

CAHOW RECOVERY PROGRAM 2014 – 2015 Breeding Season Report



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“To conserve and restore Bermuda’s natural heritage”
BERMUDA GOVERNMENT

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

BREEDING SEASON REPORT
For the Nesting Season October 2014 to July 2015
Of Bermuda's Endangered National Bird



**Fig. 1: Adult Cahow several miles offshore from Nonsuch Island,
November, 2014 (Kirk Zufelt)**

Cover photo: J. Rieterer

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SECTION 1:

1(a): EXECUTIVE SUMMARY:

Key Words: Burrow-cam, Cahow, New Colony, Nonsuch Island, Southampton 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*. This program is focused on encouraging the increase of the breeding population through the control of threats to the species, construction of artificial nesting burrows, and the establishment of entirely new nesting colonies.

The Cahow is endemic or unique to the Islands of Bermuda and was originally superabundant, possibly numbering more than half a million birds. It was catastrophically affected by the discovery of Bermuda in the early 1500s and colonization of the island by English settlers in the early 1600s. This was due both to direct hunting by the settlers and by invasive predators introduced by man, such as Rats, Cats, Dogs and Pigs. After less than 12 years of settlement, the Cahow by the 1620s had declined to the point where it was thought to be extinct, a belief that persisted for almost 350 years until the rediscovery in 1951 (**Murphy & Mowbray, 1951**) of a remnant population on four tiny offshore islets.

Since 1960, a conservation and recovery program has been in place that has addressed and controlled most threats to the Cahow. This program was administered by Dr. David Wingate until his retirement in 2000, since which it has been administered by the author of this report. This program has enabled the breeding population to begin a slow, but accelerating increase from only 18 pairs producing a combined 8 chicks annually in the 1960s to a new record number of 111 breeding pairs in 2015, producing a total of 53 successfully fledged chicks. Increased knowledge and public interest in the Cahow has been brought about from several films, documentaries and books that have highlighted the conservation and recovery work being carried out on the species.

The main threats to the Cahow include the erosion and flooding of the present nesting islets by hurricane activity and continuing sea-level rise, predation by Rats and other invasive species swimming to these islets, a lack of sufficient numbers of suitable 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 2015 Cahow nesting season:

- The new nesting colony of Cahows established on Nonsuch Island by the translocation of chicks between 2004 and 2008 continues to grow, with 14 pairs established in nest burrows and laying eggs. From these, nine chicks hatched and successfully fledged out to sea, tying last season's record number of chicks for Nonsuch.

- **The total breeding population of the Cahow has increased to a record number of 111 nesting pairs** (pairs that produced an egg, whether it hatched or not), compared to 108 pairs in the 2013-2014 breeding season. This is despite the loss of 5 established breeding pairs in hurricane “Gonzalo” in late October, 2014.
 - The number of chicks that successfully fledged in 2015 dropped to 53, compared to the record number of 59 during the previous, 2013-2014 nesting season. This is almost entirely due to the loss of established breeding pairs and damage to nest burrows during hurricane “Gonzalo” on October 17th, 2014.
 - **The second translocation of Cahow chicks to Nonsuch continued at the ‘B’ translocation 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 and Squid. **12 of these chicks fledged successfully out to sea.** Coupled with 12 and 19 Cahow chicks translocated to and fledging from this site in 2013 and 2014, a total of 43 Cahow chicks have now fledged successfully from this site after being translocated to Nonsuch Island.
 - **The infrared “burrow-cam”** developed by JP Rouja of LookTV with financial assistance from the Ascendant Group of Companies was installed in one of the Cahow nest burrows on Nonsuch Island, with video being “live-streamed” on a website for much of the nesting season. This allowed school groups and the public to see the hatching of a Cahow chick, observed for the first time ever, live over the internet on the 22nd March. The burrow-cam then enabled the development of the chick, including feeding visits by both parents, to be followed until it fledged out to sea around May 28th. This website at **www.nonsuchisland.com** included weekly checks of the chicks, and “virtual tours” showing panoramic vistas of the breeding colony and other sites on Nonsuch Island, as well as images of additional terrestrial and marine plant and animal species from Nonsuch and the surrounding marine habitats.
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In summary, the Cahow Recovery Program continues to achieve both its primary objective of increasing the Cahow breeding population, and secondary objective of establishing new nesting colonies. This is despite a number of real threats and challenges to the breeding population during the 2014-2015 nesting season, ranging from the first recorded mortality of breeding adult Cahows due to the direct impact of late-season hurricane “Gonzalo” to the invasion of several nesting islands by rats, which are a known predator on Cahow chicks. Regular monitoring of the entire breeding population has proved to be indispensable for the rapid identification and solving of these threats as they arise.

Full details on the 2014 – 2015 breeding season are given in the following report, in addition to research and management proposals for the next two seasons.

Section 1 (b): Objectives of Cahow Recovery Program:

The Cahow Recovery Program was set up to co-ordinate management and research efforts for the Bermuda petrel or Cahow *Pterodroma cahow*, which is recognized as one of the rarest seabirds on earth and is endemic to the islands of Bermuda, nesting nowhere else on Earth. This program is now recognized internationally as one of the most successful recovery programs for a critically endangered species in the wild.

This program has a number of short and long-term objectives, which are covered in full in the Cahow Recovery Plan (**Madeiros, 2005**); briefly put, these objectives are:

- (1) To prevent nest-site competition with the White-tailed Tropicbird (*Phaethon lepturus catsbyii*) through the use of wood “baffle plates” at the entrances of all Cahow nest burrows to prevent Tropicbirds from entering.
- (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 or suspected, to eradicate them by use of anticoagulant rodenticides, using bait and boxes provided by or purchased from the Health Department.
- (3) Carry out a program for the construction of additional artificial nest burrows at all appropriate nesting islands, and at locations where new nesting colonies are being established, to support a continued increase in the breeding population.
- (4) To establish new nesting colonies of Cahows on larger, more elevated islands free of mammal predators, which are safer from hurricane erosion and have the potential of supporting larger populations of the birds; this has already been achieved on Nonsuch Island with the establishment of one colony, and is also presently underway at a second location on Nonsuch.
- (5) To learn more about the biology of the species through an ongoing banding program initiated in 2002; also through developmental studies of Cahow chicks and morphometric measurements of adult Cahows.
- (6) To carry out studies of the oceanic range of Cahows using archival geolocational data loggers attached to individual birds, which record daily position fixes for periods of up to 2 years. These have already been successful in recording foraging areas for the Cahows at sea, both during the breeding and non-breeding seasons.
- (7) To use presentations, the media, scientific publications and new technology such as infrared “burrow-cams” to increase public knowledge and appreciation of the Cahow and its place in Bermuda’s history.



**Fig. 2: adult Cahow photographed at sea 3 miles southeast of Coopers Island, Bermuda
(Kirk Zufelt)**

SECTION 2:

2 (a): Introduction - Effects of Hurricane “Gonzalo”

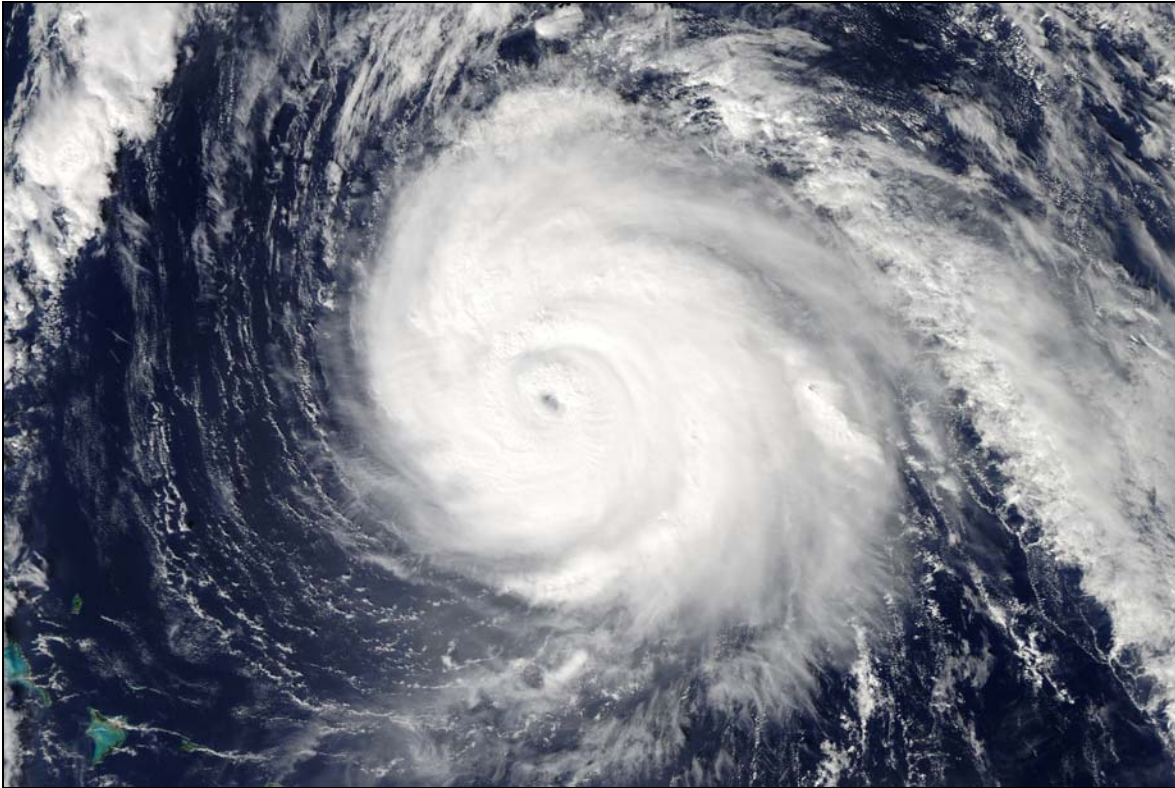


Fig. 3: Hurricane “Gonzalo” 24 hours before scoring a direct hit on Bermuda

Effects of Hurricane “Gonzalo” on the Cahow breeding population

The 2014-2015 Nesting Season of the critically endangered Bermuda petrel or Cahow (*Pterodroma cahow*), Bermuda’s national bird, began with a near catastrophe when strong **Category 2 Hurricane Gonzalo made a direct hit on Bermuda on the 17th October**, just as the first of the Cahows were returning to their nest burrows on the exposed Castle Harbour Islands.

Despite a quiet start to the hurricane season in 2014, two storms formed to the south and southeast of Bermuda in October, with the first, “Fay”, approaching the island as a Tropical Storm, but rapidly strengthening into a hurricane just as the center of the storm passed directly over Bermuda on the 12th October, with wind gusts recorded at 115-125 mph. Despite severe damage to utilities, boats, building roofs and vegetation throughout Bermuda, little damage was caused to the Cahow nesting islands.

Hurricane “Gonzalo”, a much larger, more powerful storm, formed well to the southeast of Bermuda, following almost exactly the same path as Fay and hitting the island just 5 days later. The first half of Gonzalo hit Bermuda with easterly winds gusting to 125 mph, after which the 60-mile wide calm center, or “eye” of the hurricane moved directly over the

island, causing a lull or calm lasting more than 1 hour. This was followed by the second half of the storm, with sustained west-northwesterly winds of 110 mph gusting to 144 mph. There was extensive wind damage to vegetation, utility poles, boats and houses, with almost all of Bermuda losing power and over 1200 buildings sustaining roof damage.

Luckily, the hurricane hit during low tide, reducing the height of the storm surge, **but 20-foot waves on the south and eastern coastlines caused some damage and submerged two of the low-lying islets that the Cahow nests on.** Long Rock and Green Island were both completely overwashed by large breakers, with the Cahow nesting burrows submerged and many of the heavy concrete nest lids washed overboard. Many of the burrows were also filled with rocks and debris. It now appears that at several nests, namely the E1 and H1 burrows on Long Rock and the A2, #1 and F1 nests on Green Island that the male Cahows had already returned and were inside their burrows when the storm hit. This resulted in these birds being trapped in their burrows and drowned during the hurricane. Although most of the female birds appeared to have survived and were recaptured within these burrows over the next few weeks and identified by their band (ring) numbers, without the male birds, these burrows were all abandoned later in the season.

Band and recapture studies of Cahows over the last 13 years have shown that (a) the male Cahow almost always returns from the ocean to their nest burrow about a week or so before the female bird, and (b) when a female bird dies, the surviving male will almost always try to attract a new female to the same burrow, whereas if a male bird dies, the female survivor will usually abandon the burrow and look for a new mate at a new nest location.

Despite the loss of these 5 nesting pairs, so many new pairs (8) established in new nest burrows that the total number of breeding pairs in the Cahow population increased to a record high number of 111 (compared to 108 pairs during the last breeding season).

The impact of these hurricanes illustrates the fact that **the Cahow breeding population is still subject to a number of continuing threats and limiting factors.** These include nest competition from the native White-tailed Tropicbird, the threat of introduced mammal predators (especially rats) swimming out to the nesting islets (**see section 3(c)**), a shortage of suitable nesting sites at the present islets, and the annual threat of massive erosion and damage to the islets from hurricane waves and storm surge. Much of the present management carried out on the Cahow through the Recovery Program has been focused on addressing and overcoming these various threats to the species, with a generally high degree of success so far.

Hurricane Gonzalo illustrated the fact that damage and major erosion to the nesting islets from severe hurricanes and storms, coupled with accelerating sea-level rise, is considered to be the single most important threat to the Cahow. After a thirty-five year period (early 1950s to late 1980s) with few to no major impacts from hurricane waves and storm surge, there have been no fewer than eleven major hurricane impacts to the nesting islets from hurricanes between 1989 and 2015 (hurricanes “Dean” in 1989; “Lily” in 1991; “Felix” in 1995; “Gert” in 1999; “Fabian” in 2003, “Florence” in 2006; “Bill” in 2009; “Igor” in 2010; “Katia” in 2011, “Rafael” in 2012 and “Gonzalo” in 2014.

The impacts on the nesting islands from these hurricanes have included the undermining and collapse of large sections of the islands, and breaking away of large chunks of limestone and cliff face, coupled with overwashing of the smaller islets, when large waves break completely over the island. This has resulted in both the complete destruction of many of the original nesting burrows used by Cahows, and in damage to and filling in by rocks and debris of much of the remainder. A great deal of dangerous and labor-intensive work is needed to repair nests after hurricane strikes in many years, before the Cahows return for their nesting season. It is considered important to repair as many of the original nests as possible, as their loss results in established pairs breaking up and needing several years to re-establish new nests with new mates.

To address this threat, **a major component of the recent recovery program has been to establish new nesting colonies** on islands that are larger and of greater elevation than the original tiny nesting islets, which are generally only half an acre (0.2 Ha) in area each (**See Fig. 5**). This has already been accomplished on Nonsuch Island, which at 16.5 acres is the largest isolated island in the Castle Harbour area, and is maintained rat-free as part of the Living museum ecological restoration project. **A new colony has been established** with 14 active nest burrows now occupied by returned Cahows which had originally been translocated as chicks to Nonsuch Island (**Carlile et al 2012**). **102 chicks were translocated** between 2004 and 2008, and were then hand-fed until they fledged out to sea, imprinting on Nonsuch Island in the process. By 2015, a total of 49 of the translocated Cahows had been confirmed returning as adults, of which 29 have been recaptured in nests back on Nonsuch Island.

As this first effort to establish a new Cahow nesting colony proved to be successful, **work is now underway in establishing a second colony site at another location on Nonsuch Island (see Section 3(b))**, so that the Cahow has a second foothold on this much larger, more elevated island. During the last three years, a total of 47 near-fledged Cahow chicks have been translocated to this second colony site, of which 42 have fledged successfully out to sea.

Ironically, the only other offshore island in Bermuda that has been determined to be suitable for the establishment of a new Cahow nesting colony, Southampton Island, was recolonized naturally by the 2012-2013 breeding season by the expanding Cahow population. In the 2014-2015 breeding season, three breeding pairs of Cahows on this island produced one successfully fledging chick.

2 (b): Review of 2014/2015 Cahow Nesting Season and Management Actions



Fig. 4: newly hatched downy chick removed from burrow on Green Island, March 2015

Following is a review of the events and management / research work carried out for the Cahow Recovery Program through the 2014-2015 breeding season:

- (1) The breeding season normally begins with preparatory work for the upcoming Cahow nesting season in early October, including the unblocking of nest burrows, removal of entrance baffles etc. but was disrupted by the impacts of Hurricane Gonzalo. After the storm, considerable work was needed to repair and remove debris from damaged nest burrows, and dive up or replace concrete nest lids which were washed overboard from the smaller nesting islets.
- (2) The first Cahows were recorded returning from the open ocean to their nesting burrows on the 21st October 2014, with all back by the second week of November. During late October and November, 2014, a total of 92 adult Cahows were removed briefly from nests to check band numbers, body condition and weight.
- (3) During most of December, 2014, the Cahow breeding population returned out to sea for their pre-egg laying exodus. During this period, both partners of a nesting pair carry out 3 to 4-weeks of intensive feeding at sea, the female to develop her single large egg and the male to accumulate enough fat reserves for the first long shift of egg incubation, lasting up to 21 days with no food, while the female returns to sea

- to feed and recover after laying an egg which can mass up to one-fifth of her total body weight.
- (4) The first Cahows returned to the nesting islands from their pre-egg laying exodus at the beginning of January 2015, with the first eggs confirmed on the 6th January. During the egg incubation period, which lasts about 53 days, an additional 59 of the incubating adults were checked to determine sex, weight and band numbers. Checks to the nesting islands were made impossible at times, especially during January and February 2015, by gale-force winds on a nearly weekly basis as winter storm systems passed over the Bermuda area. Strong to gale-force winds occurred on at least 30 days between January and March 2015.
 - (5) The first Cahow chicks were confirmed as hatching by the 26th February, 2015, with almost 60 confirmed by the end of March. Some of these had to be confirmed in the deeper natural nests by the use of infra-red “burrow-scope” equipment. Once the chicks had hatched, a sub-sample of 38 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 used for a study of chick growth rates, but also has practical application in identifying chicks that are neglected or abandoned prematurely by the adults and need to be taken into care. Most importantly, it is also essential in identifying when chicks that are chosen for translocation are at the optimal stage of development to be moved to their new nest sites. Checks of chick growth rates continued until they all had departed to sea between late May and early July.
 - (6) All accessible chicks that could be reached by hand 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 2014-2015 Cahow nesting season, a total of 36 chicks were fitted with identification bands, out of a total of 53 chicks which successfully fledged (68 % of all chicks). *See section 3(e) for complete information on the Cahow Banding Program.
 - (7) The total number of active nesting pairs of Cahows increased to a record high of 111, compared to 108 nesting pairs in the 2012 – 2013 nesting season and 55 pairs in the 2000 – 2001 seasons. A total of 53 chicks successfully fledged from all nesting islands, slightly less than the record number of 59 chicks that were fledged in the 2013 – 2014 nesting season (See Fig. 5).
 - (8) 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. As of June 2014, a total of 29 of the translocated birds have returned to Nonsuch Island as adults, with 14 nesting pairs laying eggs in 2015. From these, ten chicks hatched, of which 9 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).

(9) During May and June, a total of twelve Cahow chicks were translocated from the four original nesting islets to a second site on Nonsuch Island (See Fig. 6). Ten of these chicks eventually fledged successfully from this new site, termed the ‘B’ site. This makes a total of 43 translocated chicks that have fledged to sea successfully over the last three breeding seasons from the ‘B’ translocation site, out of 48 chicks that have been translocated (89.6% success rate). This new translocation effort started five years after the first translocation project, which has been successful in establishing a new breeding colony on Nonsuch. It is planned to eventually move 80-90 chicks to this new location over a 5-year period (See section 3(d)). The last Cahow chick to depart from Nonsuch fledged on 19th June, 2015.

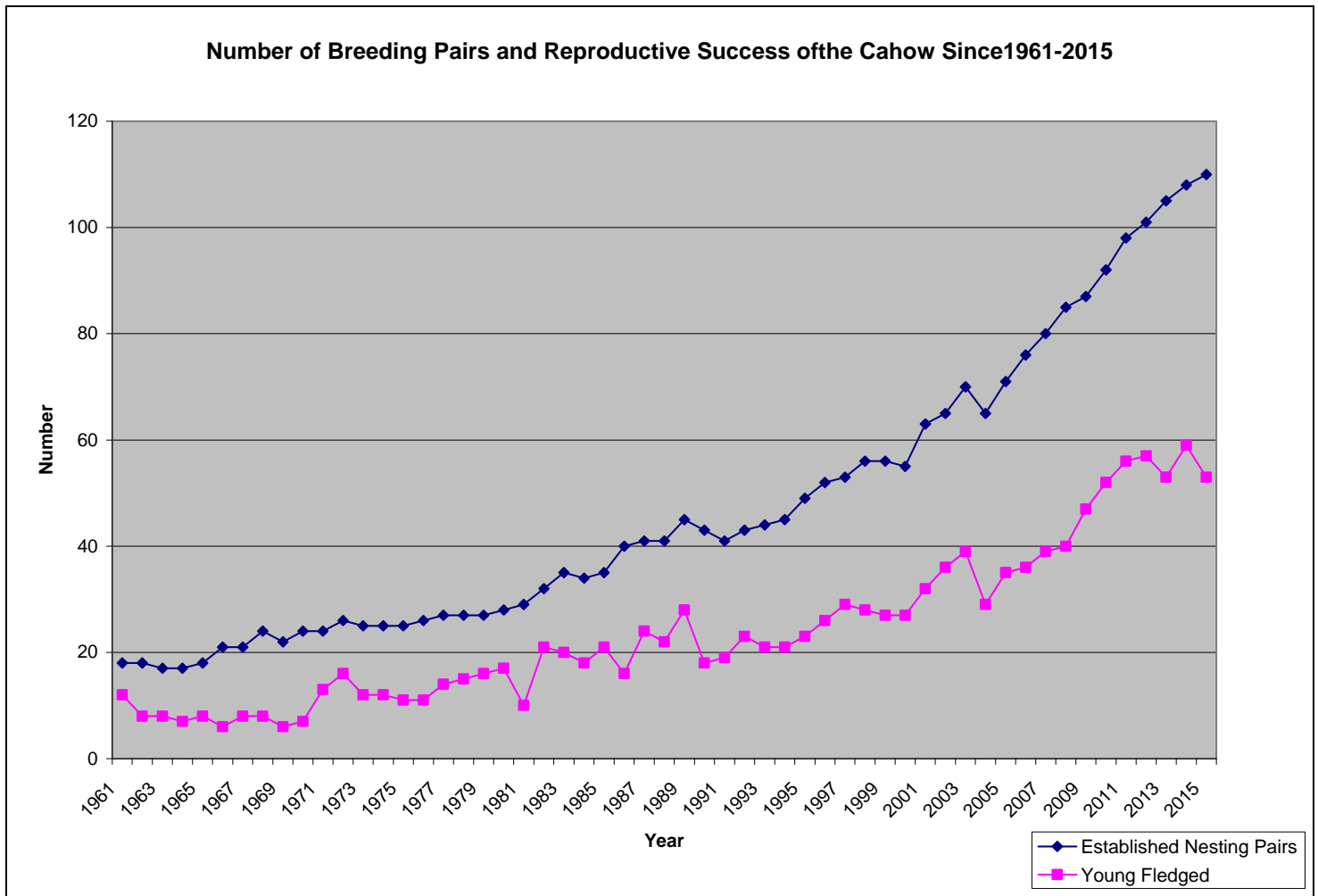


Fig. 5: Number of breeding pairs and fledged young Cahow over 54-year period (L. Madeiros)

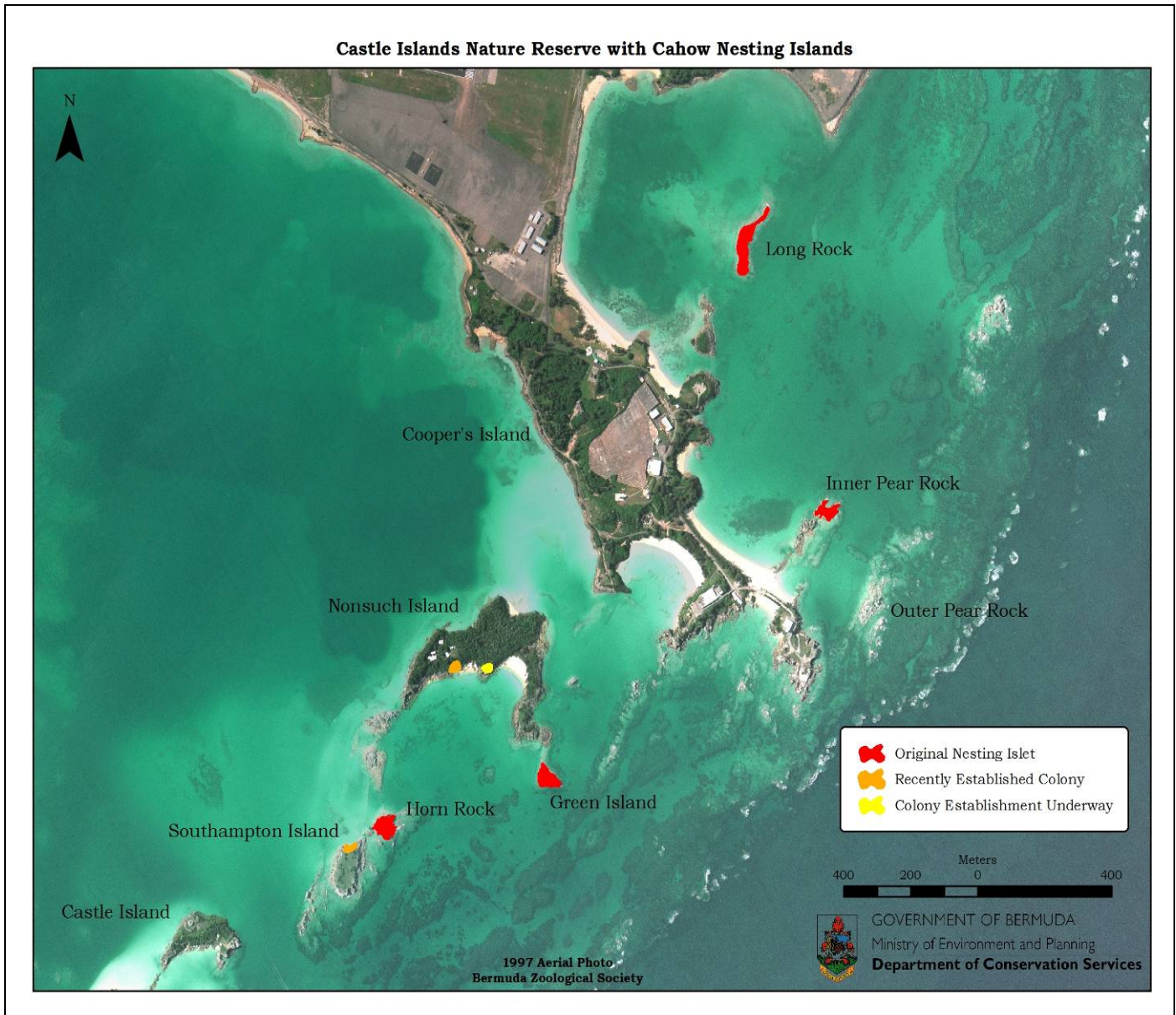


Fig. 6: 2015 Map of Cahow Nesting Sites on the Castle Harbour Islands Reserve, showing original nesting islets, recently established nesting colonies and the site where new colony establishment is currently underway.
(M. Shailer)

2(c): Summary of 2014 - 2015 Cahow Nesting Season:

This Cahow nesting season has been highlighted by (a): an increase in the number of breeding pairs; (b): the number of successfully fledging chicks decreased from last year's record number of 59 down to 53, due largely to disruption from hurricane "Gonzalo" at the start of the season, 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 111 breeding pairs, of which 53 produced successfully fledging chicks. This represents a breeding success rate of 47.7 %, which is notably less than the 54.6 %, recorded in the 2013-2014 nesting season. In addition, new prospecting or pre-breeding activity was recorded at 7 additional nest sites, including 1 new nest site on Nonsuch Island.

Following is a summary of the 2014-2015 nesting season results:

Total number of nest burrows with confirmed nesting activity:	111*
Number of new nest sites with prospecting activity:	5
Total number of confirmed successfully fledged chicks:	53
Total number of active nest sites with unsuccessful nesting:	59
Number of failures from nest sites with observable nest chambers:	49
Number of failures from nest sites with non-observable nest chambers:	10
Breakdown for causes of breeding failure from nests where observation of nest chambers was possible:	
Chick died hatching:	2
Chick died within one month of hatching:	3
Chick died later in development:	2
Eggs broken or pipped:	17
Egg broken during nest check:	0
Non-hatching / infertile eggs:	18
Egg buried or knocked off nest:	4
Egg washed off nest by storm waves:	0
Egg disappeared (Crab/rat predation?):	2
Chick killed by Tropicbird:	1

* Indicates record high numbers

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

Following is a breakdown of breeding results for all present Cahow nesting islands for the 2014/2015 nesting season. It is very evident that the two nesting islets that were submerged in Hurricane “Gonzalo” at the beginning of the season, Long Rock and Green Island, had very low breeding success, at 30.8 % and 34.8 % respectively. In contrast, other islands that were not submerged (Inner Pear Rock, Horn Rock, Nonsuch Island) had much higher breeding success rates of 50.0 %, 52.5 % and 64.3 % respectively.

LONG ROCK:

Active nest burrows with nesting confirmed (eggs laid and/or chick hatched): 13
New nest burrow prospected by confirmed pair: 1
Nest burrows with successfully fledged chicks: 4
(B, D1, D2, D4)
Nest burrows with confirmed failed nesting: 9
(A (cause unknown), C (cause unknown), D3-egg broken, D5-egg crushed, D7-egg disappeared-Land Hermit Crab predation, D8- chick disappeared at 7 weeks of age – rat predation?, D9-chick died at 9 days of age, E4-egg infertile and undersized, 14-egg broken)

INNER PEAR ROCK:

Active nest burrows with nesting confirmed: 18
New nest burrows prospected by confirmed pairs: 0
Nest burrows with successfully fledged chicks: 9
(A1, B1, B3, B4, B8, B9, C2, C4, D1)
Nest burrows with confirmed failed nesting: 9
(B2-egg infertile, B5 (cause unknown), B6-egg broken, B7-egg infertile, B10-egg buried, C3-chick died shortly after hatching, D2-chick died at 3-4 days old, D4-chick killed by Tropicbird at 7 weeks of age, E1 (unknown causes).

GREEN ISLAND:

Active nest burrows with nesting confirmed: 23
New nest burrow prospected by confirmed pair: 1
Nest burrows with successfully fledged chicks: 8
(A1, F3, # 3-4, # 6, # 10, # 11, # 12, # 13,)
Nest burrows with confirmed failed nesting:15
(D1-infertile egg, E1- cause of failure unknown; F1 – cause of failure unknown, F2-egg broken, # 2-egg broken, # 3-egg broken, # 4-egg infertile, # 4/5- egg rolled off nest into tunnel, # 5- egg broken, # 5-6-egg infertile, # 7-egg broken, # 8-egg broken, # 9-infertile egg buried in nest, # 14-egg broken, # 15-egg infertile)

HORN ROCK:

Active nest burrows with nesting confirmed:	40
New nest burrows prospected by confirmed pairs:	3
Nest burrows with confirmed successfully fledged chicks:	21
(B6,C4, C6, C7, C8, C11, C13, C14, C16, C19, C22, C23, C24, C25, C26, D4, F3, F5, F6, F7, G3)	
Nest burrows with confirmed failed nesting:	19
(B3-egg knocked off nest/buried, B5-unknown causes, C5-infertile egg, C9-infertile egg, C10-broken egg, C12-chick died when fledging, C15-chick died shortly after hatching, C17-broken egg, C20-infertile egg, C21-infertile egg, C27-egg crushed, C28- egg broken, D1-chick died at fledging-unknown causes, D3-egg buried on nest, E1-unknown, E2-unknown, F2-egg infertile, F4-egg infertile, F8-egg broken)	

NONSUCH ISLAND:

Active nest burrows with nesting confirmed:	14
New nest burrows prospected by confirmed pairs:	1
Nest burrows with confirmed successfully fledged chicks:	9
(R816, R818, R819, R820, R821, R831, R832, R835, R836)	
Nest burrows with confirmed failed nesting:	5
(R817-infertile egg, R830-infertile egg, R833-egg infertile/buried, R834-infertile egg, R837-egg rolled off nest and broken)	

SOUTHAMPTON ISLAND:

Active nest burrows with nesting confirmed:	3
New nest burrows prospected:	1
Nest burrows with successfully fledged chicks:	1
(S3)	
Nest burrows with failed nesting:	2
(S1, S2 -cause unknown)	

SECTION 3:

3(a): Update on New Nesting Colony at Nonsuch Island:



Fig. 7: Adult Cahow being measured and weighed on Nonsuch Island (J. Rieterer)

The Cahow Translocation Project is an ongoing project to establish new nesting colonies of the Bermuda petrel on larger, more elevated islands that have been chosen as suitable habitat, and are less at risk from hurricane erosion and overwashing during hurricanes than the original tiny nesting islets. It involves moving (translocating) Cahow chicks approximately 18 days before fledging from their nests on the four tiny original nesting islets to new complexes of artificial burrows constructed on the larger, chosen islands.

Since the original nesting islands range only between 0.5 to 1.0 acres in size, with maximum elevations ranging from 15' (4.8m) to 32' (10m), Nonsuch Island, which is both larger at 15.5 acres (6.5 Ha) and of higher elevation at up to 65' (20m) was chosen for the first of these translocations (See Fig.6). It offers much greater protection both from storm flooding and erosion, and also has a much larger area to allow for growth of the Cahow breeding population to a more self-sustaining level. It also contains adequate soil and forest cover (Wingate, 1985) to enable the Cahows to dig out their own nest burrows. Nonsuch is the site of a long-term ecological restoration project which aims to restore the original plant and animal communities found on the island before human colonization.

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*. To this end, a total of 105 Cahow chicks selected from all four of the original nesting islets were moved to a new nest burrow complex 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 then 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 the open ocean on their own. A total of 102 translocated Cahow chicks eventually fledged successfully from Nonsuch by 2008 (**Carlile et al. 2012**).

In addition, a solar-powered sound attraction system was set up at the translocation site in 2008 to help attract returning birds to land and prospect for new, empty nest burrows. Although Gadfly petrels tend to return to their original fledging site, they also prefer to nest close to already active nest sites, a trait known as *social attraction*. Until a nucleus of nesting pairs was established on Nonsuch Island, the sound system broadcasted a recording of Cahow courtship calls automatically at night to encourage returning, newly matured translocated birds to prospect for new nest burrows on Nonsuch.

By 2008, the first four returning Cahows translocated three years earlier to Nonsuch were recaptured back at the translocation site on Nonsuch, and their identities confirmed from their band numbers. Some of these birds were also observed investigating nest burrows at the translocation site. The first real evidence that the effort to establish a new Cahow breeding colony on Nonsuch was succeeding occurred during the **2009 nesting season**, with the first pairs of Cahows establishing in nest burrows. This resulted in the first egg laid and 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 2014, the number of established breeding pairs carrying out nesting activity and laying eggs at the new Nonsuch Island nesting colony rose from 4 to 13, with the number of successfully fledged chicks produced each year by this colony increasing from 1 chick in 2010 to 9 chicks in 2014. The total number of returning adult Cahows on Nonsuch Island that had been translocated 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.

For the most recent 2014-2015 breeding season, the total number of breeding pairs on Nonsuch rose to 14, of which 9 produced successfully fledging chicks. The total number of Cahow chicks that have hatched and successfully fledged from the new Nonsuch nesting colony since 2009 has now risen to 36 (**See Tables 1 and 2**)

TABLE 1: Breeding results at new translocation colony on Nonsuch Island 2008/2009 to 2014/2015 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

A comparison was made of the origins and sex of all Cahows now comprising the nesting pairs breeding at the new Nonsuch Island colony site. Sex of birds was determined by external cloacal examination of adults immediately following egg-laying. A total of 8 of the nesting pairs on Nonsuch have both adult birds originating from the 2004-2008 Translocation Project. Another 6 pairs are comprised of one adult from the Translocation Project, and one non-translocated bird. It is worth noting that in all six pairs with adults of mixed origin, that the male birds were in every case translocated to Nonsuch as chicks, but they have all attracted non-translocated female birds fledging from all 4 of the original nesting islets.

This provides additional evidence that male *Pterodroma* petrels are much more likely to return to their natal nesting and fledging sites, whereas female birds are far more likely to be attracted to nesting areas other than those that they fledged from, in search of potential mates. Banding studies of the Cahow have now shown that this is true for both translocated and non-translocated (naturally fledging) chicks.

For the 2014-2015 nesting season, the R831 nest burrow on Nonsuch was fitted for the second year with an infrared “Burrow-Cam” developed by Mr. J.P. Rouja, which live-streams video footage from inside the burrow’s nest-chamber via an antenna mounted on the chimney of the warden’s residence. This was featured on the www.nonsuchisland.com website, where it can be viewed live by the general public. This video feed documented the hatching and growth of the Cahow chick (named “Rainbow” by Sophie Rouja), until its eventual departure out to sea three months later. This chick fledged successfully out to sea on the night of 6th June, 2015 (See section 3(d), page 28 for full details).

Overall, for the 2014-2015 Breeding Season, the first Cahow chick to fledge to sea at the (A) translocation colony site did so during the night of May 29, 2015, while the last one fledged out to sea on the night of June 25th, 2014.

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 2015, when the number of breeding pairs increased to 14. It also shows the year at which the breeding pairs in each burrow first became active; Cahow pairs display high site fidelity, faithfully returning to the same nest burrow every year.

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

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

3 (b): Third Year of Second Translocation Project at (B) Location on Nonsuch



Fig. 8: Translocated Cahow chick out of burrow to exercise on Nonsuch Island

2015 marked the third year of a second translocation project aiming to establish a second nesting colony for the Cahow on Nonsuch Island.

With the first translocation project proving to be successful in establishing a new breeding colony on the southern coastal hillside of Nonsuch, the obvious next stage was to build and improve on that success by undertaking to establish 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. This was to be accomplished by building a new complex of artificial nest burrows about 200 meters to the east of the original colony site. A total of 80 to 90 fledgling Cahows would then be moved over a 5-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 imprint on the new site, hopefully to return there 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, overlooking the main, south beach, and is situated at 35' to 45' above sea level, 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 9 new Cahow nest burrows at the new translocation site (**See Fig. 9**). Another six artificial burrows of a new design developed by former Conservation Officer Dr. David Wingate, and made of heavy sunlight-resistant polyethylene, were also installed at this site on a trial basis, bringing the total number of burrows at this site to fifteen.



Fig. 9: New concrete Cahow nest burrows being built at “B” translocation site.

In the event, both the traditional concrete artificial burrows and the new design plastic burrows seemed to work well, being readily accepted by the translocated chicks during the approximately two to three-week period. Thirteen Cahow chicks were translocated to the “B” nest colony site from three of the four original nesting islets, eleven of which successfully fledged out to sea. Out of 11 successfully fledging chicks, 7 originated from nest burrows on Horn Rock (C6, C11, C14, C22, C26, F7, G3), 3 from nests on Green Island (# 3/4, # 6, # 10), and 1 from a nest on Long Rock (Long D4).

The first Cahow chick (from the Green Island # 10 nest) was translocated to Nonsuch Island on the 13th May, 2014. This also became the first chick to successfully fledge out to sea, on the 29th May, after 16 days in its translocation burrow on Nonsuch. The final chick was not translocated until the 11th June, fledging out to sea on 19th June. The median date for translocation of chicks was the 22nd May, while the median date for fledging of chicks was the 9th June. The age of chicks at their translocation ranged from 70 to 87 days after hatching (mean age = 78 days). (**See Table 3 for full translocation results and figures**).

TABLE 3: 2015 Bermuda Petrel Translocation Project

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 (Origin – Island & nest No.)	Translocation		Number of Feeds		Emergence to fledging (days)	Fledging			
	Date moved (2014)	Age when moved (days)	No. of feeds after moving	Total Feed weight (grams)	(Exercise period)	Date fledged (2014)	Age from hatching (Days)	Weight (grams)	Wing Chord (mm)
GREEN 10	13 May	74	10	658 g	3	29 May	91	264g	259mm
HORN C22	15 May	75	13	536 g	6	1 June	93	304g	270mm
GREEN 3/4	15 May	75	10	431 g	4	2 June	94	237g	268mm
HORN C11	16 May	70	9	513 g	3	2 June	88	260g	263mm
HORN G3	19 May	80	9	521 g	4	5 June	98	270g	263mm
GREEN 6	22 May	77	10	488 g	2	9 June	96	188g	246mm
LONG D4	22 May	80	9	416 g	5	12 June	93	266g	268mm
HORN C26	24 May	80	4	205 g	8	11 June	98	307g	270mm
HORN F7	27 May	80	6	274 g	6	11 June	95	301g	262mm
HORN C6	2 June	83	8	341 g	3	15 June	97	234g	267mm
HORN C14	11 June	87	5	217 g	4	19 June	95	241g	257mm
Median	22 May					9 June			
Mean		78.1	8.45	418g	4.36		94.4	261.09g	263.0mm

While 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 human-quality fresh unfrozen squid (*Loligo sp.*) obtained from Miles Supermarket, Pitts Bay Rd. Pembroke. In addition, fresh fish were netted locally and provided by Mr. Chris Flook, who had also provided fish for the original translocation project from 2004 to 2008. Fish provided were mainly Anchovy (*Sardinella anchovia*), but also included Atlantic Threadfin Herring (*Opisthonema oglinum*). A typical meal for one Cahow chick consisted of 1 or 2 Squid bodies (with or without heads) and 5 to 6 Anchovies or equivalent.

The number of meals given to each translocated Cahow chick before fledging ranged from 4 – 13 meals (mean = 8.45 meals), and individual meal weights usually ranged from 40 grams to 70 grams (extreme ranges 14 grams – 94 grams). The total combined amount of food from all meals given to each chick also varied widely from a low of 205 grams to a high of 658 grams (mean = 418grams).

The number of nights that the chicks emerged to exercise before fledging ranged from 2 to 8 nights (mean = 4.36 nights), with chicks fledging to sea between the 28th May and the 19th June (median fledging date = 9th June).

The weight of the chicks at fledging ranged from a high of 307 grams to a low of only 188 grams, with the latter considered to be well below the target weight of 250-280 grams. However, the mean fledging weight was 261.09 grams, which compares favorably with naturally fledging chicks. The wing chord (outer wing length from the wrist joint) of fledging chicks ranged from 246mm to 270mm (mean = 263.0 mm).

The total age from hatching of the translocated chicks by the time they fledged ranged from 88 days to 98 days (mean = 94.4 days).



Fig. 10: Translocated Cahow chick exercising outside nest burrow at night on Nonsuch

A number of difficulties were encountered during the 2015 translocation of Cahow chicks to the (B) colony site on Nonsuch, the third year that chicks had been translocated to this site. These included a scarcity of fresh Anchovy baitfish, which are one of the primary food items fed to translocated chicks, but which were in very short supply throughout 2015. This led to a decision to reduce the number of Cahow chicks to be translocated by 50%, from a planned 24 down to 13. Another difficulty was time-consuming but essential rat eradication efforts, which had to be continued through the entire translocation period.

3(c): Second Outbreak of Black Rats on Nonsuch Island



Fig. 11: Black Rats caught in traps on Nonsuch Island, March 2015.

For the second consecutive year, Black Rats (*Rattus rattus*) were able to colonize Nonsuch Island during 2015, most likely by swimming over from Coopers Island, which is located only 300m northeast of Nonsuch. There is also a possibility that a small number of rats managed to survive eradication efforts in 2014 in remote parts of the island.

Rats pose an extreme threat to many aspects of the Nonsuch Living Museum Project, eating and destroying the seed and fruits of many endemic and native plant species, as well as posing an extreme threat to the eggs and young of seabirds like the Bermuda petrel and White-tailed Tropicbird, and land birds like the White-eyed Vireo, Catbird, European Goldfinch, Mourning Dove and Ground Dove. Therefore, all efforts are made to prevent rats from reaching Nonsuch (or any of the other Cahow nesting Islands), and when they do, to eradicate them as quickly as possible.

By the time the presence of the rats was again confirmed in March, 2015 (by evidence of droppings and chewed Olivewood and Bay-Grape seeds), they had already built up a substantial population, primarily around the buildings and down towards the South Beach area. Both “live-traps” and anticoagulant rodenticide bait were used to try and eradicate the rodents. “Break-neck” spring traps were not used because of the danger they pose to ground-foraging native birds such as the Catbird (*Dumetella carolinensis*). Up to 12 live-traps were set at a time around Nonsuch Island, checked and re-set with fresh bait daily, and any rats euthanized, for more than seven months, with more than 73 rats eventually trapped and destroyed (see Fig.11).

A number of non-target species were also caught in the live-traps; the most common of which was the native Catbird, which has a large population on Nonsuch Island, especially during the spring breeding season. A total of 5 Catbirds were found in live-traps, all of which were released without harm except for one which died, underlining the importance of daily checks when using these traps. In addition, large Red Land Crabs (*Gecarcinus lateralis*) were found eight times in traps, and Land Hermit Crabs (*Coenobita clypeatus*) were found four times in traps. All of these were released without harm.

Traps alone can bring rat numbers down and achieve temporary control, but can not completely eradicate them on an island as large and heavily vegetated as Nonsuch. This is largely due to the fact that a small number of rats are “trap-shy” and will not enter traps at all. There is also the problem that rats now have abundant alternative supplies of other food, such as Palmetto, Olivewood and Bay-grape berries, prolifically available on the island at different times of the year.

As a result, during the “window” from January through April 2015, when plant fruits and berries were not available and there were few alternate food resources available for the rats, **Vector Control (Health Dept.) was contacted and with their assistance, anticoagulant rodenticide bait was set out in approximately 40 bait boxes over the whole of Nonsuch Island.** This is the only practical way of achieving the complete eradication of rats on Nonsuch Island, and was the method used successfully to eradicate rats the last time they colonized Nonsuch in 2005.

In addition to Nonsuch Island, Black Rats were also able to reach at least two of the other Castle Harbour Islands that are nesting sites for the Cahows. These were Long Rock (May 2015) and Green Island (April 2015). As these islands are much smaller and have much less plant cover and available food sources compared to Nonsuch, complete eradication of the rats there was in all cases achieved within two weeks of detection through the use of anticoagulant bait blocks deployed in lockable plastic bait boxes.

By May, 2015, the number of rats on Nonsuch Island had again been reduced to nearly undetectable levels, and remained so through the rest of the summer period. However, a few rats again survived unseen in the eastern end of the island, so that small numbers (no more than 1-2 per week) began to be caught again by late September. Eradication efforts were resumed and were ongoing at the time of this report.

3 (d): Live-streaming of Cahow Burrow-cam from Nonsuch

2013 had marked the first time that an infrared “night vision” video camera was used in a Cahow nest burrow to record video footage of the late egg incubation stage, egg hatching and the development of a chick from 1 week of age to fledging. Video clips of the public development of the chick, which came to be called “Backson”, was provided free to the

over the LookTV website as follows: <http://lookbermuda.com/CahowCam> .This project, which was funded entirely by the Ascendant Group of Companies, involved the modification of several of the concrete nest lids with 4” PVC electrical conduit pipes so that a customized “Go Pro 2” camera modified by Mr. JP Rouja to be sensitive to infrared light (See Fig. 12) could be installed to take video footage of the Cahow adults and chicks inside their burrows, which are completely dark.



Fig. 12: Cahow chick as seen in nest burrow with Infra-red “Burrow-cam”

This video camera, fitted with military-grade infrared lights that are completely undetectable by humans or animals, enables high-definition video footage to be taken whenever power is available at the colony site. The CahowCam has the great advantage of making observations of these critically endangered birds available to the public at any time, without causing disturbance to the birds or threatening their breeding success in any way. Another advantage that this system brings is that it allows the managing researcher to check on the progress of egg incubation, growth of the chicks etc. in the nest without causing any disturbance to the birds. Breeding, courtship and nest-building behavior of the adult birds, as well as chick behavior, can also be observed in a totally non-obtrusive manner for the first time. This not only has great benefits for behavioral and breeding biology research, but also can be provided to the public, who can participate in the “citizen science” aspect by seeing new behavior at the same time as the researchers.

Although live-streaming of CahowCam footage was not possible during the 2013 Cahow breeding season because of the lack of electrical supply on Nonsuch Island, the installation of a new Solar Power System was carried out by PUREENERGY RENEWABLES LTD. and volunteers from the Ascendant Group of Companies, Dept. of Conservation Services, Dept. of Public Works and Bell Landscaping during June, 2013. This development allowed

live-streaming to be carried out from Nonsuch Island for the first time during the 2013-2014 breeding season. The CahowCam was installed in the R831 Cahow burrow for the latter half of this season, and allowed the growth of the chick (named “Lightning”) in the completely dark burrow to be followed from just after hatching until the chick fledged out to sea. This resulted in a number of new findings about the breeding biology and chick-rearing aspects of Cahow nesting behavior.

For the 2014-2015 breeding season, the Burrow-cam was installed in the R831 nest burrow on Nonsuch Island on the 2nd March, towards the end of the egg incubation period. Only 2 days later, on the 4th March, the egg hatched in that nest, with the chick fledging by June 3.

Following are some of the highlights that the CahowCam revealed during 2015:

- (1) For the first time ever, the hatching of a Cahow chick was captured and live-streamed over the internet. The hatching took several hours, and the chick was evidently helped from the eggshell by the adult male bird (who was incubating the egg at the time) in the latter stages of this process.
- (2) Once the wet, exhausted chick was free from the eggshell, the male bird then intensively preened the chick before settling down on it to brood it for several hours. By the time the chick was seen again, its down had completely dried out and it had assumed the familiar “puffball” appearance.
- (3) A surprising observation occurred when the brooding male bird fed the chick only 4 hours after hatching on proventricular oil (pre-digested, oily, vitamin-rich food from the adult’s last meal more than 10 days before).
- (4) A large number of feeding visits by the adult Cahows to the chick were recorded, usually lasting only an hour or two before the adult returned out to sea. On one occasion, both adults visited and fed the chick on the same night, carrying out reciprocal preening of each other and the chick for at least 3 hours.

The infrared CahowCam has already proven its value, both in revealing previously unknown behavior and in public outreach. It has enabled the public to follow the development and behavior of the chick and adult Cahows at the same time as researchers, revealing the private life of Bermuda’s critically endangered National Bird to an international audience over the internet. For the next, 2015-2016 breeding season, it is planned to live-stream video from the CahowCam from the beginning of the nesting season in November, to follow the return, nest-building and courtship phase of the season by the nesting adults.

Other public outreach efforts relating to the Cahow Recovery Project included guided tours and “Cahow encounters” at Nonsuch, in addition to PowerPoint presentations at schools and the Bermuda Zoological Society’s Natural History Course. Saltus Cavendish School included the Cahow in their curriculum and in addition gave a generous donation to the Recovery Project (**See Figs. 13 & 14**). Over 20 tour groups, mostly from local school classes, were able to see Cahows at close range on Nonsuch Island being assessed and measured as part of the research program.



Fig. 13: Presentation of cheque towards Cahow research work by Saltus Cavendish Primary School



Fig.14: Student dressed as Cahow “chick” in nest at Saltus Cavendish School!

3 (e): Update on Cahow Banding Program for 2015:

The Cahow banding program has been a key component of the Cahow Recovery Program since 2002, with 5.5 mm metal bands made of a strong, corrosion-resistant alloy called incoloy being fitted to the right legs of adult Cahows and the left legs of fledgling birds. These bands can last for the life of the birds and are imprinted with a unique code and a return address. The bands are vital for allowing easy, positive identification of individual Cahows in the field, and enable researchers to follow these birds for essentially their entire breeding lifespan, through recaptures over successive years.

The Cahow Banding Program has now been underway for thirteen years, As of June, 2015, a total of 585 Cahows have been fitted with identification bands, the majority of which have been fledgling birds* This includes 143 birds banded as breeding adults, and 442 birds banded as chicks before fledging to sea. In other terms, these numbers represent almost 75 % of the current adult breeding population, and about 85% of all chicks to have fledged since 2002. (*This does not represent the total population of Cahows, as only about a third of fledglings survive their first years at sea before returning as adults; the total world population of the species is conservatively estimated at approximately 315 individuals, including immature and non-breeding birds).

Banding of Cahow chicks is of particular value due to the fact that it enables the easy identification and study of individual birds whose age is accurately known, as well as the nest, island and parent birds that they originated from. These known-age birds have already provided a wealth of previously unknown information on many aspects of behavior and breeding biology, including the following:

- 1) The survival rates of chicks during the period between fledging to sea and their first return to the nesting grounds as sexually mature young adults;
- 2) The differences in survival rates of naturally-fledged birds (raised entirely by the adults), as compared to those that have been translocated (raised partly by adult birds, partly by humans).
- 3) The age of chicks upon their first return to the nesting grounds, which was found to differ between male and female birds;
- 4) The period of time between the first return of the young birds, to the choosing of nest sites and mates, and the first breeding attempts;
- 5) Whether young Cahows always return to their exact point of departure, or if they sometimes return to other islands/nesting colonies; the banding program has confirmed that this differs considerably between male and female birds.

In addition, the banding of adult Cahows is providing concrete data on breeding success rates, site faithfulness and pair faithfulness, and eventually on the longevity of individual birds (**Madeiros et al. 2012**). The information gathered by the Cahow banding project will continue to increase knowledge of the species, as long as the banding project and annual recapture and band checks of the birds continue into the future.

Section 4 (a): Planned 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:

2015 – 2016 Breeding Seasons:

- Continue translocations of near-fledged Cahow chicks from nesting islands to “B” colony site on Nonsuch Island, moving 20 – 25 chicks annually until a target figure of 75 to 90 chicks have been moved to and fledged from Nonsuch;
- Install 2nd sound attraction system at new “B” colony site on Nonsuch Island and play disc of recorded Cahow courtship calls and cries during breeding season; discontinue use of sound attraction system at “A” translocation site on Nonsuch;
- 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.
- Carry out 10-year review of 2005 Cahow Recovery Plan.
- Investigate the potential deployment of extremely accurate GPS loggers on Cahows to more accurately determine oceanic range and important foraging areas for the species.

2016 – 2017 Breeding Seasons:

- Continue translocating 20 – 25 near-fledged Cahow chicks annually from the original nesting islands to the “B” colony site on Nonsuch Island;
- Continue 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 2014 – 2015 breeding season:

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I am deeply indebted to the Terrestrial Conservation Crew for their hard work in building artificial concrete nest burrows and assistance in managing the nesting habitat for the Cahows on both Nonsuch Island and the original nesting islets. The Terrestrial Conservation Crew consists of Barry Smith (Foreman), Llewellyn Rewan, Kiwon Furbert and Marvin Jones.

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, has also been an important supporter of the project. Special thanks also go out to the Ascendant Group of Companies, who have supported and provided volunteers to construct new Cahow nest burrows and a new solar power system for the Cahow Recovery Project. We are deeply grateful for the interest and generosity shown by these and other donors.

In conclusion, I would like to acknowledge and thank my family, whose support and patience have made this demanding project possible over the last 15 years.

Jeremy Madeiros,
Senior Terrestrial Conservation Officer

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Fig. 15: Adult Cahow flying at sea 1 ½ miles southeast of Nonsuch Island (J. Rieterer)