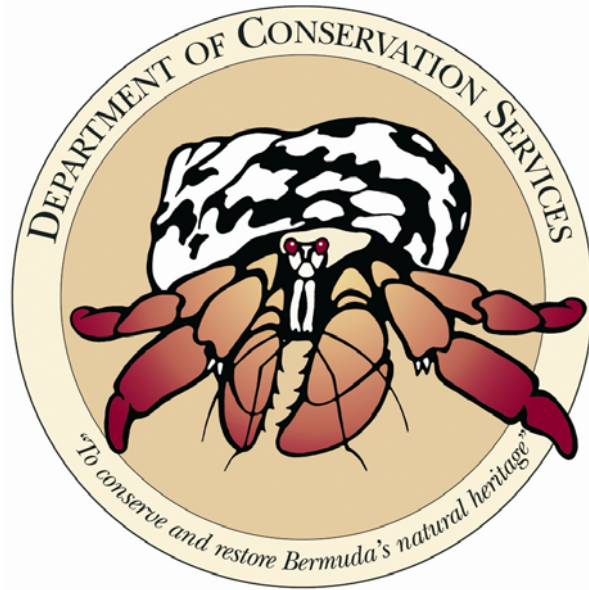


CAHOW RECOVERY PROGRAM
Breeding Season Report for 2005/2006



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BERMUDA GOVERNMENT



DEPARTMENT OF CONSERVATION SERVICES
Terrestrial Conservation Division
Applied Ecology Section

CAHOW (BERMUDA PETREL)
Pterodroma cahow
RECOVERY PROGRAM

For the Nesting Season Period October 2005 to June 2006

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* All photos by Jeremy Madeiros except where indicated

Introduction

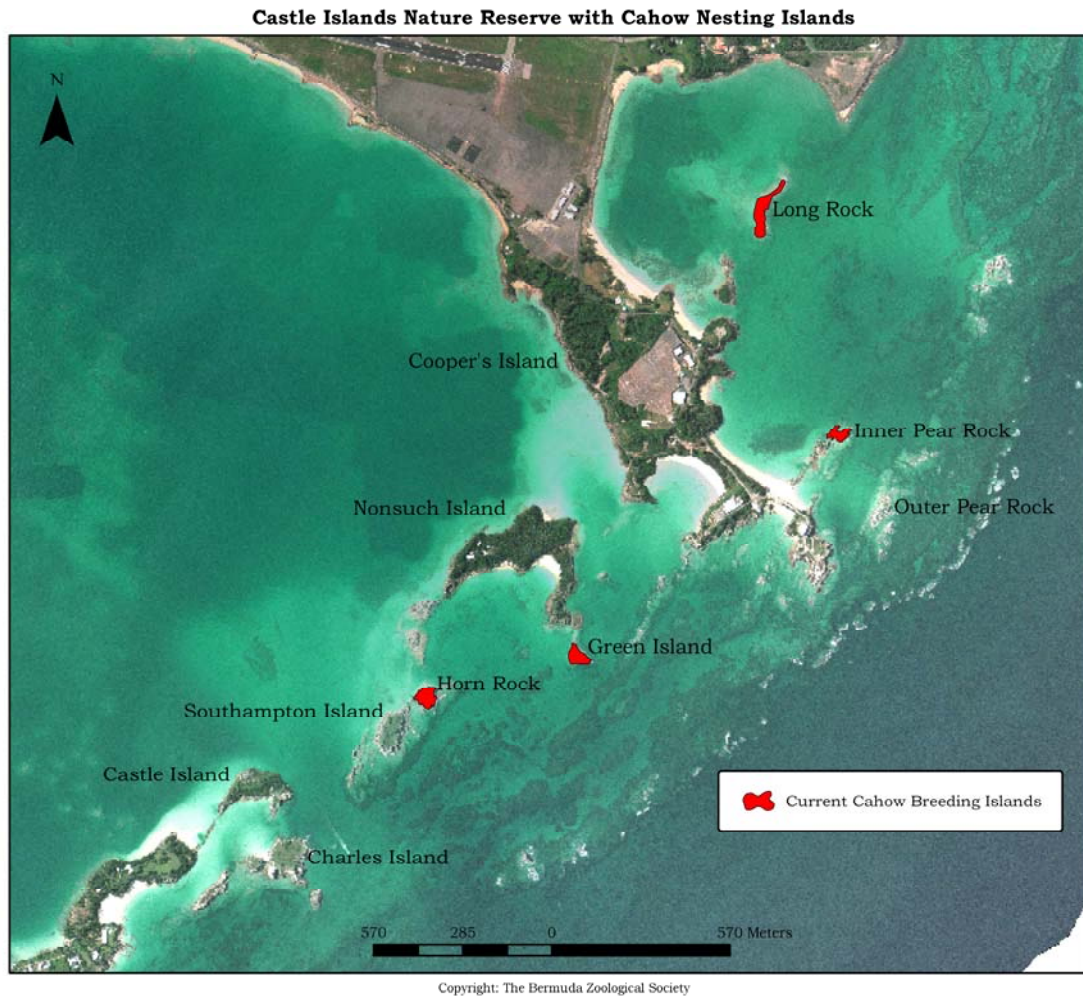


Fig. 1: Castle Harbour Islands showing location of current Cahow breeding islets

The 2006 Nesting Season of Bermuda's national bird, the endemic and critically endangered Bermuda Petrel or Cahow *Pterodroma cahow*, ended positively when the last of 36 chicks fledged successfully on the 17th June. This nesting season has seen the continued recovery of the Cahow breeding population, due entirely to the intensive management program for the species, with the number of active nest sites reaching a new record high of 75 on 4 tiny nesting islets (see Fig. 1), up from 18 breeding pairs in 1960.

The Cahow is subject to pressure from a number of threats and limiting factors, including nest site competition from the native White-tailed Tropicbird *Phaethon lepturus catsbyii*, the threat of introduced mammal predators (in particular Rats) swimming out to the nesting islets, predation by avian predators, lack of available nest sites and habitat at the present suboptimal nesting areas, and the yearly threat of damage or destruction to nest sites and the present exposed nesting islets by hurricane waves and storm surge. Much of the present management program for the species is focused on addressing and overcoming these various issues, with a high degree of success. The high probability of

further major damage to the nesting islets from severe hurricanes and storms is now considered to be the single most important threat to the Cahow. This threat cannot be fully addressed on the present tiny nesting islets, highlighting the need to establish new nesting colonies on nearby larger island which are managed to exclude mammal predators and have controlled human access.

There were several highlights for this nesting season, which extended from mid-October 2005 with the first arrival of adult Cahows on the breeding islets and ended during mid-June 2006 with the departure to sea of the last Cahow chicks. These include the following:

- 1) A total of 36 Cahow chicks successfully fledged in 2006, compared with 35 chicks in 2005 and 29 in 2004.
- 2) The third year of a translocation project to establish a new breeding colony of Cahows on Nonsuch Island was carried out with 21 chicks moved to the new site, of which 20 fledged successfully out to sea. This brings to 55 the number of Cahow chicks which have fledged successfully from Nonsuch in the last 3 years.
- 3) This year saw the first return of Cahows banded as fledglings in their nest burrows to the nesting islets as adults. A total of 8 first-return birds were recorded, 6 of which were banded as fledglings in 2002 and 2 which were banded as fledglings in 2003.
- 4) Some 7 new nest burrows were newly occupied by prospecting pairs of young Cahows during this nesting season, with several others prospected by single birds.
- 5) A record number of 26 fledgling Cahows were regularly monitored, weighed and measured as part of an ongoing growth study and to indicate when fledglings chosen for the translocation project are ready to be moved.

Full details on the 2006 breeding season are given in the following report; a brief summary of the Cahow Recovery Program is also included in addition to research proposals for the next several years.



Fig. 2: 55-day old Cahow chick removed from nest for weighing & body measurement

Objectives of Cahow Recovery Program

The short and long-term objectives of the Cahow Recovery Program are covered in full in the Cahow Recovery Plan 2005; Briefly put, they are as follows:

1. To prevent nest-site competition with the White-tailed Tropicbird through the provision of wooden “baffle” plates to the entrances of all Cahow nest burrows, and by providing additional artificial “Igloo” nests to meet the nesting requirements of the Tropicbirds and reduce pressure on the Cahow burrows.
2. To regularly and frequently monitor all nesting and nearby islands for the presence of rats (*Rattus rattus* and *R. norvegicus*) and, when their presence is detected, to eradicate them with the use of anticoagulant rodenticide, using bait boxes purchased from the Health Department.

3. To learn more about the biology of the species through an ongoing banding program initiated in 2002; also by carrying out growth studies of Cahow chicks from hatching to fledging (see Fig. 2) and morphometric measurements of adult Cahows.
4. To establish new breeding colonies of Cahow on larger, more elevated islands free of mammal predators which are safer from hurricane erosion and damage and have the potential of supporting larger populations of the birds; already underway on Nonsuch Island using translocation of near-fledged chicks and sound attraction; if successful here, also planned in the future for Southampton Island. (See page 26: review of translocation project).
5. To continue the program of building additional artificial nest burrows on all existing nesting islets and at locations where new nesting colonies are being established (see Fig. 3); to support continued increase in the breeding population.
6. To initiate studies of the oceanic and foraging ranges of the Cahow away from the nesting islets, by using miniature Data Loggers, fitted to the legs of individual Cahows for varying periods during the future 2007/2008 nesting seasons. These will record daily position fixes to determine the foraging range of Cahows when at sea, information that at present is largely unknown, as well as recording how deep the birds dive underwater when catching food.



Fig. 3: Artificial Cahow nest burrows being constructed on Horn Rock

Cahow Recovery Program – Review of 2005/2006 Cahow Nesting Season

Methods used in Cahow Recovery Program:

Most of the methods used in monitoring the cahow nesting population are essentially the same as those worked out by former Conservation Officer David Wingate in his role as director of the conservation program for the Cahow between 1960 and 2000.

Checks of the nesting islets are carried out 2 to 3 times weekly (every 2 to 4 days), depending on weather conditions. These checks are carried out in the Terrestrial Conservation Division's 17' Guardian Boston Whaler boat, which is light and agile enough to make the close approaches to the islets, over shallowly submerged rocks and reefs, which are involved in landings. Larger vessels have been tried for this purpose, but are not maneuverable enough and draw too much water, raising the constant threat of serious damage to or loss of the boat or personal injury.

Because of the exposed nature of the islets, they are often subject to strong ocean swell or waves, which, along with strong winds, may make landings impossible for up to several days at a time. The protocols for landings stipulates that sustained winds exceeding 20 – 25 knots generally render landings unsafe, although this is somewhat affected by the wind direction. Landings on the two western nesting islets are not safe with southerly or westerly winds over 25 knots, or with northwesterly or northerly winds over 18 knots, although it is usually still possible to land on the two eastern nesting islets, which are protected by Coopers Island in these wind directions. It may also not be possible to land on the two eastern nesting islets with strong northeasterly or easterly winds exceeding 20 to 25 knots. Strong southeasterly winds or ocean ground swell from hurricanes passing to the south of Bermuda may render it unsafe to travel around the southern tip of Coopers Island (Coopers Point). Large breakers may form without warning between the reef line and the headland and extreme caution should be exercised at these times.

During landings, a quick check of the island is made, followed by systematic inspection of all active and potential nesting burrows. Over three-quarters of the nest burrows have removable concrete observation lids which enable inspection of birds in the nest chambers. These are removed for a brief time (no more than 1 minute is usually necessary) and a note is made of the number of adults, if any, present, nest-building activity, and the presence of an egg or chick. It is particularly important to determine the date of egg-laying and the date of egg hatching, as these will help to determine when the chick will be ready to fledge. The nests are also checked for the presence of rocks or small stones which could cause breakage or cracking of the single egg and are still a significant cause of breeding failure. Any rocks or stones detected should be carefully removed. Adult Cahows can be briefly removed from nest chambers through the observation lids for morphometric measurement and checking of band numbers (if unbanded, for fitting with an identification band). This is best carried out during the nest-building stage in November or during egg brooding in February. Only single birds should be removed, with pairs of adults generally being left alone unless an assistant is present.

After hatching, chicks are also weighed and measured as part of an ongoing growth study (see page 24; Update on Growth Study of Cahow Fledglings) and in support of the ongoing translocation project (see page 26; Update on Translocation Project).

Review of 2005/2006 nesting season management actions:



Fig. 4: Carrying out Cahow nest check on nesting islet; boat used for landings in background

The first action for the impending nesting season was the removal of Tropicbird exclusion baffles from the entrances of all Cahow nest burrows during the first week of October. This is carried out at this time because at this point the Tropicbird nesting season is essentially finished so there is no longer any danger of nest takeover by this aggressive species. The baffles are removed to provide greater ease of access for the returning adult Cahows during the important courtship, nest-building and egg-laying periods of the nesting season.

The first adult Cahows were confirmed as having returned to nest sites on Green Island and Horn Rock by the 19th October, 2005. The first Cahows returning to the eastern islets were confirmed by the 21st October. The rest of the established nesting Cahows arrived at their nest burrows on the nesting islets through the end of October, with all birds having returned by the first week of November. At this time, bags of St. Augustine Grass *Stenotaphrum secundatum* have to be collected on Nonsuch Island and taken out to the nesting islets. This has to be done because these islets are so barren and rocky for the most part that the Cahows have insufficient material to gather to make a good nest. This can result in eggs being laid directly on the rocky floor of the nest chambers, making

them much more susceptible to cracking and failure. The grass is broken into shorter lengths and placed in piles to the sides of the burrow entrances, where it can be collected and pulled into the nest chambers by the adult birds at night.

The main nest-building and courtship period for established Cahow nesting pairs extends through the month of November. In addition to the usual nesting islet checks carried out during daylight hours, a total of 8 'night-watch' checks were carried out after dark during November 2005 to observe courtship behaviour and activity by the adult birds. These night checks are necessary as Cahows only fly over the nesting islets at night, remaining out on the open ocean or in their nest burrows during the day. In addition, to obtain film footage of adult Cahows flying at sea outside the reef line for the film documentary 'Bermuda's Treasure Island' by producer Dierdre Brennen, a trip was made out to an area about 2 miles offshore of the nesting islets in rough conditions on 20th November 2005 using the private boat of Mr. Jack Ward (Director, Dept. of Conservation Services). At least 12 Cahows were observed on this trip, including 6 or 7 which approached very closely to the boat. The desired film was successfully obtained and became the first high-quality film footage aired of Cahows flying at sea off the Bermuda coastline. Bermudian film director Luci Spurling also later obtained offshore footage of Cahows in the same general area for her own documentary on the Cahow, 'Rare Bird'.

On the 27th November, the Bermuda Audubon Society hosted a 'Cahow Watch' from the southern tip of Coopers Island to give members of the public a chance to observe flying Cahows from shore for the first time. Over 35 people took advantage of this opportunity and were rewarded by over 12 Cahows, some in groups of up to 6 birds, which flew in close enough to be easily visible through binoculars and the naked eye as they assembled offshore waiting for night to fall.

Both of the film documentaries being made which highlighted the Cahow, the restoration of Nonsuch Island and the translocation project were completed during the beginning of the nesting season with infra-red night photography of adult cahows visiting and departing from burrows on the nesting islets and offshore footage of flying Cahows. 'Bermuda's Treasure Island' premiered in early February 2006 and 'Rare Bird' in April, with both now available as DVDs for sale to the public. These documentaries were supported by the Dept. of Conservation services in order to fulfill the Department's objectives of public education and providing information to the public about the issues facing Bermuda's natural environment and the management and recovery work being carried out to protect the endangered Cahow and other threatened flora and fauna.

During the month of December, the Cahow breeding population departs to sea for several weeks on a 'pre-egg laying exodus' so that the female can feed intensively to enable her relatively large single egg to develop. The male uses the same period to build up fat reserves needed to carry out extended periods of incubating the egg.

The Cahows returned to the nesting islets by the beginning of January, 2006 with the first being confirmed as having been laid by the 6th January. All nesting pairs were back in their nest burrows, with most brooding eggs, by the 20th January 2006.

Following the long 53-day egg incubation period, the first chicks were confirmed as having hatched by the 28th February. Over 30 chicks were confirmed as having hatched by the 15th March. At this point, regular monitoring of the growth and development of the chicks became the most important component of the nesting islet checks. Note was also taken where possible of the frequency and number of adult feeding visits.

As an additional aspect of the nest checks, 24 Cahow chicks were regularly weighed and their wing chord growth recorded during the 2006 nesting season, as part of a growth study of Cahow chicks and how maximum and average weights achieved by chicks appear to vary from year to year (see page 24; 'Update on Growth Study of Cahow Fledglings').

During the first week of March, the Tropicbird exclusion baffles were fitted back on the entrances of all cahow nest burrows in preparation for the return of White-tailed Tropicbirds to the Castle Harbour Islands for the start of their own nesting season. This is an essential procedure to prevent burrow invasions by prospecting Tropicbirds, which would otherwise kill the Cahow chicks and take over the nest sites.

2006 marked the third year of the Cahow Translocation Project to establish a new nesting colony on Nonsuch Island, and resulted in 21 fledglings being moved from the present nesting islets to a new complex of artificial nest burrows on Nonsuch, with 20 fledging successfully. This is covered in full later in this report (see page 26; 'Update on 2006 Cahow Translocation Project'). One beneficial effect of the translocation project was that it enabled groups of students from local schools to see the translocated Cahow chicks undergoing daily feeding, weighing and measurement while visiting the island on natural history tours. As a result, three tour groups with over 75 school children were able to see the Cahow close up, and it is planned to introduce more school groups to Bermuda's national bird in this way over the remaining two years planned of the translocation project.

The first two Cahow chicks to fledge left for the open sea on the night of 23rd May, 2006. The last Cahow chick left from the translocation site on Nonsuch Island on the night of 17th June, 2006, bringing the nesting season to a close.

Several strong winter gales affected the Cahow nesting islets during the period December to February, with the strongest occurring over a 3-day period from the 14th to 16th January. During this gale, winds gusted to hurricane-force at 78 knots, with high waves overwashing the lowest nest burrows on Green Island, washing eggs and nests away and causing breeding failure in at least two nest sites. Luckily, the adult Cahows incubating the eggs in both these nests survived the ordeal. As this is the second time that nest burrows on the lower terrace area on this islet have suffered breeding failure due to flooding during winter gales, their Tropicbird baffles will be left in during the winter months in future nesting seasons, in the hope that they may break much of the force of waves surging over the area during future gales.

Summary of 2005/2006 Cahow Nesting Season

The 2005/2006 Cahow nesting season was considered to be a success with 36 chicks successfully fledging out to sea, compared with 35 in 2005 and 29 in 2004 (see figures 1 and 8); in addition, a total of 5 new nest burrows were colonized by new prospecting pairs of Cahows (Horn C24, Horn F6, Horn G1, Green #9 and IPO D1), while 1 established nest (Horn C4) was abandoned, bringing the total number of active nest sites to a record high of 75.

Following is a summary of the nesting season:

Total number of occupied nest sites with nesting activity confirmed.....	75
Number of new nest sites occupied for first time by establishing nesting pairs that had attempted breeding and built nests.....	5
Total number of confirmed successfully fledged Cahow chicks.....	36
Number of successfully fledged chicks from nest sites where observation of the nest chambers was possible.....	32
Number of successfully fledged chicks from non-observable nests.....	4
Total number of occupied nest sites with unsuccessful breeding.....	39
Number of confirmed failures from nest sites where observation of nest chambers was possible.....	29
Breakdown of causes of breeding failure from nest sites where observation of nest chambers was possible:	
Chick died hatching	2
Chick died from deformed wing joint	1
Chick died from unknown causes	1
Broken or pipped eggs	5
Non-hatching/infertile eggs	8
Egg washed off nest by storm waves	2

In addition, no eggs were produced at 10 nest sites where otherwise normal nest-building and courtship activity was observed.



Fig. 5: Adult Cahow brooding egg in nest burrow – February 2006



Fig. 6: 25-day old Cahow chick removed from nest for weighing – April 2006

Analysis of Breeding Success on each Nesting Island:

HORN ROCK

- 31 confirmed nest sites with breeding activity (including 3 newly occupied nest sites – C24, F6 & G1);
- 14 nest sites with successfully fledging chicks (B5, C8, C9, C11, C12, C13, C14, C19, C20, C22, D1, D4, F3, F4);
- 17 nest sites not producing chicks;
- 14 confirmed failures from nests with observable nest chambers (B3 – egg broken; C5 – unhatched egg; C6 – 2 eggs laid in nest by 2 different females, 1 broken, 1 unhatched; C7 – no egg produced (* new nest); C10 – egg broken; C15 – egg broken; C17 – egg unhatched; C18 – egg broken; C21 – no egg produced; C23 – unhatched egg; C24 – no egg produced (* new nest); F2 – egg broken; F6 – no egg produced (* new nest); G1 – no egg produced (* new nest).
- 3 failures from non-observable nests (D3, D5, E1).

GREEN ISLAND

- 20 nest sites with confirmed breeding activity (including 1 newly occupied nest site - # 9);
- 10 nest sites with confirmed successfully fledging chicks, 9 from sites with observable nest chambers (A2, F2, # 1, # 5, # 6, # 8, # 11, # 12, # 13), 1 from nest site with non-observable nest chamber (F1);
- 9 confirmed failures from nests with observable nest chambers (A1 – egg washed off nest and broken by storm waves; D1 – egg washed off nest by storm waves; # 2 – no egg produced; # 4 – chick drowned while attempting to fledge because of deformed wing joint; # 4/5 – no egg produced; # 5/6 – unhatched egg; # 7 – unhatched egg; # 9 – no egg produced (* new nest); # 10 – chick died hatching);
- 1 failure from non-observable nest site (F3).

INNER PEAR ROCK (OUTER)

- 16 nest sites confirmed with nesting activity (including 1 newly occupied nest site – D1);
- 5 nest sites with chicks confirmed as fledging successfully, all from nests with observable nest chambers (B4; B7; C4; D2; D3);
- 11 nest sites not producing a chick; 10 confirmed failures from sites with observable nest chambers (A1 – unhatched egg; B1 – unhatched egg; B3 – chick died in nest at 55 days of age of undetermined causes; B6 – no egg produced * new nest; B8 – egg knocked out of nest; B9 – no egg produced; C2 – no egg produced; C3 – chick died hatching; D4 – no egg produced; E2 – no egg produced (* new nest);
- 1 failure from non-observable nest site (E1).

LONG ROCK

- 9 nest sites confirmed with nesting activity;
- 7 nests total confirmed with chicks fledging successfully, 5 from nests with observable nest chambers (D1; D5; D7; E1; H1);
- 2 confirmed from nests with non-observable nest chambers (B; C);
- 2 confirmed failures from nest sites with non-observable nest chambers (D3; E4).

Update on Cahow Banding (Ringing) Program

A banding (ringing) program for the Cahow was initiated during 2002, using Incoloy identification bands (rings) supplied by Porzana Ltd. (U.K. Wetlands Trust affiliation); prior to this, no banding or tagging of the species had taken place with the exception of a small number of nesting adults in the 1950s when the Cahow was first rediscovered. Because the different sexes are visually identical and few birds have distinctive markings which enable them to be positively identified, banding is the only easy method to positively identify individual Cahows.

The main priority of the present program is to annually band a minimum of 75% of all fledglings produced by the Cahow nesting population. This target has been met or exceeded every year since the program commenced 4 years ago. The banding of fledglings is a priority as it results in identifiable known-age birds that can be tracked through their entire lifespan, from first departure from their natal nest sites, to their first return, choosing of nest site and mate, and through the rest of their breeding lifespan.

Although the main emphasis in the program is on banding fledglings, the decision was also made to band pairs of breeding adult Cahows from accessible nest burrows whenever possible. This has already enabled various aspects of breeding biology to be confirmed for the adult pairs, in particular that breeding pairs stay together over long periods (possibly for their entire breeding lifespan), and that most pairs return to the same nest burrows every year.

During the 2005/2006 nesting season, 27 fledglings were fitted with identification bands out of a total of 36 that successfully fledged. In addition, 11 adult Cahows were also banded. This makes a total of 223 Cahows that have now been banded since 2002, consisting of 140 birds banded as fledglings and 83 banded as adults.



Fig. 7: Cahow chick being fitted with identification band (ring)

First Confirmation of Return of Banded Fledglings

The most significant development related to the banding program for the 2005/2006 nesting season was confirmation of the first return to the nesting islets of Cahows banded as fledglings in their nest burrows (see figure 7). This involved birds from both the 2002 and 2003 cohorts of fledglings. Previously, it had been thought that fledging Cahows, once they had departed to the open Ocean, did not return to the nesting grounds until they were at least 5 to 8 years of age, and one of the key objectives of the banding program had been to confirm the age of first return of young Cahows. Out of 29 fledglings fitted with bands in the 2002 nesting season, 6 of them were confirmed as returning in 2006 between February and April. In addition, 2 fledglings out of a total of 33 that were fitted with bands during the 2003 nesting season also returned during the 2006 season, both found in new nest sites, one joining up with an unbanded bird of unknown origin to form a new pair on the island it fledged from, and the other alone in a nest site on a different island from where it fledged.



Fig. 8: First Cahow banded as fledgling in Horn Rock C13 nest, May 21st, 2002 to be confirmed returning as adult in Horn C14 nest on Feb. 20th, 2006

Records of First-return Banded Chicks From 2002/2003 Nesting Seasons

Because of the importance and interesting results from the first return of banded chicks, essential information on each individual bird is included as follows:

(1) Chick from Horn C13 nest (2002 cohort)

- November 1st 2001.....pair of adults confirmed in nest burrow;
- January 9th 2002.....egg confirmed (brooded by adult);
- March 3rd 2002.....adult brooding newly hatched chick (first chick for this pair);
- May 21st 2002.....chick banded in nest, band number E0007, weight = 330 grams;
- May 31st 2002.....chick departs to open Ocean.

2006 Return:

- Feb 20th, 2006.....First return bird with band # E0007 found brooding egg **In Horn Rock C14 nest burrow**, paired with older adult bird (egg hatches and chick fledges successfully).

(2) Chick from Green Island F2 nest burrow (2002 cohort)

- November 1st, 2001.....pair of adults first returns to nest;
- February 9th, 2002 egg confirmed (brooded by adult);
- March 10th, 2002..... newly hatched chick alone in nest;
- May 25th, 2002..... chick fitted with band number E0013;
- June 1st, 2002..... chick out to exercise first night;
- June 11th, 2002..... chick departs for Open Ocean.

2006 Return:

- February 20th, 2006..... **bird found in Horn Rock C21 nest burrow** (nest already occupied by an established pair, that failed and has already abandoned nest for season) bird weight = 327gms, wing chord = 275mm.

(3) Chick from Horn Rock C10 nest burrow (2002 cohort)

- November 1st, 2001..... Pair of adults first returns to nest burrow;
- February 21st, 2002..... One adult confirmed brooding egg;
- March 23rd, 2002..... Chick confirmed, both adults in nest;
- May 21st, 2002..... Chick fitted with band number E0003
- June 16th, 2002..... Chick out to exercise first night;
- June 25th, 2002..... Chick departs to open Ocean.

2006 Return:

- February 22nd, 2006..... Returned bird lured to ground & captured on Horn Rock at night between C11 and C20 nests; weight = 312 gms; Wing chord = 271mm.
-

(4) Chick from Green Island # 4 nest burrow (2002 cohort)

- November 1st, 2001..... Pair of adults first confirmed at nest burrow;
- February 9th, 2002..... One adult confirmed brooding egg;
- March 7th, 2002..... Chick confirmed, in nest with 1 adult;
- May 25th, 2002..... Chick fitted with band number E0016
- June 1st, 2002..... Chick already out exercising at night
- June 9th, 2002..... Chick departs to open Ocean.

2006 Return:

- February 22nd, 2006..... Returned bird lured to ground & captured at night on Horn Rock between C11 and C20 nests; released but recaptured 3 times in 20 minutes; weight =302 gms, wing chord = 270mm
-

(5) Chick from Horn Rock C11 nest burrow (2002 cohort)

- November 8th, 2001..... Pair of adults already back at nest burrow with good nest made.
- January 14th, 2002..... One adult confirmed brooding egg
- March 7th, 2002..... Newly hatched chick confirmed
- May 24th, 2002..... Chick out to exercise first night
- May 25th, 2002..... Chick fitted with band number E0021
- June 4th, 2002..... Chick observed exercising during night watch;

observed departing to Sea at 12.25 am on June 5th.

2006 Return:

- March 2nd, 2006..... **Returned bird found in Horn Rock G1 nest burrow**; also second prospecting adult (banded on January 23rd with band # E0185) recorded at this nest (new pair)
-

(6) Chick from Green Island #5 nest burrow (2002 cohort)

- January 6th, 2002..... One adult sits close on nest
- January 9th, 2002..... Egg confirmed, brooded by one adult
- February 27th, 2002..... Adult in nest with newly hatched chick
- May 19th, 2002..... Chick out to exercise first night
- May 25th, 2002..... Chick fitted with band number E0015
- May 27th, 2002..... Chick departs to open Ocean

2006 Return:

- March 21st 2006..... **Returned bird found in Inner Pear Rock D1 nest burrow**; weight = 295 grams; wing chord = 265 mm
-

(7) Chick from Green Island #10 nest burrow (2003 cohort)

- October 28th 2002..... Pair of adult Cahows first confirmed in nest burrow
- January 11th 2003..... Returned; I adult brooding egg on nest
- March 1st – 7th 2003..... Recently hatched chick alone in nest
- May 15th 2003..... Band fitted to ¾ fledged chick; band number E0068
- May 23rd 2003..... Chick out to exercise first night
- June 2nd 2003..... Chick departs for open Ocean

2006 Return:

- February 16th 2006.....Prospecting visits to Green Island # 9 nest burrow
 - February 22nd 2006.....Prospecting adult Cahow in Green # 9 nest burrow
 - March 2nd 2006..... Pair of prospecting Cahows together in Green Is. # 9 nest burrow.
 - March 29th 2006.....**First return Cahow found in Green Island # 9 nest burrow** and removed for band check; band no. E0068; weight = 315 grams; wing chord = 277 mm.
-

(8) Chick from Green Island F2 nest burrow (2003 cohort)

- November 1st 2002..... Adult Cahow returns to nest burrow for start of new nesting season
- December 10th 2002..... Adult birds depart for pre-egg laying exodus
- January 22nd 2003..... Adult Cahow returned and brooding egg
- March 7th 2003..... Adult Cahow brooding newly hatched chick
- May 19th 2003..... Band number E0074 fitted on chick
- June 3rd 2003..... Chick out to exercise first night
- June 6th 2003..... Chick departs for open Ocean

2006 Return:

- April 6th 2006..... **Returned bird found in Green Island 4/5 nest burrow;** band number E0074; weight = 287 grams, wing chord = 270 mm. (joins 2nd adult already recorded in nest since 2005, band number E0137 (* see Figure 9))



Fig. 9: First-return Cahow banded as chick in 2002 at Green Island F2 nest, Recovered on Horn Rock, February 20th, 2006

Results and Findings from First-return Cahows Banded as Fledglings

Cahow fledglings have been banded as fledglings in their nests since 2002 and 2006 was the first year in which they were recorded as returning to the nesting islets. These birds now have known histories, can be positively identified and can thus be followed for the rest of their breeding lifespan. This has been a primary aim of the banding program and has already begun to provide a great deal of interesting results and findings, which are outlined as follows:

- Out of 29 Cahow chicks banded from the 2002 cohort of 36 chicks, a total of 6 returned as prospecting adults during the 2006 season (20.6% of chicks banded in 2002);
- Out of 33 Cahow chicks banded from the 2003 cohort of 39 chicks, a total of 2 returned as prospecting adults during the 2006 season (6% of chicks banded in 2003).
- 6 of the returned birds were captured in nest burrows, while 2 were captured by luring them to the ground as they were flying with other Cahows at night over the nesting islets.
- 2 of the returned birds paired up with older adult birds, already occupying nest burrows for 2 or more years, that had lost their original partners; one of the resulting pairs (Horn C14) successfully raised a chick in the 2006 season, while the other (Green 4/5) did not produce an egg in 2006 .
- 3 first-return Cahows were captured in new nest burrows not previously occupied by established adult pairs; 2 of these birds (Green 9 and Horn G1 nests) eventually attracted a partner (both unbanded birds of unknown origin), while the third (Inner Pear D1 nest) had not been seen with a partner by the end of the season.
- 1 returned bird was captured in a nest burrow (Horn C21) already occupied by an established pair of adult Cahows which had failed for the 2006 season and had already departed back to sea. This bird was not recaptured in this burrow in subsequent checks.
- 5 of the 8 returned birds were recaptured on the same island they had originally fledged from, while the other 3 were recaptured on other islands.
- Of the 8 returned birds, 3 originated from Horn Rock, while 5 originated from Green Island. To date, no banded birds fledging from either Inner Pear Rock or Long Rock have been recovered.
- All 3 of the Horn Rock birds were recaptured on the island of their birth, while only 2 of the 5 Green Island birds returned to Green Island; 2 were recaptured on Horn rock, while 1 was recaptured on Inner Pear Rock.

Update on Growth Study of Cahow Fledglings

Objectives and methodology

In 2002 a growth study of Cahow fledglings was initiated as part of the effort to investigate various aspects of breeding biology of the species which were not well understood. This study is being carried out in tandem with the banding program, and aims to track the development of a sample of each breeding season's cohort of chicks from hatching until final departure out to sea. The study involves removing chicks briefly from their nest chambers through the removable inspection lids which approximately 80% of all Cahow nest burrows are equipped with. The chicks are measured for body mass (weight) and wing chord (outer wing length), and occasionally other morphometric body measurements to determine development and rate of growth.

This study has several objectives:

- 1) To determine the normal range of weight and body size among a representative sample of fledglings over a number of years;
- 2) To support the translocation project by determining how close the fledgling is to final departure, and thus when the chick is ready to be translocated;
- 3) To identify any fledgling that is dangerously underweight, through abandonment or mortality of one or both adults or insufficient adult feeding visits, and to help determine when to remove such chicks for care in the Wildlife rehabilitation Centre at BAMZ before the chick is beyond hope of recovery;
- 4) To help determine the general productivity of the oceanic foraging grounds of the Cahow; by determining the mean maximum weights achieved by all Cahow fledglings which are part of the study during any one year, and comparing this to the mean maximum weights achieved by samples of fledglings during other years.

All equipment used for growth studies are obtained from AFO (Association of Field Ornithologists) Banding Supplies, Box 1770 Manomet, MA 02345 508/224-6521, USA. Weighing of fledglings is carried out using small Pesola spring scales with a range of 0 to 600 grams. Measurement of wing chord length is carried out using a specialized stainless steel wing chord ruler. Measurement of other morphometrics (bill length, bill depth at gonys, total head length, tarsus length, and total foot length) is carried out using a Scherr-Tumico caliper. To facilitate the weighing, measurement and banding of the birds, cloth bird weighing bags obtained from AFO Banding Supplies have been found to be very effective in gently holding and calming birds, while immobilizing them to enable measurement and banding to be carried out.

A total of 21 fledglings were used in the study during its first year in the 2001 – 2002 nesting season. Body mass (weight) was the only measurement taken of fledglings during this season, with checks carried out every 2 to 4 days on average. 21 fledglings were also studied during the 2002 – 2003 nesting season, with measurement of wing chord growth also being taken of fledglings from about 60 days of age onwards. Checks of fledglings were also carried out on consecutive days to determine the amount of food provided during adult feeding visits. 20 chicks were studied during the 2003 – 2004 nesting season,

of which 14 were translocated to the new nesting colony site on Nonsuch Island in the first year of the Cahow Translocation Project (see page 26: Update on Cahow Translocation Project). The other 4 chicks were used as controls to determine if there were any differences between naturally fledging chicks (raised entirely by the adult Cahows) and those which were translocated and artificially fed during their final fledging period. The weight studies were crucial in determining that translocated chicks were fledging over 40 grams lighter on average than birds which were not moved. This resulted in the decision to provide larger amounts of food during feeding of translocated chicks during the next nesting season and over the duration of the translocation project.

During the 2004 – 2005 nesting season, a total of 24 Cahow fledglings were measured as part of the growth study, of which 21 were eventually translocated to Nonsuch Island. As a result of the feed size adjustments, the chicks fledged at weights comparable to the control (non-translocated) birds.

For the 2005 – 2006 Cahow nesting season, a total of 26 fledglings were included as part of the growth study. 21 of these birds were eventually translocated to Nonsuch Island, while 5 birds were used as controls. The results show that the translocated Cahow fledglings fledged at essentially the same weight, wing chord and age as control birds. This is illustrated on Table (1), showing the growth measurements for mass (weight in grams) recorded on checks for 3 fledglings translocated at about 77 days of age (Green 6, Long D7 and Horn C22 and 2 naturally fledging (non-translocated) birds (Green #1 and Green # 13).

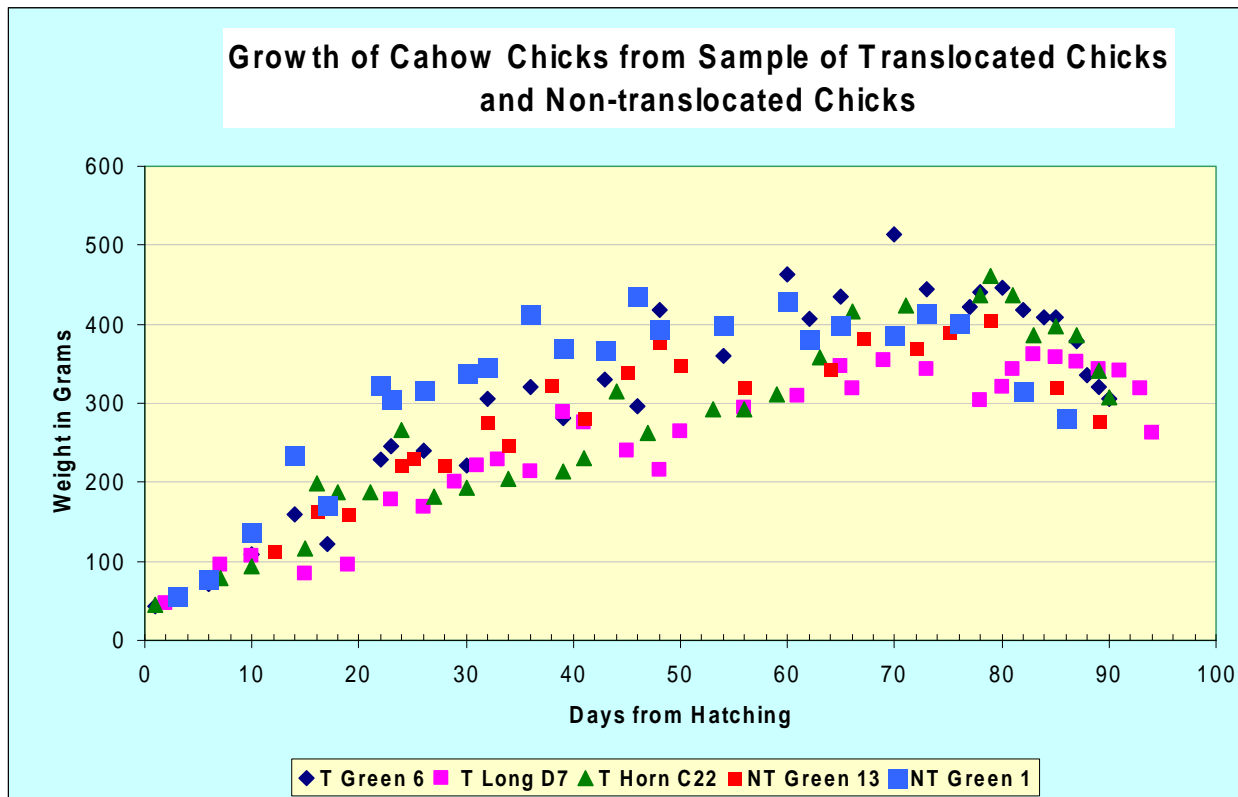


Table (1) – Growth records for 3 Translocated Cahow chicks (Green 6, Long D7 and Horn C22) and 2 Non-Translocated Chicks (Green 13 and Green 1)

Update on 2006 Cahow Translocation Project



Fig. 10: Cahow chicks translocated to Nonsuch Island, May 2006

Review of Translocation Project to date:

During 2006, the third year of the Cahow Translocation Project was carried out as the centerpiece of a project to establish a new breeding colony of Cahows on the Nonsuch Island Living Museum. This project is being carried out for two main reasons;

(1) The present nesting islets have suffered severe erosion and damage from several recent hurricane events, and remain vulnerable to further erosion and damage to nest sites. There exists the real possibility of catastrophic collapse of large sections of some of the nesting islets in the event of a severe hurricane, as was the case during hurricane Fabian in 2003.

(2) The small size and low elevation of the present nesting islets place physical restraints on the future growth and recovery of the Cahow population.

The goal of the Translocation Program is to move a total of 95 Cahow fledglings over a five-year period from nest sites on all 4 of the present nesting islets to a new complex of artificial burrows built at a new colony site on Nonsuch Island (see Fig. 11). During the trial year of the project in 2004 a total of 14 Cahow fledglings were moved to the nest complex on Nonsuch, with all fledging successfully. A smaller initial number of birds

were moved during this trial year to check the methodology and techniques used for the project, to look for any possible problems and to fine-tune the exact time to best move the fledglings, feed size and food items used etc. Nicholas Carlile, a petrel and seabird specialist from the New South Wales Department of Parks and Wildlife with experience in the translocation of *Pterodroma* petrel species, was engaged to come to Bermuda and oversee the trial year. This expertise was important as every effort is being made to ensure the success of the translocation project, which is considered vital to the long-term survival and recovery of the Cahow. The trial year was considered a success as all chicks fledged successfully, with age at fledging (89 days) and wing chord at fledging (250 mm) very similar to that of 10 non-translocated control chicks (93 days and 251mm respectively). The only concern was that translocated chicks fledged on average about 49 grams lighter (mean weight = 231 grams) than the control chicks (mean weight = 280 grams). It was unknown whether this would affect chick survival after fledging.

In 2005, the second year of the translocation project resulted in 21 Cahow chicks being moved to the new nest burrow complex on Nonsuch Island, with all 21 again fledging successfully out to sea. Experience from the 2004 season resulted in slightly larger feed amounts being given to the chicks, averaging 50 to 90 grams of squid and fresh anchovies (range 34 – 108 grams). This resulted in chick departure weights essentially identical to those of departing non-translocated chicks which were raised solely by the adult birds.



Fig. 11: Translocated Cahow chick being moved to artificial nest burrow on Nonsuch Island

Results of 2006 Cahow Translocation:

2006 was the third year that Cahow chicks have been moved to Nonsuch Island and represented the midway point of the translocation project. A total of 21 chicks were moved to Nonsuch, of which 20 successfully fledged to sea from the island. The first Cahow chick was translocated from Green Island #8 burrow on 6th May, and the last two were translocated on the 31st of May, with the median date for chick translocations being the 17th May. This is three days earlier than the median date for chick translocations in 2005 (20th May, range 8th May to 2nd June) and 5 days earlier than in 2004 (22nd May, range 13th May to 1st June).

The chicks were 78 days old on average when translocated to Nonsuch Island (range 69 to 92 days of age). This is very close to the figure in 2005 (81 days mean, range 73 to 87 days) and in 2004 (77 days mean, range 68 to 88).

The average mean weights of 10 naturally fledging (non-translocated) Cahow chicks at departure was recorded in 2004 and 2005 as being 280 grams and 288 grams respectively. During the trial 2004 translocation, the 14 translocated chicks fledged at an average mean weight of 231 grams, some 49 grams lighter than the control sample. This was of some concern since it is thought that the amount of fat reserves that a chick fledges with could affect their survival rate during the first, crucial week or two at sea when they are learning to forage and hunt for themselves. As the average meal size for the 2004 translocation was about 40 grams, it was decided that for subsequent years the meal size should be substantially increased.

Accordingly, for the 2005 and 2006 translocations, average meal sizes were increased to between 50 grams and 70 grams. This appears to have addressed the problem, as the average mean weight of the 21 chicks translocated in 2005 was 302 grams at fledging (range 232 grams to 375 grams) and of the 20 translocated chicks fledging in 2006 was 281 grams (range 243 grams to 332 grams). Therefore, the departure weights of translocated chicks during 2006 was essentially identical to naturally fledging (completely adult raised) chicks, indicating that the amount of food being fed to the chicks was now optimal (see Fig. 12).

Food provided to the Cahow chicks consisted of fresh unfrozen Squid (*Loligo sp.*) obtained from Miles Supermarket, Pitts Bay Road, Pembroke. Fresh Fish was netted locally and provided by Chris Flook, chief collections officer for the Bermuda Aquarium, Museum and Zoo (BAMZ). Fish provided was mainly fresh Anchovy *Sardinella anchovia*, but also included Redear Sardine *Harengula humeralis* and Atlantic Threadfin Herring *Opisthonema oglinum*. A typical meal for one chick consisted of 2 Squid bodies (with or without heads), and 6 to 10 Anchovies or equivalent.



Fig. 12: Translocated Cahow chick being fed fresh Anchovy on Nonsuch Island

Cahow chicks are translocated when their wing chord length exceeds 190 mm and they have attained adult plumage on at least 5 of the following 8 body parts (face; head; shoulders; wings; rump; tail; chest; belly). The first chick (Green Island #8) was translocated to a nest burrow at the translocation site on Nonsuch Island on the 6th May, 2006. This was followed by the other chicks at the rate of one or two a day until the last 2 chicks (Horn Rock C19 and C22) were translocated on the 31st May (see page 32: Summary of results for 2006 Cahow Translocation Project). The Green 8 chick was also the first bird to fledge 16 days after its translocation on the 22nd of the month. The final chick to fledge (Horn C19) did so on the 17th June. This chick had been somewhat underweight when moved to Nonsuch, and so was fed every day rather than on alternate days. Despite taking longer than normal to fledge at 109 days, the daily feeding enabled the chick to build up adequate fat reserves and depart at a normal weight of 274 grams.

Once the cahow chicks are fully fledged (determined when wing chord length exceeds 250 mm and/or all natal down is lost and the chick develops all adult plumage) feeding is discontinued and the chicks complete development from their fat reserves. At this point, the chicks begin to emerge from their nest burrows at night to exercise their flight muscles and explore and imprint upon their surroundings. Studies of non-translocated chicks since 2001 indicate that the mean period between first emergence and final fledging out to sea can range between 5 and 8 days. Translocated chicks have proven to generally fledge within this range, averaging 7 days in the 2004 translocation, 4 days in the 2005 translocation, and 5 days in the 2006 translocation.



Fig. 13: Translocated Cahow chick exercising at night on Nonsuch Island, May 26, 2006.

One chick died after falling into the sea on a particularly windy and rough night, and was found 2 days later washed up on Nonsuch South Beach by JP Skinner who was leading a tour around the island. A post-mortem of the specimen by Dr. Ian Walker, including X-rays of the carcass taken at the Endsmeet Animal Hospital, revealed a deformity of the outer right wing joint which, although not obvious until the chick attempted to fledge, made it impossible for the chick to fly. It is therefore probable that the chick attempted to fledge from the cliff edge below the translocation colony site, fell into the water and was overcome in the high breakers caused by strong 30 to 35-knot southerly winds on the night that the chick disappeared.

Even with the first mortality recorded of a chick in the translocation project, a total of 55 Cahow chicks have now fledged successfully from the new colony site on Nonsuch Island. 60% of the target total of 95 Cahow chicks has therefore been moved to Nonsuch and fledged to sea in the first 3 years of the 5-year Translocation Project. The final two years of the Project will aim for the translocation of 20 more chicks per year to reach the final target figure. It is hoped that by the last year of the project in 2008, that the first returns of translocated chicks will be recorded, based on the results this year with the first return to the present nesting islets of Cahows banded as chicks in 2002 and 2003 (see page 18: First Confirmation of Return of Banded Fledglings).

One concern associated with the Translocation Project was that Cahow chicks moved to the new colony site on Nonsuch would return as adults to the site to prospect for their own nest sites and partners, only to be attracted back to the present tiny nesting islets by the activity of the breeding pairs there. This is thought to be a potential problem due to the fact that although returning Petrels tend to return to the point from which they originally fledged, social facilitation is also a strong motivating factor for this family of seabirds. There is strong evidence that prospecting Cahows can be attracted to concentrations of nest burrows that are currently active.

In order to encourage returning Cahows to stay at the translocation site to prospect for nest burrows and attract mates at that location, the ‘Murremaid’ Sound Attraction System has now been moved to Nonsuch and set up at the Translocation site. This Sound System was first set up during 2004 and 2005 on Horn Rock at a new artificial nest burrow complex built on the most elevated section of the island. These were built to replace nest burrows low on the sides of the islet which were destroyed during hurricane Fabian in 2003. The ‘Murremaid’ Sound System uses solar panels to generate electricity, which is stored in batteries and used to power a DVD player which plays a recording of Cahow courtship calls, timed to switch on just after dark and turn back off at dawn. This Sound System, coupled with physical transfer of adult birds found at the destroyed nest sites into the new nest burrows, was successful in attracting Cahows to the new nest complex, with 4 burrows occupied by nesting pairs by 2006. This system is in good condition despite more than two years out on the exposed Horn Rock and should be ready to be switched on for the next breeding season (see 2005 Cahow Recovery Plan for full information).



Fig. 14: ‘Murremaid’ Sound Attraction System installed on Horn Rock, November 2003

Summary of Results for 2006 Cahow 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		Exercise Period (days)	Fledging			
	Date of Translocation	Age when moved (days)	No. of feeds after moving	Total Feed weight (grams)		Date of Fledging	Age from hatching (Days)	Weight at fledging (grams)	Wing Chord (mm)
GREEN 8	6 May	69	6	331g	5	22 May	85	301g	264mm
HORN C13	7 May	69	9	562g	8	26 May	88	291g	268mm
IPO B4	8 May	74	7	395g	7	23 May	89	281g	254mm
HORN C20	12 May	76	5	228g	5	23 May	87	253g	250mm
IPO D2	12 May	75	8	456g	5	28 May	91	272g	260mm
HORN C11	13 May	67	7	435g	5	29 May	83	272g	263mm
LONG E1	15 May	70	7	358g	5	29 May	84	307g	254mm
GREEN F2	16 May	77	7	440g	5	30 May	91	288g	245mm
HORN C12	16 May	76	7	425g	5	30 May	90	276g	263mm
LONG D5	17 May	79	6	370g	3	28 May	90	271g	257mm
LONG D7	17 May	80	7	424g	6	31 May	94	263g	260mm
HORN C9	19 May	80	9	567g	5	6 June	98	274g	257mm
HORN F3	21 May	80	6	323g	7	2 June	92	305g	255mm
GREEN 6	23 May	77	6	308g	4	5 June	90	306g	259mm
GREEN 12	23 May	84	8	459g	6	9 June	101	243g	261mm
GREEN 11	24 May	78	9	637g	10	8 June	93	332g	259mm
IPO D3	28 May	82	7	508g	4	12 June	97	283g	255mm
GREEN 5	29 May	85	7	546g	3	10 June	97	300g	257mm
HORN C19	31 May	92	*16	1171g	3	17 June	109	274g	247mm
HORN C22	31 May	78	6	271g	3	12 June	90	308g	257mm
Mean		78	8	467g	5		91	281g	257mm
Median	17 th May 2006					31 st May 2006			

* HORN C19 chick was underweight when first translocated and so was fed every day; all other chicks were fed every other day until their wing chord exceeded 250mm.

Future Management and Research Proposals

There are a number of new or ongoing management and research proposals anticipated for the next two Cahow nesting seasons; the most important are outlined as follows:

- 1) The final two years of the Cahow Translocation Project are scheduled to take place during the 2006/2007 and 2007/2008 nesting seasons. A total of 55 Cahow chicks have already fledged from Nonsuch Island, with translocated chicks now fledging with essentially identical body weights, wing measurements and timing as their non-translocated counterparts. It is therefore planned to translocate another 20 chicks annually from the present 4 nesting islets over the next two nesting seasons, to bring the number of translocated chicks to the target number of 95 proposed for the entire five years of the Translocation Project.
- 2) The Sound Attraction System should be used at the Nonsuch translocation colony site for at least the next two to three years, in order to encourage returning translocated chicks to stay at the site to prospect for and occupy nest burrows. It is hoped that this will counteract any tendency for returning birds to be attracted back to the present nesting islets by the activity around their existing Cahow breeding colonies.
- 3) It is proposed to initiate studies of the almost entirely unknown oceanic range of the Cahow away from Bermuda through the deployment of miniature Data Loggers, which have been field-tested and used with an increasing number of seabirds in the Pacific and Southern Oceans during the last two years. This includes Albatross, Shearwater and Petrel species, with very interesting results already obtained regarding foraging and migratory ranges and diving depths during foraging. At present it is proposed that this should take place during the 2007 – 2008 Cahow nesting season, and that an overseas expert in deployment, use and recovery of the Data Loggers and downloading and interpretation of information they have recorded be engaged to come to Bermuda to assist and lend advice in this project.
- 4) At present there is a problem with some 20% of Cahow nest burrows that cannot at present be observed or accessed in any way. This makes it difficult to interpret what is happening in the burrow, and often it is difficult to even know if the burrow contains a chick until the last few days before the chick fledges. Some of these burrows also habitually fail, possibly because of a simple problem such as a rock or pebble in the nest causing egg breakage. This represents a significant percentage of the breeding population where simple management procedures which can increase breeding success cannot be carried out due to lack of information. It is proposed that a 'Burrow-scope' instrument is purchased to solve this problem, the instrument basically being an endoscope with flexible, maneuverable cable which has an infra-red light and mini- camera. This can penetrate up to 15' into a small burrow and allow the user to see what is happening inside. This equipment also has great scope for use with other species, including Tropicbirds, Bermuda Skinks and Crab species.

Acknowledgements:



Fig. 15: Moving Cahow chick to translocation site on Nonsuch Island

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I would also like to personally acknowledge the continued support given to the Cahow Recovery Program by the Bermuda Zoological Society and the Bermuda Audubon Society, as well as various interested individuals. The continuing success of the project owes much to their logistical, financial and moral support.

Final thanks definitely go to my wife and friend Leila Madeiros, without which I would not have been able to put in the long hours necessary for this work.

Jeremy Madeiros