* 22: pp. 34 – 45.

Madeiras, J., Flood, R., & Zufelt, K. 2014. *Conservation and At-sea Range of Bermuda Petrel (Pterodroma cahow)*. *North American Birds*, pp. 546-557. Quarterly Journal of Ornithological Record Published by the American Birding Association. Volume 67: No. 4, 2014

Murphy, R. C., & Mowbray, L. S. 1951. *New Light on the Cahow (Pterodroma cahow)*. The Auk, Vol. 68, pp.

Wingate, D. B. 1985. The restoration of Nonsuch Island as a living museum of Bermuda's pre-colonial terrestrial biome. In: Moors, P.J. (ed.), *Conservation of Island Birds*, pp. 225-238. ICBP Technical Publication No. 3. International Council for Bird Preservation, Cambridge.



Fig. 10: Translocated Horn Rock F7 Cahow chick being readied for feeding at Nonsuch ‘B’ colony site.