

CAHOW RECOVERY PROGRAM 2012 – 2013 Breeding Season Report



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**BERMUDA GOVERNMENT
DEPARTMENT OF CONSERVATION SERVICES**

“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 2012 to July 2013



**Fig. 1: Translocated 10-week old Cahow chick on Nonsuch Island, June 2013
(Tim White)**

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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. This program is focused on increasing the breeding population through the control or elimination of threats to the species, provision of additional artificial nesting burrows, and the establishment of entirely new nesting colonies.

The Cahow nests only on the Islands of Bermuda and was thought to have originally numbered more than half a million birds, but was catastrophically affected by the arrival of humans on the island 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 20 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 of a tiny 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 species. 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 105 breeding pairs in 2013, 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 been completed highlighting 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 storm 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 2013 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 12 pairs established in nest burrows and laying eggs. From these, five chicks hatched and successfully fledged out to sea. New pairs and prospecting activity was noted in 2 additional nests, and a total of 29 of the translocated birds have so far returned to Nonsuch as adults, in addition to 3 non-translocated Cahows attracted to the new colony by the returned translocated birds.

- The total breeding population of the Cahow has reached 105 nesting pairs, numbers which almost certainly have not been seen since the early 1600s.
- Despite the increase in the number of nesting pairs, the number of chicks that successfully fledged fell slightly to 53, compared to 57 during the 2011-2012 nesting season.
- Despite the impact of hurricanes ‘Raphael’ and ‘Sandy’ in fall of 2012, little damage and erosion to nesting burrows was recorded, and there appears to have been little effect on breeding success in the 2012-2013 breeding season.
- The second translocation of Cahow chicks to Nonsuch was commenced at the ‘B’ translocation site, on the south hill overlooking the south beach area of Nonsuch and approximately 200m east of the ‘A’ colony site. A total of 14 Cahow chicks were translocated from the four original nesting islets to artificial nest burrows at the site and hand-fed on fresh Anchovies and Squid. 12 of these chicks fledged successfully out to sea.
- The biggest surprise of the season was the discovery that Cahows have naturally colonized Southampton Island, located to the southwest of Nonsuch Island and only 80m from the largest present Cahow nesting colony on nearby Horn Rock. Three nesting pairs were discovered using deep rock crevices near the northern end of the Island.
- For the first time, an infrared “burrow-cam” developed by JP Rouja of LookTV was installed in one of the Cahow nest burrows on Nonsuch Island and weekly video updates posted on a website to allow school groups and the public to follow the development of a Cahow chick, named “Backson”, from hatching to departure out to sea. It is hoped that online live-streaming will be possible by 2014.

The Recovery Program continues to achieve its primary objective of increasing the Cahow breeding population and the number of successfully fledged chicks being produced. Increasing public and scientific interest in the Cahow and the Recovery Program has been helped by the publishing of a new multimedia guide to Gadfly petrels of the Atlantic, by Robert Flood and Adrian Fisher. The Cahow is featured on the cover of this book.

Full details on the 2012 – 2013 breeding season are given in the following report, in addition to research and management proposals for the next several years.

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 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 as follows:

- (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) To continue the program of construction of additional 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, and 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 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 and migration routes used by Cahows, both during the breeding season, and during the summer, non-breeding season.
- (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.

SECTION 2: 2 (a): Introduction:



Fig. 2: 1-week old Cahow chick removed from burrow for weighing (J. Madeiros)

The 2012-2013 Nesting Season of Bermuda's national bird, the endemic and critically endangered Bermuda petrel or Cahow (*Pterodroma cahow*) began in late October 2012 and ended in mid-June 2013 with the departure of the last fledglings out to the open ocean from their nesting burrows. This nesting season has been marked by the continued increase in the nesting population of Cahows, with a **record number of 105 pairs** nesting on the original nesting islets, at the new colony site on Nonsuch Island, and at the new breeding location on Southampton Island, with a total of 53 chicks successfully fledging out to sea. These are up from a total of just 18 nesting pairs and 8 fledged chicks when the recovery program began in 1960.

The Cahow is subject to pressure from a number of threats and limiting factors, including nest competition from the native White-tailed Tropicbird, the threat of introduced mammal predators (especially rats) swimming out to the nesting islets, lack 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 high degree of success.

The single most important threat to the Cahow is now considered to be damage and major erosion to the nesting islets from **severe hurricanes and storms**, coupled with accelerating sea-level rise. 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 no fewer than ten major hurricane impacts to the nesting islets from hurricanes between 1989 and 2012 (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, and “Rafael” in 2012.

The impacts 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 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 was needed to repair nests at the end of hurricane season in many years before the Cahows return for their nesting season. It is important to repair as many of the original nests as possible, as their loss will result in long-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 recovery program is to establish new nesting colonies on islands that are both larger and more elevated than the original tiny nesting islets, which are generally only half an acre (0.2 Ha) in area each (See Fig. 7). 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 13 active nest burrows now occupied by returned Cahows which had originally been translocated as chicks to Nonsuch Island. **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 2013, a total of 47 of the translocated Cahows had been confirmed returning as adults, of which 29 so far have been recaptured in nests back on Nonsuch Island.

As this first effort to establish a new Cahow nesting colony has proven to be successful, work is now underway to **establish a second colony site** elsewhere on Nonsuch Island. In the meantime, one of the biggest developments of this nesting season was the discovery that Cahows have occupied a number of nest sites on **Southampton Island**. Although smaller than Nonsuch at 2.36 acres, Southampton Island is still larger than the original nesting islets and is located only 80 meters from a current Cahow nesting colony. Work will be carried out this season to encourage the growth of this new potential nesting colony by using a combination of sound attraction, using pre-recorded courtship calls played back at the new colony sites to attract returning Cahows, and the installation of additional artificial nest burrows near the existing nests. (Incidentally, it had been originally planned in the 2005 Cahow Recovery Plan (Madeiros, 2005) to concentrate new colony establishment efforts on Southampton Island, once new colonies had been established on

Nonsuch Island, as Southampton Is. had been identified as the only other offshore island at Bermuda where the Cahow could still successfully breed.)

It was discovered on the 27th November (2012) that a large vagrant raptor (tentatively identified as a Great Horned Owl *Bubo virginianus*, based on distant views by Patrick Talbot and myself) had **killed and mostly eaten** two and possibly three adult Cahows. Two of the carcasses were discovered on Horn Rock and another on nearby Charles Island. Nest disruption and subsequent failure at two of the nests on Horn Rock indicate that two of the predated Cahows may have come from these nests. Luckily, the raptor only appeared to have stayed for a few days before it left Bermuda, and the Cahow population appears to now be robust enough to sustain occasional short-term predation incidents like this.

During November, 2012, British birder Robert Flood and photographer Mike Danzenbaker spent ten days in Bermuda in order to take photographs and video footage of Cahows at sea off the eastern end of the island (generally 2-8 miles southeast of Coopers and Nonsuch Islands). This was the second year that Mr. Flood had travelled to Bermuda for this purpose, in order to obtain material for the second in a series of **multimedia guide books** to seabirds of the Atlantic Ocean. This guide includes a section on the identification and conservation history of the Cahow, and includes two DVDs, one of which includes two taped interviews with Dr. David Wingate and Jeremy Madeiros recounting historical and present management efforts for the Cahow. The guide was published in 2013.

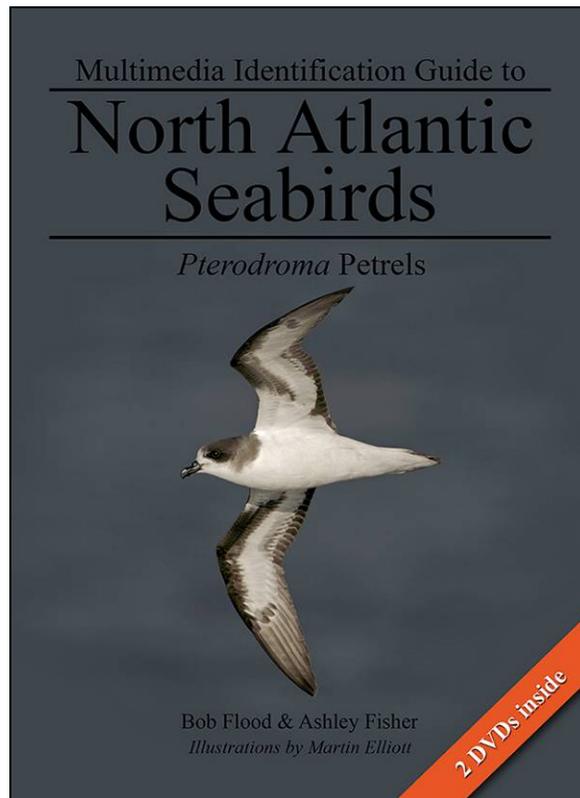


Fig. 3: Cahow on front cover of newly published Atlantic seabird guide (Bob Flood)

2 (b): Cahow Recovery Program – Review of 2012/2013 Nesting Season and Management Actions:



**Fig. 4: “Backson” Cahow chick exercising outside burrow at night, June, 2013.
(J. Madeiros)**

- (1) Preparatory work for the upcoming Cahow nesting season began in early October, 2012, with the unblocking of nest burrows, removal of entrance baffles, used to prevent nest invasions by Tropicbirds during the spring and summer months, and the placing of rat poison in bait boxes on all nesting islands.
- (2) Minor erosion and damage was caused to the nesting islands by hurricane “Rafael” which passed only 102 miles to the southeast of Bermuda during the 16th October, 2012, bringing gale-force winds and heavy ocean swells. A few concrete nest lids were washed off Long Rock and Green Island and some nests were flooded by the waves, but little other damage was caused to the nesting burrows. On the 29th October, hurricane “Sandy” produced similar strong winds and wave action as it passed about 300 miles west of the island before going on to produce severe damage and record storm surges to New Jersey and New York. The minor damage on the nesting islands was repaired by the beginning of November.

- (3) The first Cahows were recorded returning from the open ocean to their nesting burrows after the 20th October, with nearly all back by the first week of November. During the month of November, a total of 30 adult Cahows were removed from nests to check band numbers, body condition and weights.
- (4) During most of the month of December, 2012, the Cahow breeding population returned out to sea. This period, termed the pre-egg laying exodus, occurs because both partners of a nesting pair need to carry out a 5-week period 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 15 days with no food, while the female returns to sea to recover after laying an egg which can mass between one-quarter and one-fifth of her total body weight.
- (5) The first Cahows returned to the nesting islands from their pre-egg laying exodus at the beginning of January 2013, with the first eggs being confirmed on the 3rd January. The egg incubation period, which lasts about 53 days, is the main period in which incubating adults are checked to determine sex and band numbers to determine which birds are returning to which nests. Checks to the nesting islands were made impossible at times during this period by frequent gale-force winds as winter storm systems passed over the Bermuda area.
- (6) The first Cahow chick was confirmed hatching on the 28th February, 2013, with more than 26 confirmed by March 6th. By the end of March, almost 60 chicks had hatched, some of which 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 about 36 chicks was chosen which were then checked at least twice weekly, weather conditions permitting, for weight, wing chord length, and plumage development. This information is being 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 used for identifying when chicks that are being translocated are at the optimal stage of development to be moved to their new nest sites. Checks of chick growth rates continue until the chicks depart to sea between late May and early June.
- (7) The 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 2013 Cahow nesting season, a total of 38 chicks* were fitted with identification bands, out of a total of 53 chicks which successfully fledged (71.7 % of all chicks).
*See section 3(e) for complete information on the Cahow Banding Program.
- (8) The total number of active nesting pairs of Cahows increased to a record high of 105, compared to 101 nesting pairs in the 2011 – 2012 nesting season and 55 pairs in the 2000 – 2001 seasons. Due to higher than normal mortality of Cahow chicks after hatching in 2013, a reduced number of 53 chicks successfully fledged from the nesting islands, compared to 57 chicks that were fledged in the 2011 – 2012 nesting season (See Fig. 5).

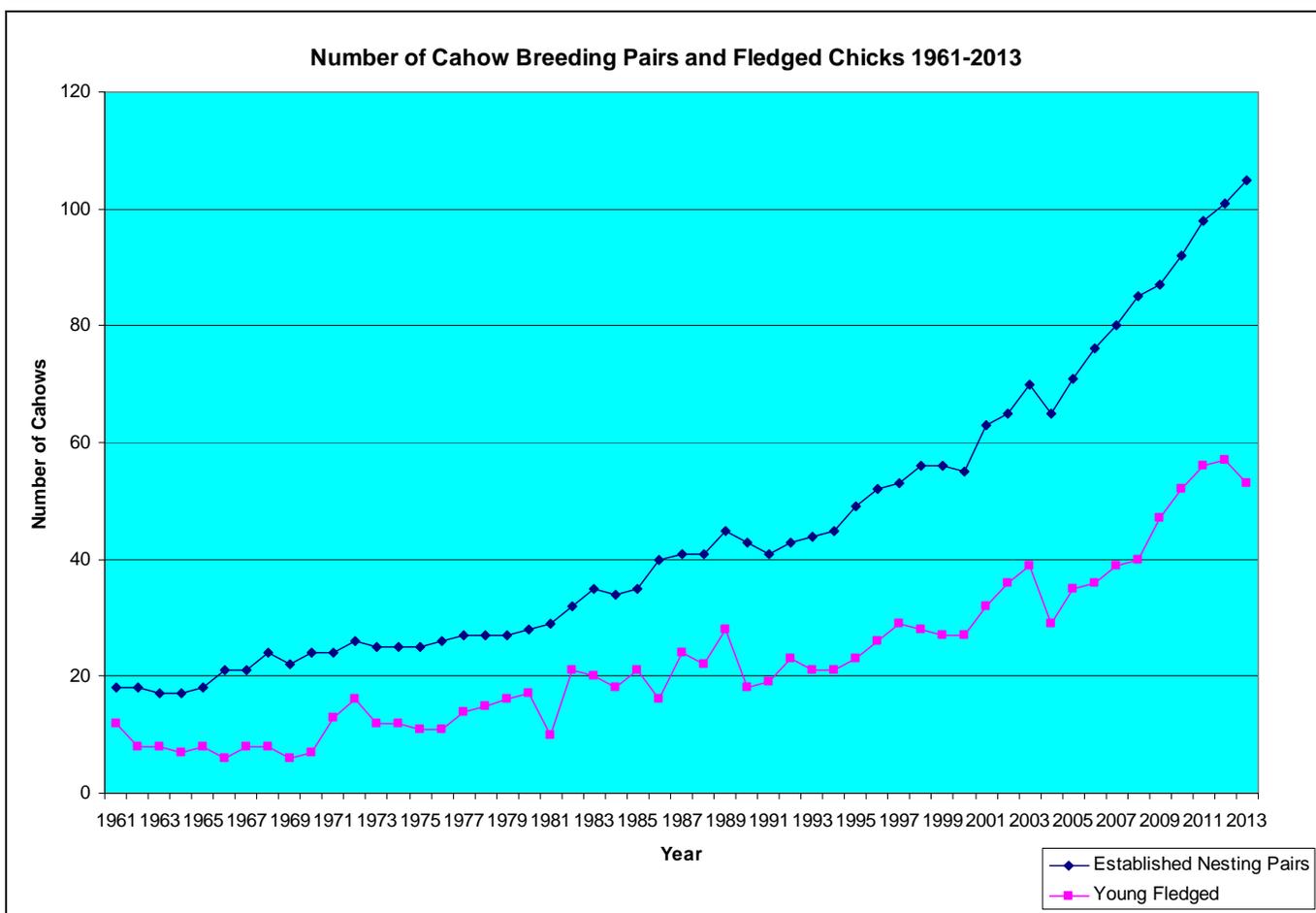


Fig. 5: Number of breeding pairs and fledged young Cahow over 52-year period (L. Madeiros)

- (9) 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 2013, a total of 27 of the translocated birds have returned to Nonsuch Island as adults, with 12 nesting pairs laying eggs in 2013. From these, five chicks hatched and fledged successfully out to sea, while a new pair of prospecting adult Cahows has established themselves in one additional nest. This means that a total of 13 nesting burrows on Nonsuch Island now have nesting or pre-nesting activity. (See section 3(a) for full details)
- (10) In early 2013, following a series of clues, a search of Southampton Island (located only 80m west of an existing nesting colony on Horn Rock) successfully located at least three active Cahow nesting sites in deep rock crevices on the north side of the island. One of these nest sites produced a successfully fledging chick. This represents the first time since its rediscovery that the cahow has re-colonized a former nesting location without human help, no doubt helped by the close proximity of the largest existing nesting population, on Horn Rock (with 37 nesting pairs). (See section 3(c) for full details).

- (11) In early May, the first of fourteen Cahow chicks were translocated from the four original nesting islets to a second site on Nonsuch Island (See Fig. 6). Twelve of these chicks eventually fledged successfully from this new site, termed the ‘B’ site. This new translocation effort starts five years after the first successful translocation project, which has been successful in establishing a new Cahow breeding colony on Nonsuch. It is planned to eventually move 70-80 chicks to this new location over a 4-year period (See section 3(d) for full details).

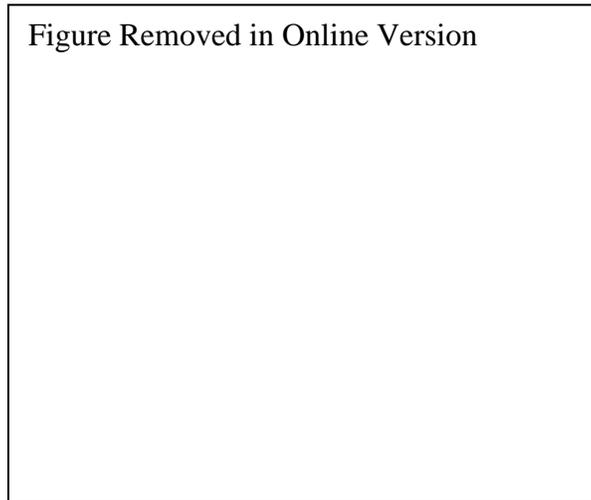


Fig. 6: 2013 Map of Cahow Nesting Sites on the Castle Harbour Islands Reserve
(M. Shailer)



Fig. 7: Translocated Cahow chick being fed fresh Anchovy on Nonsuch Island, June 2013 (T. White)

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- (12) An unusually high number of 12 Cahow chicks died at various points in their development, many from parental abandonment and others from unknown causes. It is a normal occurrence for several chicks to die during a breeding season, although all efforts are made to save as many abandoned chicks as possible. It was notable that most of the chicks that were regularly monitored were at lower than normal weights over much of their development, which may indicate a scarcity of normal prey items used by the adults to provision chicks, possibly coupled with

adverse weather conditions. The first Cahow chick fledged out to sea on May 26th from Nonsuch Island, while the last chick did not depart until 7th July, 2013.

2(c): Summary of 2012 - 2013 Cahow Nesting Season:

This Cahow nesting season has been highlighted by the highest number of breeding pairs to be recorded since the rediscovery of the species, and by the continued growth of the new nesting colony that has been established on the Nonsuch Island Nature Reserve, as well as the discovery of nesting pairs on Southampton Island for the first time since the rediscovery of the species.

The numbers of nesting pairs of Cahow have increased to a record high number of 105, of which 53 produced successfully fledging chicks. This represents a breeding success rate of 50.47%, which is slightly down from the last several years. In addition, new prospecting or pre-breeding activity was recorded at 5 additional nest sites, including 2 new nest sites on Nonsuch Island.

Following is a summary of the 2012-2013 nesting season results:

Total number of nest burrows with confirmed nesting activity:	105
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:	52
Number of failures from nest sites with observable nest chambers:	46
Number of failures from nest sites with non-observable nest chambers:	6

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

Chick died hatching:	2
Chick died later in development:	12
Eggs broken or pipped:	11
Egg broken during nest check:	0
Non-hatching / infertile eggs:	17
Egg buried or knocked off nest:	4
Egg washed off nest by storm waves:	0

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

LONG ROCK:

Active nest burrows with nesting confirmed (eggs laid and/or chick hatched):	12
New nest burrow prospected by confirmed pair:	1
Nest burrows with successfully fledged chicks:	6
(C, D1, D2, D3, D8, E4)	
Nest burrows with confirmed failed nesting:	6
(A (cause unknown), B (cause unknown), D5–chick died (parental neglect), D7–egg infertile, E1-egg knocked off nest, H1-chick died at 1 month-cause unknown)	

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
(B1, B3, B5, B8, B10, C3, C4, D1, E1)	
Nest burrows with confirmed failed nesting:	9
(A1-egg infertile, B2-egg broken, B4-egg knocked off nest, B6-egg broken, B7-chick died at 6-8 weeks (cause unknown), B9-egg broken, C2-egg buried in nest, D2-egg infertile, D4-chick died 6-8 weeks-cause unknown)	

GREEN ISLAND:

Active nest burrows with nesting confirmed:	23
New nest burrows prospected by confirmed pairs:	1
Nest burrows with successfully fledged chicks:	11
(A1, F1, # 3-4, # 4-5, # 5, # 6, # 8, # 11, # 12, # 13, # 14)	
Nest burrows with confirmed failed nesting:	12
(A2-broken egg, D1-infertile egg, F2-chick died at 1 week (parental neglect), F3-chick died at 3-4 weeks (cause unknown), # 2-egg infertile, # 4-chick dies at 10 weeks (parental neglect), # 5-6-egg infertile, # 7-egg broken, # 9-egg infertile, # 10-egg broken, # 15-egg infertile)	

HORN ROCK:

Active nest burrows with nesting confirmed:	37
New nest burrows prospected by confirmed pairs:	1
Nest burrows with confirmed successfully fledged chicks:	21
(B3, B5, B6, C6, C10, C11, C13, C14, C20, C22, C23, C24, C25, C26, C28, D3, D4, F6, F7, F8, G3)	
Nest burrows with confirmed failed nesting:	15
(C4-infertile, undersize egg, C5-infertile egg, C7-chick died at 1 week, C8-infertile egg, C12-broken egg, C15-broken egg, C16-infertile egg, C17-broken egg, C19-infertile egg, C21-chick died at 9-10 weeks; parental neglect, C27-egg crushed, D1-unknown, E1-unknown, F2-egg infertile, F3-egg buried in nest, F5-chick dies at 11-12 weeks)	

NONSUCH ISLAND: (See Fig. 6)

Active nest burrows with nesting confirmed:	12
New nest burrows prospected by confirmed pairs:	1
Nest burrows with confirmed successfully fledged chicks:	5
(R816, R832, R835, R836, R837)	
Nest burrows with confirmed failed nesting:	7
(R817-infertile egg, R818-broken egg, R820-chick died hatching, R830-chick died at 4-6 weeks (unknown cause), R831-infertile egg, R833-chick died at 2 weeks (parental neglect), R834-infertile egg)	

SOUTHAMPTON ISLAND (New):

Active nest burrows with nesting confirmed:	3
New nest burrows prospected:	1
Nest burrows with successfully fledged chicks:	1
(S2)	
Nest burrows with failed nesting:	2
(S1-cause unknown, S3-chick died at 12 weeks from parental neglect)	

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



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Fig. 8: Cahow nest burrows on Nonsuch Island in 2013 (M. Shailer)

Between 2004 and 2008 a project was carried out to attempt to establish a new nesting colony of Cahows on a larger, more elevated nesting island than the original nesting locations, which have become increasingly threatened by massive erosion and flooding caused by hurricanes. The Cahow Translocation Project involved the translocation of near-fledged Cahow chicks at approximately 18 days before fledging from their nests on the four original nesting islets to a new complex of artificial burrows constructed on the Nonsuch Island Nature Reserve. Since the original nesting islands range only between 0.5 to 1.0 acres in size, with maximum elevations ranging from 15' (5m) to 32' (10m), Nonsuch Island, which is both much larger at 15.5 acres (6.5 Ha) and of higher elevation at up to 60' (19m) offers much greater protection both from storm flooding and erosion. It also has a much larger area to allow for growth of the Cahow breeding population to a more self-sustaining level, and contains adequate soil and forest cover to eventually allow the Cahows to dig out their own nest burrows.

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 the new nest burrow complex on Nonsuch Island over a five-year period between 2004 and 2008, banded and fed daily on imported squid and locally sourced fresh Anchovies and Pilchards, and their weight, wing growth and plumage development recorded daily until they were fully developed. At this point feeding was discontinued, emulating normal parental behavior, and the chicks were then monitored through their exercise period when they emerge nightly to exercise flight muscles and imprint on their surroundings, until they fledge to the open ocean on their own. A total of 102 translocated Cahow chicks eventually fledged successfully from Nonsuch by 2008.

In addition, a solar-powered sound attraction system was set up at the translocation site to help attract returning birds, encouraging them to land and prospect for new, empty nest burrows. This was undertaken because while it is known that Gadfly petrels tend to return to the original site they fledged from, they also strongly prefer to nest in close proximity 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. By the end of that year's nesting season, some of these birds had already been seen prospecting nest burrows at the translocation site.

The 2009 nesting season experienced a great success with the first pairs of Cahows establishing in nest burrows on Nonsuch, culminating in the first egg laid and chick hatched on this Island since at least the 1620s. This chick, known as "Somers" in honor of Admiral Sir George Somers, commander of the "Sea Venture" which was wrecked on reefs off Bermuda in 1609, fledged successfully to sea on the 17th June. In addition, a total of 15 returned translocated Cahows were recorded back at the translocation site by the end of this season. The Government Minister of the Environment and Sports, Mr. Eugene Blakeley and other Government officials travelled out to Nonsuch Island to see the chick, which was the subject of an official Government news release that drew interest from Reuters news and environmental publications around the world.

In the 2009 / 2010 season, the number of established breeding pairs carrying out nesting activity and laying eggs rose to 4, although only one of these produced a successfully fledging chick. This chick, known as "Bermudiana", was produced by the same pair from the R818 nest that had produced the "Somers" chick the previous year. Newly established pairs of Cahows were also confirmed in three additional nests. The total number of returning birds on Nonsuch Island that had been translocated as chicks rose to 17, one from the 2004 translocation cohort, eight from the 2005 cohort, six from the 2006 cohort and one from the 2007 cohort.

For the 2010 – 2011 nesting season, the new Cahow nesting colony on Nonsuch continued to grow in numbers of nesting pairs, and in that of successfully fledged chicks. Nesting activity with eggs laid was confirmed in a total of 7 burrows, with 4 producing successfully fledged chicks. In addition, the number of returning translocated Cahows rose to 28, representing birds from all five years that chicks were translocated to Nonsuch. It is also very noteworthy that at least two non-translocated Cahows were recaptured on Nonsuch Island, one of which paired up with a translocated bird.

In the 2011-2012 nesting season, the number of breeding pairs of Cahows at Nonsuch rose to ten, of which seven produced successfully fledging chicks. The total number of Cahows translocated to Nonsuch as fledglings which returned to the nesting islands rose to 47, of which 29 were found on Nonsuch, with the remaining 18 returning to the four original nesting islets (see Table 1). In addition, two other nest burrows were prospected by newly returning Cahows.

For the most recent, 2012-2013 breeding season, the number of breeding pairs of Cahows rose to 12, with another nest burrow being prospected by a newly returning pair. Although all twelve nesting pairs produced eggs, with seven of these eggs hatching, only five chicks successfully fledged out to sea, after two of the chicks died after hatching, one at two weeks of age, and the other at four to six weeks of age. The first chick died due to parental neglect after hatching, the second due to unknown causes. Despite this, the total number of Cahow chicks that have successfully fledged from the new Nonsuch colony since 2009 has risen to 18.

Table 1 shows the breakdown of all translocated Cahows that have been confirmed as returning to the nesting islets as of June, 2013:

YEAR Of chick cohort	Total Returns by 2011	Returns to Nonsuch	Returns to other islets
2004 (14 chicks fledged)	5 (28.5%)	1 (7.1%)	4 (21.4%)
2005 (21 chicks fledged)	16 (76.2 %)	8 (38.1 %)	8 (38.1 %)
2006 (21 chicks fledged)	9 (42.8 %)	8 (38.1 %)	1 (4.7 %)
2007 (24 chicks fledged)	9 (37.5 %)	6 (25.0 %)	3 (12.5 %)
2008 (22 chicks fledged)	8 (36.4 %)	5 (22.7 %)	3 (13.7%)
Totals: 102 chicks fledged	Total = 47 (46.1 %)	Total = 28 (27.5 %)	Total = 19 (18.6 %)

TABLE 1: Returns of Cahow Chicks Translocated to Nonsuch Island by June, 2013

3 (b): First Year of Second Translocation project to New (B) Location on Nonsuch



Fig. 9: Translocated Cahow chick readied for feeding & measurement on Nonsuch
(T. White)

2013 marked the first year of a second translocation project aiming to establish a second foothold 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 concept was to build and improve on that success by building a new complex of artificial nest burrows about 200 meters to the east of the original colony site. The new burrows are located on top of a promontory formed by the south hill of Nonsuch, overlooking the main, south beach, and are situated at 35' to 45' above sea level.

These new nest burrows were built largely with the assistance of volunteer groups from the Ascendant group of companies, which include the Bermuda Electric Light Company (BELCO), Bermuda Gas Company, and Purenergy Renewables, Ltd. Groups of volunteers from Ascendant came out to Nonsuch Island on the 8th and 9th on November, 2012 to scrape and paint buildings and assist in mixing and pouring concrete to make 6 new Cahow nest burrows at the new translocation site (See Fig. 10). Another 3 nest burrows were completed in December 2012 and February 2013, bringing the total of concrete burrows at this new site to nine.



Fig.10: Ascendant volunteers working with Conservation Officer to build new concrete Cahow nest burrows at “B” translocation site.

Due to other work responsibilities at other Nature Reserves and the need to continue with monitoring and management work at the other Cahow nesting colonies, it was not possible to install the entire planned total of 12 to 15 nest burrows at the B translocation site before the time came to begin translocation of chicks. Rather than delay the project for another year, the decision was made to go ahead with the translocation with the 9 available burrows, and to “double-up” some of the burrows by using them twice, first with the earliest fledging chicks, then again later with the last fledging chicks.

This option, although not an ideal situation, seemed to work and a total of fourteen chicks were translocated from three of the original nesting islets to the B site nest burrows. Five of these chicks originated from Long Rock (from the D2, D3, D5, D8 and E4 nests), three from Green Island (# 11, # 12 and # 14 nests) and six from Horn Rock (C6, C10, C22, F5, F6 and F8 nests). Of these, all but the Long Rock D5 and Horn Rock F5 chicks fledged successfully out to sea.

The first chick (from the Horn Rock C10 nest) was translocated to Nonsuch Island on the 7th May, and also became the first chick to successfully fledge out to sea, on the 25th May, after 18 days in its translocation burrow on Nonsuch. The final chick was not translocated until the 15th June, fledging out to sea at the very late date of 7th July. The median date for translocation of chicks was the 21st May, while the median date for the fledging of chicks was the 5th of June. The age of chicks at their translocation ranged from 71 to 95 days after hatching (mean age = 80 days). (See Table 2 for full translocation results and figures).

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 also provided fish for the original translocation 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 4 to 6 Anchovies or equivalent.

TABLE 2: 2013 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	Age when moved (days)	No. of feeds after moving	Total Feed weight (grams)		Date	Age from hatching (Days)	Weight (grams)	Wing Chord (mm)
HORN C10	7 May	73	10	521g	4	25 May	91	256g	266mm
LONG D3	10 May	71	10	555g	6	30 May	91	272g	255mm
LONG D8	10 May	72	13	769g	6	30 May	92	261g	258mm
HORN C22	13 May	73	12	660g	7	3 June	94	222g	271mm
GREEN 11	15 May	79	10	508g	8	4 June	99	267g	261mm
LONG E4	20 May	75	5	199g	5	3 June	89	222g	255mm
GREEN 12	21 May	79	8	254g	5	6 June	95	278g	265mm
GREEN 14	4 June	87	6	320g	3	15 June	98	290g	260mm
HORN C6	7 June	95	4	75 g	2	16 June	104	256g	247mm
HORN F6	7 June	87	7	267g	4	21 June	101	215g	245mm
HORN F8	7 June	88	5	224g	2	16 June	97	282g	247mm
LONG D2	15 June	82	17	839g	2	7 July	104	237g	238mm
Median	21 May					5 June			
Mean		80 days	9	433g	4.5		96 days	255g	255.6mm

The number of meals given to each translocated Cahow chick before fledging ranged from 4 – 17 meals (mean = 9 meals), and individual meal weights ranged from 40 grams to 70 grams (extreme ranges 14 grams – 94 grams). The total amount of food given to each chick also varied widely from a low of 75 grams to a high of 839 grams (mean = 433grams).

The number of nights that the chicks emerged to exercise before fledging ranged from 2 to 8 nights (mean = 4.5 nights), with chicks fledging to sea between the 25th May and the 7th July (median fledging date = 5th June). The weight of the chicks at fledging ranged from a high of 290 grams to a low of only 215 grams, considered to be well below the target weight of 250-280 grams. The mean fledging weight was 255 grams. The wing chord of fledging chicks ranged from 238mm to 271mm (mean = 255.6 mm). The total age from hatching of the translocated chicks at fledging ranged from 89 days to 104 days (mean = 96 days).

As mentioned, two of the translocated chicks died about one week after being moved to Nonsuch. Upon investigation, it became obvious that the cause of death of both chicks was due to being fed food (fresh Anchovies and Squid) that had spoiled, due to another major project going on at Nonsuch Island during the same time as the translocation project. Due to the large numbers of workers and volunteers on the island during the installation of the new Solar Power System for the Island, many were storing their lunches and drinks in the refrigerator at Nonsuch House. As a result, the refrigerator door was being opened constantly over a 1-week period, resulting in the food thawing out slightly in the warm temperatures at that time. Past experience has already shown that petrel chicks are extremely sensitive to bacterial contamination in spoiled food, and a total of five Cahow chicks became sick due to eating this batch of food. Three of these chicks were able to be nursed back to health; however two of the lightest birds could not be saved, having regurgitated all food that was attempted to be fed to them, and developing a “rotten fish” smell to their breath before becoming listless and lethargic. Death occurred within three days in both chicks, one of which was kept for a museum specimen. The other three sick chicks were given extra water and electrolytes and fresh batches of food brought over daily from the mainland, and all appeared to recover fully within 5 days and eventually fledged successfully out to sea, albeit mostly at lower than normal weights. The effect this will have on the fledgling survival rates ultimately is most likely not favorable.

Despite this setback, the 2013 translocation was still considered to be a success. Lessons learned this year are (1) to have a larger number of artificial nest burrows installed at the B translocation site to accommodate more (20 – 25) translocated chicks for 2014, (2) to either store all food at a freezer or refrigerator on the mainland, and bring over only what is required for each day, or to prevent any extra use of the Nonsuch refrigerator and not schedule any other events on Nonsuch during the duration of the translocation.

3 (c): Natural re-colonization of Southampton Island by Cahows

One of the most surprising and unexpected developments of the 2012-2013 Cahow breeding season was the discovery that Cahows have now succeeded in naturally re-colonizing one of their original nesting locations, Southampton Island (identified in some early maps as Brangman's Island). This 2.36-acre island is located only 80 meters to the south of Horn Rock, which has the largest present concentration of nesting pairs of Cahows, with 37 nesting pairs in 2013 (See Fig. 6).

Southampton Island has been highlighted as a potential future site for a breeding colony of Cahows several times during the course of the present Recovery Program. A small number of Cahows may have survived on Southampton Island as late as the 1940s to 1950s, as Dr. David Wingate recalls finding Cahow remains, probably rat-predated and still fresh enough for some tissues to remain on the bones (D. Wingate, pers. comm.). These remains were found in rock crevices and caves on the north side of the island when he carried out a systematic search of all the Castle Harbour Islands upon returning to Bermuda from University in 1960. However, all subsequent searches of the island after that time right up to 2010 turned up absolutely no evidence of Cahows nesting on Southampton Island, although the island was annually baited with rat poison as part of the overall management objective to keep as many of the Castle Harbour Islands rat-free as possible.

The first evidence that something unusual might be happening came to light on 6th August, 2012, when the carcass of a nearly fully-fledged Cahow chick was found on top of Southampton Island. There were only two possibilities as to how this could have gotten there, (1) that a large raptor had predated the bird on nearby Horn Rock and carried it over to Southampton Is. to be consumed, or (2) that the bird came from an previously undiscovered nest on that island.

As a result of this find, several night-watches were carried out from a boat just off the northern shoreline of Southampton Island and Horn Rock during January and February, 2013, during which Cahows were seen flying repeatedly low over the northwest side of the island. This resulted in a search of the island by the Terrestrial Conservation Officer on the 7th February, 2013, during which at least 3 and possibly 4 Cahow nesting sites were confirmed in rock crevices on the northern side of Southampton Island. Specially made Tropicbird exclusion baffles were made and fitted to the entrances of these burrows to prevent nest takeovers by White-tailed Tropicbirds when they returned for their own nesting season in April. The nests were monitored for the remainder of the nesting season, and it was possible to confirm that a Cahow chick fledged successfully from one of these burrows, whereas nesting was unsuccessful in a second nest. At the third nest, a check on June – found a nearly fully-fledged Cahow chick fleshly dead just outside the baffle entrance. This chick weighed only 168 grams, which is far too low for the chick to survive and fledge successfully, and it was obvious that this chick had died due to parental neglect. The bird was collected to be preserved and used as a specimen for the Bermuda Natural History Museum.

3 (d): First use of Infrared “Burrow-cam” in Cahow Burrow

2013 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 development of the chick, which came to be called “Backson”, was provided free to the public 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 so be sensitive to infrared light (See Fig. 9) could be installed to take video footage of the Cahow adults and chicks inside their burrows, which are completely dark.

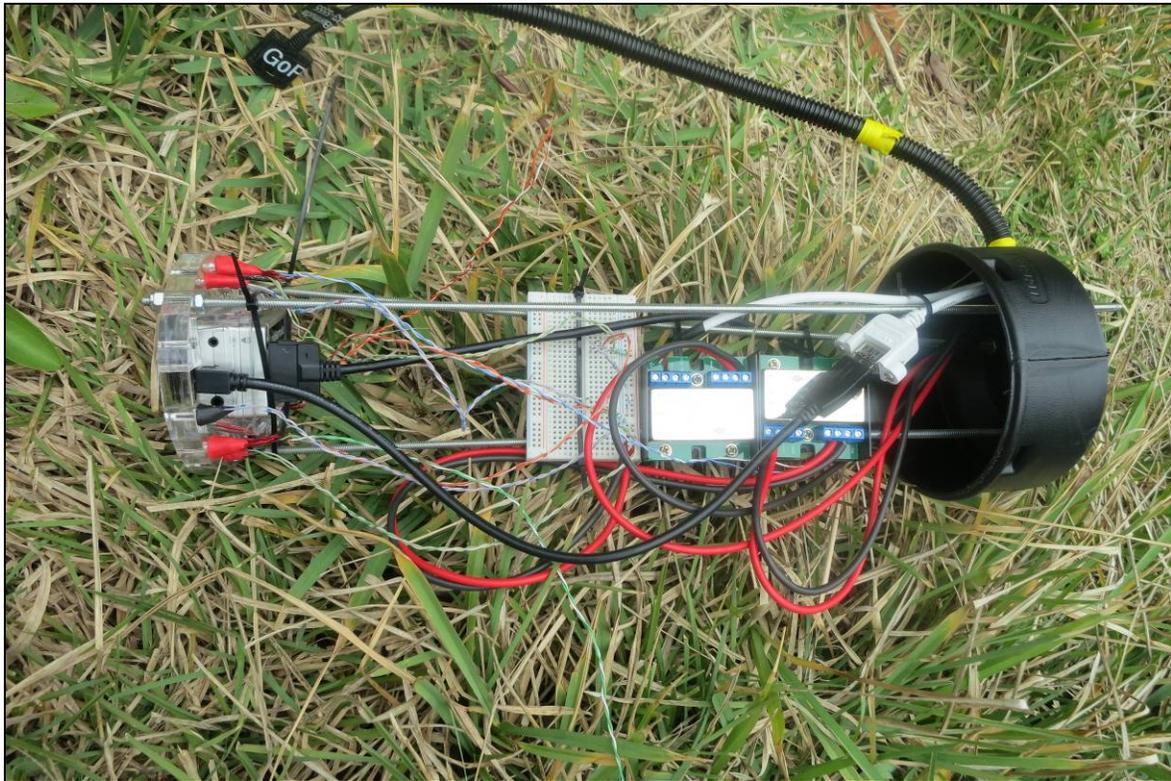


Fig. 11: Infra-red Cahow “Burrow-cam” developed by Mr. JP Rouja.

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. It was first installed at one of the nest burrows on Nonsuch Island where a pair of adult Cahows were still incubating an egg, but after it became evident that this egg had failed, the CahowCam was installed at an adjacent nest burrow on March 25th. Upon review of the video taken during the first day of installation, it was realized that the hatching of a Cahow chick (an event that was mostly

obscured by the dutifully incubating adult Cahow) had been filmed for the first time in history!

The decision was made to confine filming to this nest burrow, and over a more than 12-week period (from late March until mid-June), video footage was made every 2 to 4 weeks of the chick and of health and growth assessments made to discuss the growth of “Backson” (See Fig. 4). These video updates were carried on the website, and attracted a good following, especially among school students, many of which have been able to see Cahows in the hand during guided tours of Nonsuch Island, when “Cahow encounters” can sometimes be organized by the Conservation Officer during non-critical parts of the nesting season. 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.



Fig. 12: Image of adult Cahow incubating egg inside burrow captured by infrared “CahowCam” (JP Rouja)

Another advantage that this system brings towards the management of this species 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. In addition, breeding, courtship and nest-building behavior of the adult birds, as well as chick behavior, can 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 will now allow that option to be offered to the public during the next, 2013-2014 breeding season. Many thanks are due to all of the workers and volunteers that worked very hard in hot conditions and with difficult access to provide Nonsuch with reliable power for the first time since 2003.



Fig. 13: JP Rouja and J. Madeiros observing “CahowCam” video of Cahow chick on iPad monitor. (JP Rouja files)

3 (e): Update on Cahow Banding Program for 2013:



Fig. 14: Identification band fitted on leg of adult Cahow (J. Madeiros)

The Cahow banding program has been an important 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 used for the Cahows are made especially for Bermuda by Porzana Ltd. (U.K. Wetlands Trust affiliation) in the United Kingdom.

These 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 eleven years, As of June, 2012, a total of 493 Cahows have now been fitted with identification bands, the majority of which have been fledgling birds* This includes 125 birds banded as breeding adults, and 368 birds banded as chicks before fledging to sea. In other terms, these numbers represent almost 65 % 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 about 350 individuals, including immature or non-breeding birds).

Banding of Cahow chicks is of particular value and interest due to the fact that it enables study of individual birds whose age is accurately known, as well as the nest and island that they originated from. The return and eventual nesting of these known-age birds has already given 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, and whether this differs 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 nesting attempts;
- 5) Whether young Cahows always return to their exact point of departure, or whether they can return also to other islands/nesting colonies; and whether this differs 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 longevity of individual birds. The information gathered by the Cahow banding project will continue to increase in value the longer that the banding project and annual recapture and band checks of the birds, continues into the future.

(10): 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 continuing projects and management work already underway, or that are proposed for future nesting seasons:

2013 - 2014 Breeding Season:

- Continue establishment efforts for second nesting colony on Nonsuch Island with planned translocation of 20 - 25 Cahow chicks from original nesting islets to “B” colony site on the South Hill of that island;
- Investigate Cahow in-nest behavior using infrared “Cahow Burrow-cam”, modify additional nest-burrows on Nonsuch for use of burrow-cam, and install equipment to enable live-streaming of video to the internet.
- Continue ongoing Cahow banding program;
- Continue use of sound attraction system at “A” translocation site on Nonsuch to continue attracting returning young Cahows to prospect for nests at that site;
- Continue monitoring nesting islands for presence of rats and other predators, and set out rodenticides when necessary.
- Continue installation of additional artificial nest burrows at nesting colonies, including at the new colony on Southampton Island.

2014 – 2015 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 and have 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 Cahow Banding program;
- 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.
- Deploy more archival geolocators on the legs of both individuals of selected breeding pairs of Cahows, to determine whether male and female birds forage for food and spend the non-breeding season in different oceanic locations.

(11). Acknowledgements:

The Terrestrial Conservation Officer 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 2010 – 2011 breeding season:

Mr. Drew Pettit, Director, Dept. of Conservation Services, Mr. Peter Drew, Conservation Officer (Dept. of Conservation Services); 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, Nicholas Carlile and Dr. David Priddell, (New South Wales Department of the Environment and Climate Change, Australia), who have provided guidance on various aspects of the recovery program and collaborated in the writing of two scientific papers on the breeding biology of the Cahow and the Cahow translocation project; Chris Flook, who kindly agreed to again provide fresh Anchovies and Herring for the translocated Cahow chicks, Lynn Thorne, tours director, Bermuda Zoological Society (Nonsuch tours and “Cahow encounters” for school and BZS tour groups), and JP Rouja of LookTV (designer and installer for the infrared “Cahow burrow-cam” to enable both researchers and the public and school groups to unobtrusively study the behavior of the birds inside their nest burrows).

As usual, I am deeply indebted to the Terrestrial Conservation Crew for their hard work in building artificial concrete nest burrows for the Cahows on both Nonsuch Island and the original nesting islets. This work has included mixing and transporting thousands of pounds of concrete out to the isolated nesting islands, landing it in buckets in generally rough conditions, and carrying it to the top of the islands. The Terrestrial Conservation Crew consists of Barry Smith (Foreman), Hillgrove Iris, 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 the understanding of the oceanic range of the Cahow were purchased entirely through public donations, notably by Saltus Cavendish School and Paget Primary School. 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, in addition to painting buildings and control of invasive Casuarina trees. We are deeply grateful for the interest and generosity shown by all of these and other donors.

In conclusion, I would like to acknowledge my wife, Leila Madeiros, and children Seth and Elizabeth, without whose support and patience I would not have been able to carry out this demanding and time – consuming project over the last 13 years.

Jeremy Madeiros,
Senior Terrestrial Conservation Officer