

Treshnish Isles
Auk Ringing Group
Report for 2000

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Expedition dates:

20th May - 28th May 2000

24th June - 1st July 2000

Expedition members in May 2000:

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INTRODUCTION

Since 1971, the Treshnish Isles Auk Ringing Group (TIARG) has undertaken to monitor through ringing and census work, the breeding seabird populations of the Treshnish Isles, Argyll (Walker & Cooper 1996). This report summarises the results of the Group's 21st & 22nd expedition to the Treshnish Isles on 20th – 28th May & 24th June – 1st July 2000.

In summary the May trip undertook the first ever comprehensive Manx Shearwater survey of the islands whilst the second continued with our systematic and targeted census and ringing effort.

As in previous years, both expeditions' bases were set up around the ruined village site at the northern end of Lunga. With much logistical help from Iain Morrison and RSPB staff (from Coll & Tiree), expedition members were in addition able to land on most of the other islands. This year's census was again undertaken as part of Seabird 2000, the third census of all breeding seabirds in Britain and Ireland, following on from Operation Seafarer in 1969/70 and the Seabird Colony Register (SCR) census in 1985-87.

All TIARG census and ringing data are fed into two national monitoring programmes, the Seabird Colony Register (J.N.C.C.) and National Ringing Database (British Trust for Ornithology), respectively. The data supplied are of great conservation value as they are the sole means by which the seabird colonies of the Treshnish Isles are currently monitored. The conservation importance of these islands is recognised by their designation as a Special Protection Area by the UK Government for the breeding colonies of seabirds they support. Financial support for the monitoring work TIARG undertook in 2000 was given by Scottish Ornithologists Club (SOC), Scottish Natural Heritage and the Seabird Group (JNCC) in the form of £350, £550 and £250 grants respectively towards transport costs.

After many years of uncertainty due to the Treshnish being up for sale, they changed hands this year from the ownership of the Rankin family to THE HEBRIDEAN TRUST and this probably marks a new era in the history of the the Treshnish Isles. We wish the Trust every success and look forward to working closely with them

WEATHER

First trip: May 20th-May 28th.

It was interesting to be on the islands so much earlier in the year than usual, and the weather was different; the nights were longer and darker. This may seem obvious, but is intended as a serious comment. Also, it was often noticeably cold for the time of year. The weather in the Hebrides had been very good for the previous three weeks, but our arrival coincided with a complex sequence of low pressure which dominated the weather throughout the week, producing unsettled and changeable weather conditions, but rarely affecting our work seriously. A potential difficulty was the absence of fine, calm nights suitable for Storm Petrel netting, but since only a few petrels had appeared by the end of our visit this did not matter in practice.

Saturday 20th May

Fine and sunny when we left Oban, but off Mull became overcast with a cold breeze and the sea choppy, and 8/10 cloud. After landing on Lunga at 1200 hrs rain began, persisting into evening with a light ENE breeze. Conditions improved during evening but breeze overnight.

Sunday 21st May

Light ENE breeze backing to NW by midday, stronger towards evening. Heavy rain in early evening, stopped later but remaining unreliable with occasional showers.

Monday 22nd May

Rained heavily but briefly during night with strong gusts up to Force 4. In morning, light NW breeze with 2/10 cloud cover, mainly over Tiree and hills of Mull. Light skim cloud to west. Warm. In mid-morning, a short hailstorm then weather improved again steadily through the day. Cloud reverted to 2/10.

Tuesday 23rd May

Heavy overnight rain and fresh E wind, tents very blown. Much Manx Shearwater activity. Wet until about 1100hrs with sea agitated and poor visibility and mist. Weather improved steadily through the day, and wind backed to westerly, but remained cold, especially at night.

Wednesday 24th May

Light SW breeze at 0800hrs. 3/10 cloud cover mainly over Mull, otherwise sunny but with light rain showers. Wind backing SE during day, finally S up to Force 5. South end of Lunga exposed, tape responses difficult. Warm in sheltered areas. Cloud 2/10 by 1800hrs, heavy cumulus mainly to S and SE. Very cold in late evening.

Thursday 25th May

Overnight no wind noted but cold with intermittent rain showers. Cloud 7/10 at 0900hrs, with heavy cumulus over Mull and skim cloud over sea to West. Very light Easterly breeze. Cool but with sunny spells. Showers continuing, heavy with hail in mid-morning. Improved steadily through the afternoon, drying out and wind veering round to a light S breeze. Cloud 3/10 by evening.

Friday 26th May

Showers in early morning then fine throughout the day. Steady light SW wind, cloud cover 2/10. Very warm out of wind. Sea flat calm in evening, weather became cold in late evening. Fine sunset over Tiree with curious cloud formations.

Saturday 27th May

Quiet dry night with little wind. Morning bright and cool with light NE breeze and 2/10 cloud, mainly thin and hazy but building over Coll, Rhum and Mull by late morning. Forecast was for wind in E, backing N but actually a brisk breeze from SW. Cloud extending to 10/10 during afternoon and mist over sea. Slight rain occasionally. Brighter by evening.

Sunday 28th May

At 0800hrs on Lunga, sunny and becoming warm, with very light WNW wind and 1/10 cloud mainly over Coll/Tiree, Rhum etc. By noon, front approaching from NW bringing heavy rain and strong breeze. Rained heavily for half-hour then lessened but continued wettish well into afternoon. Better weather followed, and we left Lunga at 1600 hrs in improving conditions.

Second trip: June 24th-July 1st.

On the whole a much better week for weather than the May trip. There had been extremely bad weather in late May, with strong winds and heavy rain; but in the weeks before our June visit the weather had been good. This continued throughout the week, with warm days, no rain, only light winds and good sea conditions. The latter was fortunate since much boat work was done during the week. With a large team and no rain, the water supply caused some concern, but we did not run out.

Saturday 24th June

Cold, overcast conditions in Oban and on the Mull ferry. Better weather on the West side of

Mull, but sea fairly rough on crossing to Lunga. Weather brighter after landing, warm with light cloud by evening, wind NW force 2. No rain.

Sunday 25th June

At 0800hrs, wind very light WNW. Very light 2/10 hazy cloud. Warm, sunny, sea calm. Continued warm and sunny all day, by 1700hrs light NW breeze with light cloud over Rhum and Mull, and a light haze overall. Still warm and sunny, no rain. (on Chaisteil, also on Dutchmans' in afternoon).

Monday 26th June

Warm and sunny at 0830hrs, 2/10 cloud, light ENE breeze Force 2-3, sea flat calm. Cumulus building up over north Mull. Became overcast by mid-morning then cleared again. Strong W breeze appeared; sea became rougher then calmed again. At 1200hrs, 8/10 cloud but clear over Ulva. In afternoon went to Fladda, then back to Lunga (Harp Rock) and then back to Fladda. Weather good throughout, with strong sun in evening. Became cooler and overcast through the night. No rain.

Tuesday 27th June

Dull and overcast in morning, with cloud, no wind and midges active till 1100hrs when the sun came out; then usual warm dry day with light cloud, wind NNE but no more than Force 1-2. Became colder in evening with rather cool breeze and 4/10 cloud by midnight. No rain.

Wednesday 28th June

Usual warm dry day from early morning, with clear skies except for light skim of cloud. Wind only Force 1, NNW. Humidity increased through afternoon with minor cumulus build-up over Mull hills. Became very hot in evening. No rain.

Thursday 29th June

Dull, humid and overcast at first but hot by mid-morning but with cool, fluky breezes mainly from west. Slight ripple on sea, cumulus building up over Mull hills, and thin cloud over sea areas. Wind veered to N and freshened in evening, becoming colder. Still no rain.

Friday 30th June

Very hot by 0900hrs, little wind, sea flat calm. Skim cloud, some cumulus over Ben More Mull. By lunchtime, clouding up to 7/10 and breeze becoming moderately fresh from west. Remained fine through evening.

Saturday 1st July

Weather much as for Friday, but not as warm although breeze only light North-westerly. Left Lunga at about 1600hrs in good weather and sea conditions.

ISLAND VISITORS

First trip: May 20th-May 28th

Normal day tripper traffic throughout week. Usually one or two yachts in anchorage. Monday 2 canoeists from Durham visited camp; Wednesday 2 different canoeists (double kayak) seen at sea between Fladda and Gometra; Friday 2 canoeists (2 canoes) camped overnight on Chaisteil, left early morning. Several yachts in on Saturday, also motor cruiser from Mull mainland. Even more on Sunday, including Hebridean Trust vessel.

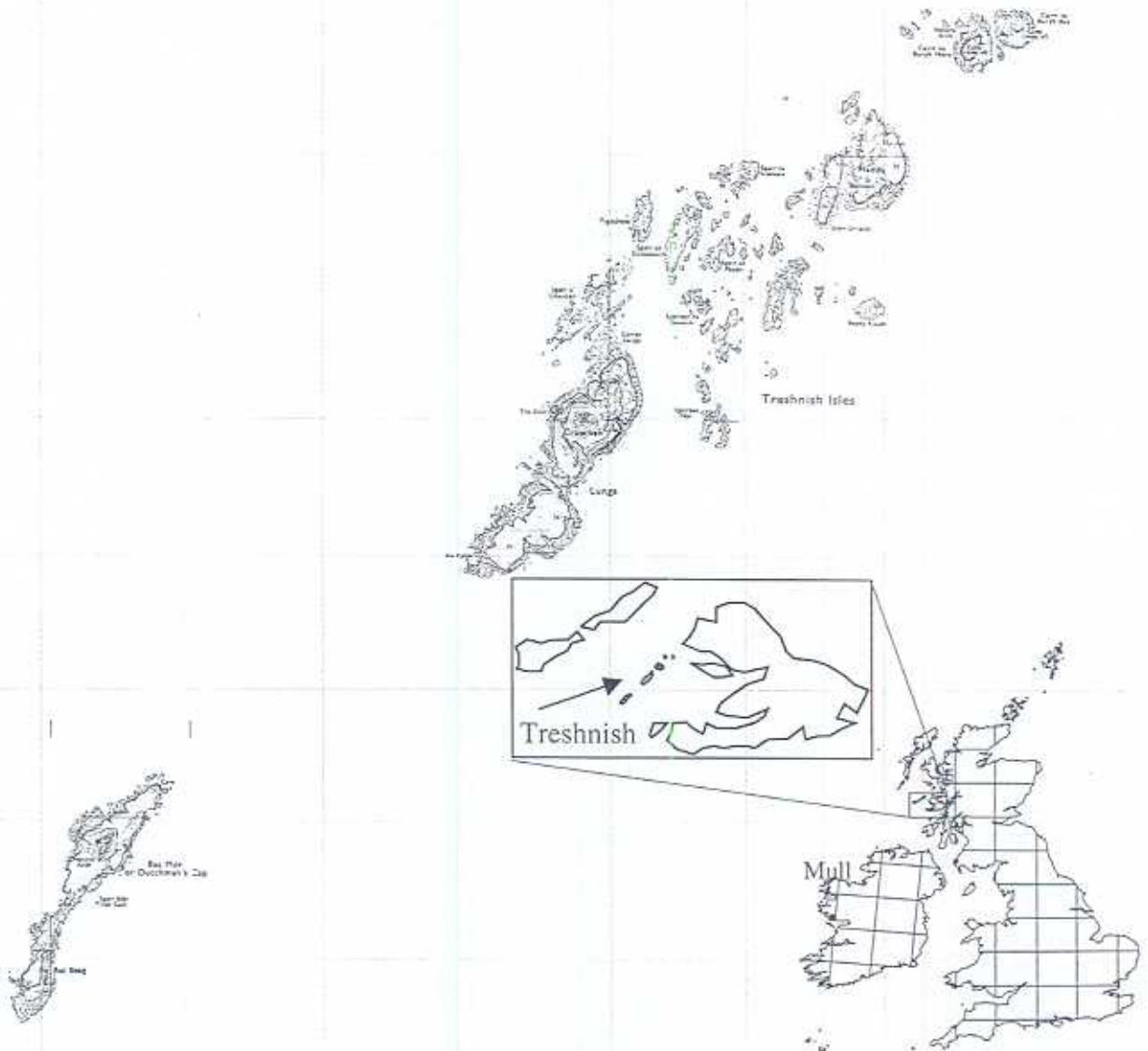
Second trip: June 24th-July 1st

Normal day tripper traffic throughout week. Usually several yachts in anchorage.

Monday RSPB staff from Coll/Tiree visited in inflatable, took us from Fladda back to Lunga, then to Fladda and back for Storm Petrel netting. Left early Tuesday morning.

Wednesday, yacht Corryvreckan (successor to the yacht which brought Peter Deans and John Hodson in 1977) called and skipper visited camp. By evening, group of about 14 canoeists landed and camped on Corran Lunga, stayed till well into next day. Also a large RIB (perhaps divers) and a converted MFV around Chaisteil.

Thursday 3 photographers camping on Lunga, brought by day boat. Took pictures of Harp Rock activity in evening and visited camp on Friday night. Went off Saturday.



The location of the Treshnish Isles in the British Isles, with (inset) their position in the Inner Hebrides and location of the larger islands in the chain.

SYSTEMATIC LIST FOR 2000 - BIRDS

The following systematic list is a brief account of those bird species seen whilst the Treshnish Isles Auk Ringing Group were present on the Treshnish Isles, 20th May - 28th May and 24th June - 1st July. The status comments refer to the species' occurrence during the breeding season based upon the records of expeditions in previous years. A detailed breakdown of breeding seabird numbers on the Treshnish Isles in 2000 is provided in a subsequent section of the report.

Fulmar *Fulmarus glacialis*

A common breeding species

An incubating bird alongside the path to Harp Rock in the early part of the May expedition had disappeared towards the end of the week with only feathers remaining. For a species known to be sensitive to human disturbance, this site is unlikely to be successful so close to the footpath.

Breeding was confirmed in June on Bac Mór, Bac Beag, Cairn na Burgh More, Cairn na Burgh Beg, Fladda, Lunga and Sgeir a Chaisteil. The breeding population for the Treshnish Isles was estimated at 1078 based upon apparently occupied sites. A single Fulmar showing characteristics of the dark morph (blue phase), sighted last year on Bac Mor was not seen in 2000.

Manx Shearwater *Puffinus puffinus*

A regular breeding species

In May, a complete census on Lunga estimated a breeding population of 1283 pairs. This is approximately twice the previous population estimate and with a more widespread distribution than identified previously. A full account of the survey is provided later in this report. Very few if any breeding birds were considered to occupy the other isles, as little or no suitable habitat exists.

One bird was mist netted at the Village at the northern end of Lunga.

Storm Petrel *Hydrobates pelagicus*

A common breeding species

Very little evidence of this species presence was noted in late May with only one or two birds churring at the Village (north end) and very few seen, indicating just the start of breeding bird arrival.

In June many birds were heard churring from burrows on Fladda and Lunga. A census of the breeding colony within the Boulder Beach at the northern end of Lunga, estimated ca1,700 pairs using the methodology of Gilbert & Hemsley (1996). The apparent increase in colony size from 350 pairs in 1996, as estimated by Gilbert & Hemsley (1996), is the subject of a paper later in this report (p52).

Gannet *Sula bassana*

Regularly seen offshore

From Lunga in May, only four were noted; these on 24th with another 6 recorded on the crossing back to Mull four days later.

Between 1 and 4 birds recorded offshore on five dates in late June, all adults other than a juvenile on 29th. Of those birds seen fishing, all were off the west coast of Lunga.

Shag *Phalacrocorax aristotelis*

A common breeding species

Breeding was confirmed on Bac Mór, Bac Beag, Cairn na Burgh More, Cairn na Burgh Beg, Fladda, Lunga and Sgeir a Chaisteil. The breeding population for Lunga and Sgeir a Chaisteil was 244 and 16 pairs respectively, based upon nest counts.

Grey Heron *Ardea cinerea*

Rare visitor

2 heading N.W. on 26th June and 1 S. on 1st July were noted over the Village at the northern end of Lunga.

Greylag Goose *Anser anser*

Regularly represented by a small number of breeding pairs and a late summer moult flock

The only evidence of breeding was recorded by the May expedition when a pair with 4 young were noted on the sea approaching Fladda. Otherwise in May 7 birds were seen on the south end of Lunga.

The late summer moult flock in June held at least 240 birds, typically residing around the islands of Sgeir an Eirionnaich, Fladda and Sgeir an Fheòir. A further 4+ moulting adult birds were

noted on Bac Mór in June. Extensive areas of vegetation heavily grazed and trampled by geese was located on Bac Mór adjacent to freshwater pools at the south and north ends. Further such areas were noted on the south end of Lunga, Sgeir an Eirionnaich and Sgeir na Giusaich.

Eider *Somateria mollissima*

Regularly breeds in small numbers

Large numbers, mostly males, were seen in May off Lunga with 62 being the highest count. The season's first brood to be noted was of 2 ducklings off the Landing Beach, Lunga, in May.

Three empty nests were found at Sgeir a Chaisteil on the 1st July where previously females were noted incubating on 25th June. Elsewhere an empty nest was found on the Landing Beach, Lunga. A minimum of 7 broods of between 1 and 4 young were noted at Sgeir a Chaisteil (1) and Lunga (5 south end, 1 Corran Lunga). At least a further 10 ducks frequented Lunga and Sgeir a Chaisteil. Of those birds not associated with broods in late June, up to 23 birds were present between Fladda and Lunga, these including at least 12 drakes.

Buzzard *Buteo buteo*

One pair breeds in most years

Singles were seen on Lunga on 20th and 23rd May, with two Ravens escorting the first individual towards Fladda.

Unlike previous years, no birds were noted during late June.

Peregrine *Falco peregrinus*

At least one bird regularly present with breeding known to occur on adjacent coasts

An immature male was seen on several occasions over Lunga in May with a second unaged male noted once.

The previous year's eyrie at Bac Mór was found vacant on 25th June. Perhaps as a consequence, only a single bird was noted in June, this unsexed individual circling over Sgeir a Chaisteil on 26th.

Corncrake *Crex crex*

Probably a regular breeder in small numbers

Two birds in May were regularly heard calling from the Village area at the north end of Lunga, these males being seen on several occasions. Elsewhere in May, the leg of a predated bird was found between the Village and Shearwater Gully.

By June, single calling birds were to be heard from 3 localities within the northern half of Lunga involving at least one individual. Two calling birds were associated with nettlebeds surrounded by Bracken, the other within a pure Bracken stand. One bird was occasionally heard during the week, and then only briefly, to the south-east of the Village (north end). Further birds were heard on single occasions from the saddle north-east of the summit of Cruachan and above Shag Alley. The lack of regular calling as in previous years may indicate the male(s) being pre-occupied with an incubating female (A. Leitch *pers comm.*).

A lone calling bird was noted during the night of the 26th June on Fladda, in the low-lying ground between the north and south bays. A further bird /birds were heard on both of the Cairn na Burghs in early June (local boatman).

Oystercatcher *Haematopus ostralegus*

Regularly breeds in small numbers

On Lunga at least two pairs were on territory in May, these both on the Landing Beach.

Four breeding pairs were later found in June to be holding territories on Lunga's beaches and rocky outcrops (1 in area 5, 1 in area 8 and 2 at Tarbet) with only one chick (Tarbet west) and no eggs located. Elsewhere territorial pairs were located at Sgeirean na Giusaich (1 pair) and Sgeir a Chaisteil (2 pairs, one with a chick). Small flocks of presumed failed breeders in June were evident on Lunga with up to 6 birds noted at Corran Lunga and the south end (areas 5 and 6a). 15 birds were noted on the islands between Fladda and Lunga on 28th June.

Ringed Plover *Charadrius hiaticula*

One or two pairs breed

A nest with a clutch of three eggs was found on the Landing Beach on the 28th May.

Observations in June suggested at least five pairs to have attempted breeding, 2 pairs on Lunga's Landing Beach each with a chick, 2 pairs on Sgeir a Chaisteil and an agitated male on

Fladda's south-east coast.

Dunlin *Calidris alpina*

Rare visitor

Six birds were flushed from the Landing Beach on 25th May, a time when the passage north of Icelandic and Nearctic breeders is still underway through Britain.

Snipe *Gallinago gallinago*

Regularly breeds in small numbers

Two drumming males could be heard from the Village (north end) in May whilst others were flushed from several sites on Lunga including two from the saddle below Cruachan summit. Fresh remains of a female, including an egg, were found at Shearwater Gully.

In June, two males regularly displayed within the vicinity of the village (north end of Lunga). Birds were also regularly flushed from this general area as were two chicks found on the cliff top path. Further east only a single bird was noted from the saddle below Cruachan summit and none within the vicinity of Shag Alley unlike previous years. Elsewhere on Lunga up to three individuals were flushed from the south end (count area 6 & 7) on a given day with a nest containing 4 eggs found in area 6. During the brief visits to some of the other islands, a single bird was flushed on Bac Mór and a single heard drumming over Fladda on 26th.

Curlew *Numenius arquata*

Irregular visitor

Single birds were heard on several occasions from the vicinity of Sgeir a Chaisteil and the north end of Lunga between 28th - 30th June.

Redshank *Tringa totanus*

Rare visitor

Single birds were heard calling from Fladda and the north end of Lunga on 27th and 30th June respectively.

Common Sandpiper *Actitis hypoleucos*

One pair occasionally breeds

Two breeding pairs were considered in May to be on territory at Corran Lunga. No successful breeding was confirmed. By June only a single bird giving alarm calls and displaying was noted at Lunga's Landing Beach with regularity, whilst agitated singles were also noted at Sgeir a Chaisteil, Fladda (south bay) and Sgeir an Eirionnaich. Further additions in June were singles south of Shag Alley (area 4) and, on the 30th, the north end of Corran Lunga.

Arctic Skua *Stercorarius parasiticus*

Small numbers seen daily presumably from the breeding colony on Coll

Up to 4 seen on four dates around Lunga. The species was noticeable by its virtual absence during June evenings at Harp Rock where birds on past year's expeditions have invariably been present daily kleptoparasitising auks and Kittiwakes. At the time, the lower frequency of observations in May was attributed to it being early in the season with few fish carrying seabirds to kleptoparasitise. However, the breeding population on Coll was reported to be down on previous years (A. Leitch *pers comm.*). Both dark and light phase birds were observed, with count maxima of 3 and 1 respectively.

Great Skua *Stercorarius skua*

An increasingly regular species, with one pair holding territory since 1996 where breeding was confirmed in 1998.

A maximum of four birds were noted in May on Lunga, these being over the Village (north end) on 24th. At the South End, two birds were seen alongside each other on the 22nd and single at the same locality on 26th but no birds there on an intervening date. Elsewhere in May, two birds were noted on Fladda on 28th.

In June breeding on Fladda was confirmed with a single chick, within the same territory as occupied since 1996. Another 2 birds regularly noted by Iain Morrison perched along the west coast of Fladda were present during the expedition's visit, flying off towards Lunga on being approached. No birds were noted at the South End of Lunga in June. At the Village (north end of Lunga) birds, often in pairs, regularly flew overhead between Harp Rock and Fladda with a maximum of four birds at one time on the 26th June.

Common Gull *Larus canus*

Irregular breeding species in small numbers

The calling of birds on a couple of occasions over Lunga were the extent of records in May.

Breeding in June was confirmed for four pairs on the south-east of Fladda (broods of 3, 1, 1, 1 & egg) with another 2 pairs on apparently occupied territories. Breeding was also confirmed on Sgeir an Eirionnaich for one pair with chicks. Elsewhere up to four adults were regularly noted over Tarbet whilst up to three birds were seen on several dates over Sgeir a Chaisteil and the northern end of Lunga.

Lesser Black-backed Gull *Larus fuscus*

Regularly breeding species in small numbers

Breeding was confirmed on Lunga (area 8) by the presence of chicks, with 6 pairs on territory. The presence of alarming adults also suggested breeding on Bac Mór and Sgeir a Chaisteil.

Herring Gull *Larus argentatus*

A common breeding species

Breeding was confirmed in June on Fladda, Bac Mór, Lunga (73 pairs), Sgeir a Chaisteil (10 pairs), Sgeir na Giusaich (1 pair) and Sgier an Fheòir (6 pairs). Where as it would be expected around 13-15 breeding pairs to be located on Corran Lunga, only 4 pairs were noted in June. Only one additional incubating bird was noted in May on Corran Lunga. In contrast, June counts of breeding adults on territory would suggest over a two fold increase in birds along Lunga's south west coast to 62 pairs.

Great Black-backed Gull *Larus marinus*

Regular breeding species that has declined in recent years

Observations in May included 55 birds in the Gullery at the south end of Lunga, 3 incubating bird on Corran Lunga and a bird incubating 3 eggs at Harp Rock. One bird was seen to drown a Puffin by repeatedly forcing it to dive.

Breeding was confirmed in June on Fladda, Bac Mór, Lunga (64 pairs), Sgeir a Chaisteil (3 pairs), and Sgier an Fheòir (2 pairs).

Kittiwake *Rissa tridactyla*

A localised breeding species

Breeding was only confirmed on Bac Mór and Lunga (815 pairs), the main colony situated around Harp Rock. No birds were noted at Corran Lunga where in the previous two years up to 3 birds nested. A flock of up to 500 adults were noted daily on rocks between Lunga and Sgeir a Chaisteil.

Common Tern *Sterna hirundo*

Irregular breeding species

In contrast to the previous year, this was the dominant species initially with only two Arctic Terns located amongst the 110 birds alarming above the team that counted 58 tern nests on Sgier an Fheòir on 25th June. By the 1st July, the numbers of adult terns had increased to 190 with a higher proportion of Arctic Terns noted. Elsewhere 5 pairs of Common Terns bred on Sgeir an Eirionnaich. The traditional mixed Common/Arctic colony on Sgeirean na Guisaich was vacant with no signs of having been occupied earlier in the year.

Arctic Tern *Sterna paradisaea*

Irregular breeding species

The species was not noted in May until the 27th when 8 were seen. At least one pair was considered to be breeding amongst the Common Tern colony on Sgier an Fheòir during a visit on 25th June. By the 1st July, the numbers of adult terns around the colony had increased to 190 with a higher proportion of Arctic Terns noted.

Guillemot *Uria aalge*

Common breeding species

Breeding was confirmed on Lunga, Fladda and Sgeir a Chaisteil, the main concentration typically located within the vicinity of Harp Rock with 8,156 adult birds estimated.

Razorbill *Alca torda*

Common breeding species

Breeding was confirmed on Lunga and Sgeir a Chaisteil. Birds were also seen on suitable breeding sites at Cairn na Burgh Beg, Cairn na Burgh More and Fladda.

Black Guillemot *Cephus grylle*

Regular breeding species in small numbers

Sightings in May were few and confined to singles around Lunga. In June, adult birds were seen around Fladda (14 birds), Sgeir an Eirionnaich (17), Sgeir an Fheòir (5), Cairn na Burgh More (5), Bac Mór (4) and Lunga's south end (21). At the latter locality, two nest sites were located (area 5 & 6).

Puffin *Fratercula arctica*

Common breeding species

In May, some birds were still excavating their breeding burrows. By June adults were apparently occupying burrows on Bac Mór, Lunga, Sgeir a Chaisteil and Fladda. A partial albino individual with white nape and collar was noted by both expeditions within the mainland colony opposite Harp Rock.

An observation made in May and not noted in June or by previous expeditions was a heavy tick infestation below the lower mandible of many birds.

Rock Dove *Columba livia*

Regular breeding species in very small numbers

Sightings in May were restricted to 3 birds between the Village (north end) and Shearwater Gully, with remains found of two other birds in this area.

Evidence of nesting by a single pair was found in June at the northern most cave on the north-west coast of Lunga between Harp Rock and Corran Lunga. Breeding was later confirmed by a single pair in a cave to the south of Shearwater Gully, Lunga. Up to two birds were seen on occasions elsewhere on Lunga in June, including the Village (north end), the South end and Harp Rock.

Short/Long eared Owl *Asio* spp.

Very rare visitor

One bird of this species pair was disturbed on 26th June from between Shag Alley and Shearwater Gully, whereupon it flew out to sea.

Swift *Apus apus*

Irregular visitor

One bird was seen above the Village, Lunga, on 29th June.

Skylark *Alauda arvensis*

Regular breeding species in small numbers

A minimum of 4 singing birds were considered to be holding territory on Lunga; two at the south end (singles in areas 6 & 7), a single bird south of the Cruachan summit and one above the Village (north end). The only other bird noted was in June, a singing bird on Fladda

Swallow *Hirundo rutisco*

An irregular visitor

Two birds were seen around Lunga on the 26th and 27th May.

House Martin *Delichon urbica*

A very rare visitor

A single bird was seen over the north end of Lunga on the 26th May.

Meadow Pipit *Anthus pratensis*

Regular breeding species in small numbers

Widespread breeding species on Lunga and Fladda, with birds also noted on territory on Bac Mór. The species may have been overlooked on the other islands visited. 12 pulli from several nests were ringed on Lunga in May.

Rock Pipit *Anthus petrosus*

Regular breeding species in small numbers

Common along the coast of Lunga with birds also noted on Bac Mór, Fladda, Sgeir an Eirionnaich and Sgeir a Chaisteil in June. A nest in the Village (north end) during May confirmed breeding on Lunga, with recently fledged juveniles being encountered around the island in June e.g. a brood of 3 on the Landing Beach. A minimum of 14 pairs were recorded around Lunga in June, often adults carrying food noted, with birds in areas 6a (4 pairs), 5 (1 pair), 9 (2 pairs), 2 (2 pairs), 1 (2 pairs), 11 (2 pairs), 12 (1 pair). Both adult birds and the presence of recently fledged juveniles are likely to have been overlooked on the other islands visited, given the limited duration of visits.

Pied Wagtail *Motacilla alba yarrelli*

Irregular breeding species

Sightings on Lunga in May were confined to singles at Tarbet, the Landing Beach and the South End.

By June, a pair with three juveniles were regularly seen foraging at Tarbet. The only other sightings at this time were also from Lunga, 1-2 adults seen at the Village (north end), Boulder Beach and Harp Rock on 1 or 2 dates.

Wren *Troglodytes troglodytes*

Regular breeding species, quite common where habitat suitable.

The vast majority of records of the species were confined to the northern half of Lunga, predominately amongst the boulder scree and bracken covered slopes from Cruachan down to the sea and on Corran Lunga. In June, singing males suggested a minimum of 11 territories along the east coast between the Landing Beach and Shearwater Gully. Fledged young were noted at Tarbet, the top of Shearwater Gulley, the Landing Beach and the Village at the north end. Elsewhere a single singing male was recorded on Fladda.

Dunnock *Prunella modularis*

Irregular breeding species

No birds were recorded by the 2000 expeditions.

Wheatear *Oenanthe oenanthe*

Regular breeding species in small numbers

During the May 2000 expedition to the Treshnish Isles an effort was made to locate the nests of Wheatears on the main body of Lunga with a view to ringing the pulli. This was in addition to catching and ringing adults using spring traps.

In recent years, the timing of the expedition in late June has meant that only fledged young and adults were able to be caught and ringed using baited spring traps.

A total of 11 broods of Wheatears were located and 10 broods were ringed comprising some 44 pulli. It was not possible to locate all suspected nests (one pair on the North Beach proved elusive despite careful observation). A nest was also found located within the walls of a cottage at the north end of the island, which proved impossible to access.

Wheatears caught on Lunga in May 2000:

	New	Retrap
Adult	6	4
Pulli	44 (10 broods)	

Male wheatears also appeared to be holding territory at two places in addition to those for which nests were located. This would put the total number of pairs of breeding Wheatears on the main part of Lunga at 13 for 2000.

As these males were not observed feeding young, it is possible that their broods had yet to hatch or were very young and were still being incubated by the female. As the female does most of the feeding in any case (Cramp S.1988), it is possible that these two males were more preoccupied with guarding their territory than feeding young. If these birds corresponded to nests with young chicks, it would increase the range of laying dates beyond that suggested by the handled pulli (see below).

Locations of broods and probable pairs are given in the table overleaf:

Location		Pulli Ringed	Pulli Alive	Pulli Age	Notes
1.	Shearwater Gully	4	4	7d	
2.	Cruachan (Upper South Slope)	4	4	5d	
3.	Tarbett	3	3	11d	
4.	Gully N of Tarbett on East Side	5	5	7d	
5.	Gully N of Tarbett on West Side	4	4	7d	
6.	Cruachan (Lower S slopes)	4	4	7d	1 egg
7.	Puffin Colony by Harp Rock	5	6	7d	
8.	Gully above Otter Cave	4	4	7d	
9.	near Cottages	6	6	9d	
10.	Gull colony on North Beach	5	5	11d	
11.	Cottage wall	0	-		
12.	North Slopes of Cruachan	-	-		
13.	Upper gully above Otter Cave	-	-		

There was a wide range in the ages of the pulli with a likely gap of around 3 days between the hatching dates of the youngest and oldest chicks found. From estimates of ages for the pulli, the earliest females would have begun incubation at the beginning of May, egg laying having commenced some 7 days previously. The latest females would not have commenced incubating until 7 days later.

It is likely therefore that the adult birds would have returned to Lunga from early April to set up territories, attract mates and begin nesting. An interesting observation is that both the most developed broods (North Beach Gull Colony and Tarbet) were located in very sheltered spots on the island. Were these the 'best' nesting locations and selected by the earliest returning pairs?

Four adults were retrapped from previous years at locations corresponding to the broods listed above, two of which were ringed as juveniles on Lunga during previous trips in 1997 and 1999.

Birds re-caught during the May 2000 expedition.

Ring No.	Date	Age /Sex	CP /BP	Wing	Weight	Location
B229978	26-05-2000	5M	CP	97	24.2	4
	Ringed 22-06-1999	3J		97	25.3	Area14
B229959	24-05-2000	6F	BP	92	23.8	10
	Ringed 02-07-1998	4F		92	26.3	Cottages
A297483	23-05-2000	4M	CP	98	23.8	9
	Ringed 28-06-1998	4M		101	19.0	Cottages
E196505	23-05-2000	4F	BP	94	24.8	9
	Ringed 02-07-1997	3J		93	28.6	Cottages

Damian Offer (Wheatear text)

Sedge Warbler *Acrocephalus schoenobaenus*

Rare visitor

No birds were recorded by the 2000 expeditions.

Hooded Crow *Corvus corone cornix*

Regular breeding species in small numbers

A maximum of 2 birds were seen on Lunga during May, these seen once to mob young Ravens near Tarbet. An adult was seen carrying an egg on one occasion.

In June the species was noted daily on Lunga referring in most cases to a party of five from Cruachan south with seven over the south end on 28th. Caches of corvid-predated gull and shag eggs were again to be found within the vicinity of the Blow Hole at the south end of Lunga. Furthermore a nest was found on the east face of the Blow Hole from where birds often departed on an observers presence being betrayed by alarm calls from other members of the resident flock nearby. Elsewhere in June, up to 4 birds were noted on Sgeir a Chaisteil and a single on the south-west corner of Fladda.

Raven *Corvus corax*

At least one pair breeds in most years

From 5 birds, two adults and 3 juveniles, seen on Lunga in May, only four were regularly seen together by June, these south of Cruachan. Five birds were however seen in June at Shearwater Gully on a single date as were pairs over the Village (north end) and at Shag Alley. Elsewhere a single was noted on Cairn na Burgh More on 24th June and 2 heading north over Fladda on 26th. One bird was seen carrying an egg in May. No nest site was found.

Starling *Sturnus vulgaris*

Regular breeding species in small numbers

With the first expedition being in May, this allowed verification of breeding areas by this species as most young have fledged by the time of the annual June expedition. Birds carrying food in May were noted at Tarbet and the Village whilst a nest was found in the second Gully north of Harp Rock. Three birds were also noted at the South end of Lunga in May.

From 1 - 7 birds seen daily between Harp Rock, Sgeir a Chaisteil and the Village (north end of Lunga) during late June, 18 were flushed from the Landing Beach on 1st July. Elsewhere 23 birds, 50% juveniles, were noted on the Bac Mór on 25th June.

Twite *Carduelis flavirostris*

Regular breeding species in small numbers

The species was reported as widespread across Lunga in May, with many males in song. Between the Village (north end) and Shearwater Gully up to 8 birds were recorded. No young were noted.

Observations in June suggested a minimum of 3 breeding pairs on Lunga with a progeny of at least 5 juveniles. The largest flock was of seven birds seen at the Village (north end), with smaller nos. seen daily between the Village (north end) and Shearwater Gully. Sightings at the South End of Lunga were confined to three juveniles resident at Tarbet.

During the brief visit by the expedition to Fladda on the 26th June, single family parties were noted in the south-east and west of the island, each with 2 juveniles. A female was also flushed from a nest with 6 eggs amongst a dense cover of bracken and bramble in the lowland between the island's two principal bays.

SYSTEMATIC LIST FOR 2000 - MAMMALS

Otter *Lutra lutra*

Evidence of presence regularly noted

Fresh tracks were found in both caves north of Harp Rock, Lunga. Regular runs and a bird kill made by a mammalian predator e.g. chewed primary feathers, suggested the presence of Otter on Fladda as well.

House Mouse *Mus musculus*

Resident

At least one animal was present indoors at the expedition base, the Village at the north end of Lunga.

Pygmy Shrew *Sorex minutus*

Status unknown

One Shrew sp. seen on the shoreline of Fladda in June was considered probably to be *S. minutus*.

Rabbit *Oryctolagus cuniculus*

Resident, numbers much reduced in recent years.

In June up to 3 animals regularly observed in the Harp Rock area, including an entirely black animal. Seven animals together at the Puffin colony north of the village (north end) included a black individual. Other sightings on Lunga included up to 2 animals at the Village, Corran Lunga, a cave north of Harp Rock and at the south end. A juvenile black individual was also noted to the north of Harp Rock. No evidence of animals on the other islands was noted.

Grey Seal *Halichoerus grypus*

Regularly breeding species

Animals were not seen or heard until 26th during the May visit with maximum of 3 on 27th.

In June up to 40 animals regularly hauled out on intertidal reefs between Lunga and Fladda with up to 26 animals noted on Sgeirean Mór.

Minke Whale *Balaenoptera acutorostrata*

Resident in Hebridean waters

Up to 3 animals were regularly seen during the 25 - 27th June between Lunga and Coll. All animals appeared (from a highly variable course taken) to be feeding.

In May, three were seen on 27th at the approach to Sound of Mull by two separate groups of visiting yachtsmen. Animals were also seen on 26th passing north of Coll. All who saw them commented on the smell!

Risso's Dolphin *Grampus griseus*

Resident in Hebridean waters

Approximately six animals were seen off Staffa from Lunga on 30th June, the animals watched and identified at closer quarters by the *Island Lass* (Turus Mara).

Bottlenose Dolphin *Tursiops truncatus*

Resident in Hebridean waters

About five animals were seen on crossing to Mull, including a juvenile.

Harbour Porpoise *Phocoena phocoena*

A resident in West Scottish coastal waters.

Up to 4 animals were regularly seen off the west coast of Lunga. All animals appeared (from a highly variable course taken) to be feeding. A further three were noted on the 27th off Lunga's east coast

SYSTEMATIC LIST FOR 2000 - BUTTERFLIES

Small White *Pieris rapae*

One below the Village (north end of Lunga) on 26th May.

Clouded Yellow *Colias croceus*

A migrant

One flying along the boulder beach at Corran Lunga on 26th June probably arrived as part of the same migration influx as the Painted Ladies and Silver-Ys.

Common Blue *Polyommatus icarus*

Regularly breeder

A good year for the species after only a single noted in May, this at Shag Alley. Over 60 individuals were regularly counted in late June when walking the length of Lunga. At least two noted on Fladda during a brief visit on 26th June.

Red Admiral *Vanessa atalanta*

A migrant

Singles seen on most days in late June around the Village (north end of Lunga) with five on 30th.

Painted Lady *Cynthia cardui*

Regular migrant in small numbers

One at the Village (north end of Lunga) on 25th June. Passage northwards evident on the 26th with at least six past the Village early afternoon and singles reported from elsewhere on Lunga. Up to 10 individuals were recorded on subsequent days around Lunga..

Meadow Brown *Maniola jurtina*

At least 15 seen when walking the length of Lunga on 27th June. Up to 5 seen on subsequent days in June.

OTHER SPECIES RECORDED SYSTEMATICALLY

Silver Y Moth *Autographa gamma*

Migrant

"Many" recorded from the 28th June on Lunga, with a single noted previous day east of the Village (north end), Lunga.

"Common" Darter type *Sympetrum (striolatum) spp.*

Presumed Migrant, first record for the islands

One seen at pools at the south end of Bac Mór on 25th June.

Oyster Plant *Mertensia maritima*

Resident species known only from "colonies" at Tarbet (west), Lunga and the north end of Sgeir a Chaisteil.

42 plants were counted on the beach at Tarbet (west), Lunga. No count was made of the Sgeir a Chaisteil population though the colony was noted to be spreading down from the species stronghold.

Breeding seabird census for the Treshnish Isles in 2000

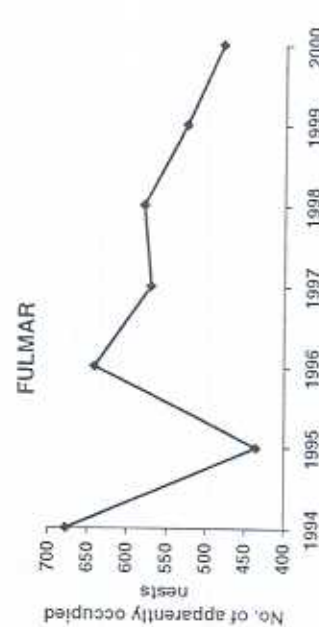
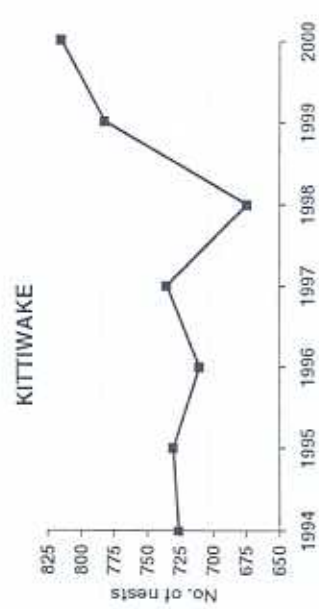
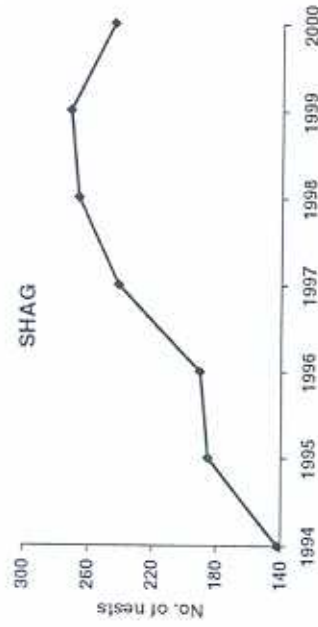
Totals for each Sub Colony Zones of Lunga and Chaisteil

Sector	Count unit	Count Sectors on Lunga and Chaisteil													Lunga & Chaisteil Totals
		1	2	3	4	5	6	6a	7	8	9	10	11	12	
Fulmar	AON	58	9	21	55	61	34	15	17	61	139	9	40	519	
Shag	AON	46	42	12	44	1	9	3	37	24	26	16	260		
Lesser B-b Gull	PRS						6						6		
Herring Gull	PRS	3	1			1	62		1	1	1	10	83		
Great B-b Gull	PRS	1		3	2	16			1			3	67		
Kittiwake	AON								19	750	46		815		
Razorbill	IND	63	22	6	105	9	17	1	54	669	152	61	1159		
Guillemot	IND		1		44	5			102	8156		41	8469		
Black Guillemot	PRS				2	9							11		
Puffin	IND	89	450	12	43	1			59	984	341	570	2659		

Key to count unit codes:

- AON = Apparently occupied nest
- IND = individuals
- PRS = pairs

Population changes in a selection of breeding seabird species on Lunga 1994 - 2000



TRESHNISH RINGING TOTALS FOR 2000

SITE	SPECIES	ADULTS	PULLI	RETRAPS /CONTROLS	TOTAL
	Lost ring			0	10
FLADDA	Storm Petrel	565	0	30	595
	Common Gull	0	5	0	5
	Totals for Fladda	565	5	30	600
LUNGA	Fulmar	12	0	1	13
	Manx Shearwater	4	0	0	4
	Storm Petrel	249	0	98	347
	Shag	5	54	3	62
	Herring Gull	0	15	0	15
	Great Black-backed Gull	0	2	0	2
	Kittiwake	13	0	10	23
	Guillemot	890	2	99	991
	Razorbill	132	1	43	176
	Puffin	389	0	49	438
	Meadow Pipit	0	12	0	12
	Rock Pipit	1	0	0	1
	Wheatear	6	44	4	54
	Totals for Lunga	1701	130	307	2138
TRESHNISH ISLES	GRAND TOTAL FOR 2000	2266	135	337	2748

Note: Rings used in 2000 were registered under *Treshnish Auk Ringing Group* and *J.R.Hodson*.

TRESHNISH RINGING TOTALS 1971 - 2000

SPECIES	1971	1974	1976	1977	1978	1980	1982	1984	1986	1989
Fulmar	17	6	4		8	21	14	18	7	21
Manx Shearwater		2	13		4	4	1	8		
Storm Petrel		254	22		1	283		203	800	411
Shag	150	7	10	10	24	80	50	160		40
Buzzard						1	2			
Oystercatcher		1				1	4	2		
Common Sandpiper										
Great Skua										
Common Gull										
Herring Gull	6	1			14	46	35	56	4	4
Great Black-backed Gull	3	6	3	7	6	22	14	35		22
Kittiwake						1	1	1	2	2
Guillemot	32	20	14		66	502	137	364	180	250
Razorbill	65	72	90		115	266	218	236	151	103
Black Guillemot										
Puffin	70	198	271		203	200	208	182	174	160
Meadow Pipit										
Rock Pipit									5	1
Pied Wagtail										
Wren										
Wheatear			12					1	3	
Willow Warbler										
Twite										
TOTAL	343	558	439	17	441	1427	684	1266	1326	1014

SPECIES	1991	1993	1994	1995	1996	1997	1998	1999	2000	TOTAL
Fulmar	15		4	27	38	7	24	23	12	266
Manx Shearwater			9	1		2	1	4	4	53
Storm Petrel	975	75	440	536	331	1104	741	732	814	7722
Shag	10		10	59	96	99	150	100	59	1114
Buzzard										3
Oystercatcher								2		10
Common Sandpiper							1			1
Great Skua							1			1
Common Gull							4		5	9
Herring Gull	3		5	24	19	52	73	39	15	396
Great Black-backed Gull	15		6	25	16	48	19	16	2	265
Kittiwake	4		6	10	1	50	41	23	13	155
Guillemot	306		109	498	349	472	503	507	892	5001
Razorbill	64		81	101	105	98	112	102	133	2112
Black Guillemot						1				1
Puffin	114		358	236	301	267	398	274	389	4203
Meadow Pipit				4		1			12	17
Rock Pipit				2	4	2		2	1	17
Pied Wagtail			1	3	2					6
Wren				3						3
Wheatear					5	24	37	22	50	154
Willow Warbler				1						1
Twite						2				2
TOTAL	1506	75	1029	1530	1230	2130	2109	1844	2401	21512

NOTES:

Data for 1971 - 1995 extracted from Walker & Cooper (1996).
 Ringing data for a three day visit in 1972 was not available.

RECENT RINGING RECOVERIES

STORM PETREL

TIARG have in the past year received details of 51 recoveries of birds ringed within Britain and Ireland in the months July - August and controlled by TIARG on Fladda or Lunga in June - July 1999. These recoveries are summarised in both the table and map below; all birds were ringed as adults (Euring code 4).

Ringing Site	No. of controls at:		Time interval (days)		Distance km	Direction (degrees)
	Fladda	Lunga	Minimum	Maximum		
Southend, Mull of Kintyre, Strathclyde	1	0	4719	4179	49	290
Sanda Island, Kintyre, Strathclyde	7	9	330	7640	145	339
Tullagh Point, Donegal, Eire	0	1	340	340	149	26
Ailsa Craig, Strathclyde	0	2	2919	2919	160	329
Priest Island, Highland Region	0	1	7247	7247	172	199
Roaninish, Donegal, Eire	0	1	702	702	223	036
Faraidh Head, Highland Region	1	1	675	676	255	202
Eilean nan Ron, Highland Region	0	1	326	326	262	209
Calf of Man, Isle of Man	2	7	7	1053	290	340
Langness, Isle of Man	1	0	339	339	293	338
Sule Skerry, Orkney	0	1	5445	5445	311	219
Burray, Orkney	0	1	2518	2518	338	219
Brough Head, Orkney	0	1	681	681	344	212
Tynemouth, Tyne & Wear	1	1	711	2880	353	297
Twinyess, North Ronaldsay, Orkney	2	1	1038	1792	395	216
Fair Isle, Scotland	1	2	331	1415	438	220
Filey, North Yorkshire	1	1	317	1797	462	303
Mousa Isle, Shetland	0	1	1390	1390	495	218
Vatsetter, Yell, Shetland	0	1	1792	1792	553	214
Beginish Islands, Blasket Island Islands, Kerry, Eire	0	1	1090	1090	554	029

Guillemot

GJ76477

4 28/06/84 Lunga, Treshnish Isles
 XF 31/01/00 Baie de Somme, Le Crotoy, Somme, France
 5696 days 877 km 143 degs
 Freshly dead; Oil Victim

Puffin

EN15133

1 21/07/84 Dun, St Kilda, Highland Region
 6 23/06/99 Lunga, Treshnish Isles
 5450 days 193 km 138 deg

Puffin

ET52555

8 29/06/97 Lunga, Treshnish Isles
 XL 29/07/99 Treshnish Point, Isle of Mull, Strathclyde
 760days 9 km 35 degs
 Dead; Leg & Ring Only Found

Great Black-backed Gull

HT80341

1 29/06/98 Lunga, Treshnish Isles
 X 4/06/99 Loch Linnhe, nr Fort William, Highland Region
 340 days 76 km 73 degs
 Dead; Bird found on beach

REFERENCES

Gilbert, G. *et al.* 1996. *A survey of Storm Petrels on the Treshnish Isles*. Unpublished RSPB Report.
 Walker, S. & Cooper, D. 1996. *Birds on the Treshnish Isles 1971 - 1995*. Treshnish Isles Auk Ringing Group.

ACKNOWLEDGEMENTS

Firstly we would like to express our appreciation to the new owners of the Treshnish Isles, THE HEBRIDEAN TRUST for permission to allow our continuing studies to be made on these beautiful islands.

We thank Iain Morrison and his family, for providing our transportation and are grateful for his continuing advice, co-operation and help.

Once again thanks to Jan Densham for organising the expedition's food and provisions (a thankless task!).

RSPB (Charlie Self & Alan Leitch) are to be thanked for the use of their boat and staff for a day. This greatly improved our efficiency and productive in the field than would have been otherwise possible in the time available.

We are grateful for the research grants from Scottish Ornithologists Club, Scottish Natural Heritage from the Seabird Group in 2000 to help with the extra costs of completing Seabird 2000. Thanks are also due to TIARG members who donated Storm Petrel rings free of charge.

The Expeditions 1971 – 2000

A list of participants through the years, with brief notes on the work performed

- 1971 Barry Lawson, Peter Deans, John Eatough, Shiela Anderson, Dick Hansford.
Full census and ringing.
This was the first trip and the Treshnish Isles were included in a "mopping up" of islands not fully covered during the 1969/70 "Operation Seafarer" National Seabird Census.
- 1972 Barry Lawson, Geoff Ward, Bevan Craddock.
Part census and ringing
Forced to leave after three days due to bad weather.
- 1973 Barry Lawson, Peter Deans, John Hodson, Geoff Cope.
Trip abandoned – unable to land due to rough seas
- 1974 Barry Lawson, Peter Deans, Geoff Ward, John Hodson, Geoff Cope, Tom Pool.
Census of Lunga and ringing
An RAF Helicopter landed a photographer onto Harp Rock, causing many bird casualties
- 1976 Barry Lawson, Peter Deans, Geoff Ward, John Hodson, Geoff Cope, Tony Kilgallen.
Full census Lunga – Fladda and ringing.
Very hot summer.
- 1977 Barry Lawson, John Hodson.
Ringing only.
Called in on "Corryvreckan" boat cruise.
- 1978 Barry Lawson, Peter Deans, John Hodson, Simon Walker.
Full census Lunga and Chaisteil and ringing.
- 1980 Barry Lawson, Peter Deans, John Hodson, Simon Walker, David Lawson.
Ringing only
- 1981 Geoff Ward, Geoff Cope.
Part census and photography
- 1982 Barry Lawson, Peter Deans, John Hodson, Simon Walker, Andrew Lawson.
Ringing only.
- 1984 Barry Lawson, Peter Deans, John Hodson, Simon Walker.
Ringing only.
- 1986 Barry Lawson, Peter Deans, Geoff Ward, John Hodson, Simon Walker, Andrew Lawson.
Full census with ringing
- 1989 Barry Lawson, Peter Deans, John Hodson, Simon Walker.
Ringing only.
- 1991 Barry Lawson, Peter Deans, Simon Walker, David & Andrew Lawson, Jan Densham.
Ringing only.
- 1993 Roger Broad *et al.* (Scottish Natural Heritage charter)
Full census of The Dutchman's, Lunga, Chaisteil and Fladda.
Chris Redfern *et al.*
Storm Petrel ringing.

The Expeditions 1971 – 2000 (con't)

- 1994 Simon Walker, Mike Smith, Dennis Cooper, Jan Densham, Danny Lenain.
Full census Lunga and Chaisteil and ringing.
- 1995 Simon Walker, Mike Smith, Dennis Cooper, Jan Densham, Fergus Henderson.
Full census Lunga and Chaisteil and ringing.
- 1996 Simon Walker, Mike Smith, Dennis Cooper, Danny Lenain, Robin Ward
Full census of Lunga and Chaisteil and ringing.
- 1997 Simon Walker, Dennis Cooper, Robin Ward, Damian Offer, Steve Willis, Chris Spray
Full census of Lunga – Fladda and ringing.
- 1998 Simon Walker, John Hodson, Dennis Cooper, Robin Ward, Damian Offer, Steve Willis,
Steve Worwood
Full census of Lunga – Fladda and ringing.
- 1999
Week 1 Simon Walker, Dennis Cooper, Steve Willis, John Osbourne.
Week 2 Simon Walker, John Hodson, Dennis Cooper, Robin Ward, Damian Offer, Jan Densham
Full census of the Treshnish Isles for *Seabird 2000* and ringing
- 2000
Week 1 John Hodson, Dennis Cooper, Damian Offer
Full census of Manx Shearwater on Lunga for *Seabird 2000*. Limited passerine ringing.
Week 2 Simon Walker, John Hodson, Dennis Cooper, Robin Ward, Steve Willis, Andrew Carter,
Steve Woodward
Full census of Lunga and Chaisteil. Tern colony censused for *Seabird 2000*. Ringing.

Migration and origins of Treshnish Isles breeding seabirds

Robin M. Ward

Introduction

Recoveries of ringed birds are a valuable tool in identifying the migration routes, moulting grounds and wintering grounds of our breeding seabirds. Such information is essential in the prediction of threats to seabirds arising away from colonies e.g. oil spills, the drowning of auks in fishing nets (Harris & Tasker 1999). Since 1971, the Treshnish Isles Auk Ringing Group (TIARG) has ringed over 18,958 seabirds between the years 1971 – 1999; a substantial proportion of the national ringing total for species in some years (tables 1 & 4). Prior to this period a limited amount of ringing had taken place on these isles, recovery data suggesting this to include the ringing of Shags in 1927, 1928, 1930 and 1950, and Guillemots in 1931.

The present paper updates the ringing recovery analysis of Treshnish Isles seabirds by Walker & Cooper (1996) and places the findings within the context of what is known today on seabird distribution and movements. The recoveries used in this analysis, over 560, were extracted from the British Trust for Ornithology's national recovery database for the period up to the end of 1999. Table 10 provides a summation of the recoveries by year and species.

Table 1. An assessment of TIARG's contribution to the British and Irish ringing scheme.

	Juv/ad ringed 1998			Pulli ringed 1998			Ringing Totals to & incl 1998		
	UK & Eire	TIARG	% UK & Eire	UK & Eire	TIARG	% UK & Eire	UK & Eire	TIARG	% UK & Eire
Fulmar	715	24	3.4	1,474	0	0	101,164	231	0.2
Manx Shearwater	1,455	1	0.07	764	0	0	288,847	45	0.02
Storm Petrel	10,940	741	6.8	31	0	0	351,946	6,178	1.8
Shag	312	8	2.6	4,825	142	2.9	182,221	955	0.5
Herring Gull	546	0	0	4,906	73	1.5	283,746	342	0.1
Great black-backed Gull	84	0	0	2,464	19	0.8	60,443	247	0.4
Kittiwake	721	41	5.7	1,223	0	0	114,009	119	0.1
Guillemot	1,529	503	32.9	10,678	0	0	235,272	3,802	1.6
Razorbill	581	107	18.4	2,359	5	0.1	89,597	1,877	2.1
Puffin	1,291	398	30.8	304	0	0	201,843	3,340	1.7

* 1998 is the most recent British & Irish annual ringing totals available at time of publication.

Fulmar *Fulmarus glacialis*

Not surprisingly given the few birds ringed by TIARG, 254 up to 1999, only one recovery exists for this species. The bird was both ringed and later recovered dead, four breeding seasons later, on Lunga.

Manx Shearwater *Puffinus puffinus*

None of the 49 birds ringed on the Treshnish Isles have been recovered. One bird ringed as an adult at Phare du Creach, Finistere, France, in September 1966, was found in July 1983 on Lunga having suffered avian predation. It is not known whether this individual was originally ringed at or near a breeding colony (few birds breed along the French Atlantic coast), the breeding season for this species extending into September. Outside the breeding season, this species disperses away from the colonies into the open ocean, many British ringing recoveries coming from the east coast of South America (Lloyd *et al.* 1991).

Shag *Phalacrocorax aristotelis*

Over 40% of the Treshnish recoveries of this species were of birds ringed between 1927 – 1961. These recoveries clearly show a reduction over the last three decades of the species persecution by fisherman, who consider them pests. Prior to 1971, 43% of the recoveries of Treshnish Isles ringed birds resulted from being shot, this contrasting with 10% for the period thereafter. Unlike the auks and petrels, this species is present in coastal waters of Britain and Ireland all year and thus more likely to suffer from hunting and shooting for sport. The species has received legal protection in Britain and Ireland since the 1970's but it is easily confused with the Cormorant, which can still be shot under licence. As with the auk species, fishing itself also poses dangers to the Shag, birds becoming entangled and drowning in fishing nets and traps. Recovery rates amongst Treshnish Isles birds suggest mortality from human fishing activities has altered little between the periods either side of 1970 (10% 1927 – 1970; 7% 1971 -1999).

Table 2. The finding circumstances on recovery of Shags ringed on the Treshnish Isles.

Finding circumstances	No. of Recoveries			
	East Scotland	West Scotland	Ireland	Total
Controlled by ringer	1	2		3
Dead, bird found		35		35
Dead, shot		14		14
Dead, bird unintentionally trapped in fishing net/trap.		6		6
Dead, intentionally bird trapped		1	1	2
		8		8
Total	1	66	1	68

Of the 68 recoveries referring to the Treshnish Isles, only one is of a movement to the Isles, a bird originally ringed as a pullus on Corr Eilean, Strathclyde and controlled 16 years later on Lunga (figure 1). 62 pulli ringed on the Treshnish Isles have subsequently been recovered, 10 of these having not moved from the Lunga. The remainder provide a comparatively detailed pattern of first year dispersion from Lunga, something not available for the other seabird recovery datasets (table 3, figure 2). Within the first calendar year, all juveniles had dispersed in a northward direction from Lunga, none further than Loch Broom. The exceptions to this pattern were single bird that had moved ESE to the adjacent island of Gometra and 101km SE to the island of Gigha, Strathclyde. First year dispersal thereafter changed little in direction and distance, other than one bird recovered in Donegal, Eire (166km, SSE).

The recovery pattern for subsequent age classes also shows the distribution of Treshnish Isles birds outside the breeding season to extend no further west than the Western Isles and north than Loch Broom (figure 1). To the south, only one record exists south of Mull, an adult recovered dead in December on Cailiness Point, Dumfries & Galloway (224km). As might be expected, adults remain closer to the breeding colony during the non-breeding season than do juveniles.

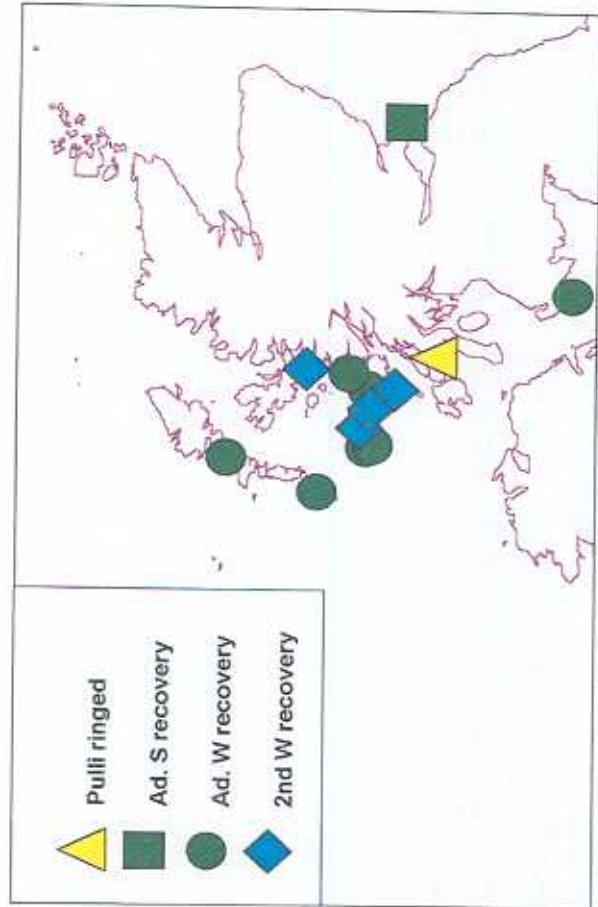


Figure 1. Shag recoveries:
 - adult winter (August - April), adult summer (one only shown) and 2nd winter recovery locations of birds ringed on the Treshnish Isles;
 - origin of an adult recovered on the Treshnish Isles ringed as a pullus.

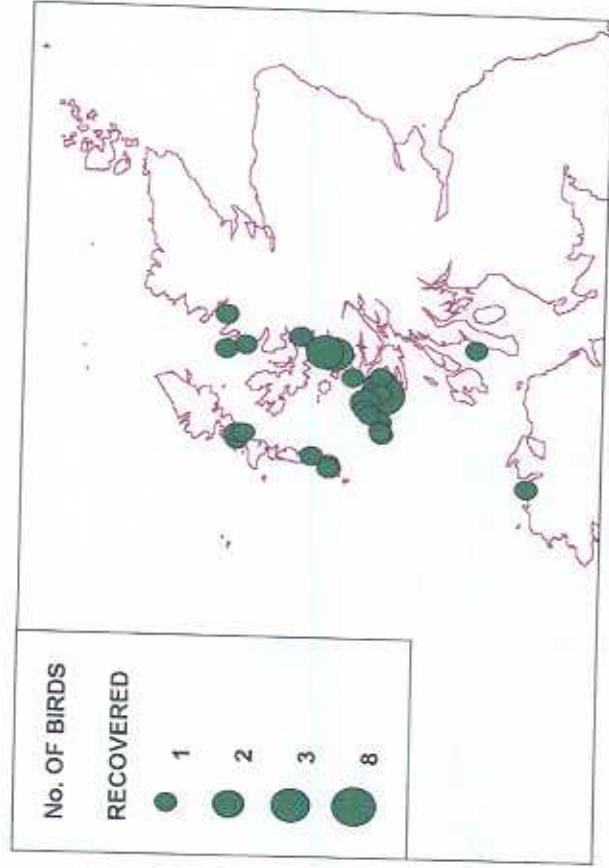


Figure 2. First winter recoveries of Shags ringed as pulli on the Treshnish Isles.

(table 3); adults mean dispersal distance from Lunga is 81km (s.e. = 29.4, n = 7) during August and April, assuming all birds are faithful to their colony before and after first breeding. This assumption seems fair given that Potts (1969) estimated that 8% of birds emigrated away from the Farne Islands before their first breeding attempt and less than 1% of breeding adults switched colonies. Other than the control of a Corr Eilean ringed bird in a colony at Lunga, the only other inter-colony movement is of a Treshnish Isles ringed pulli controlled 12 years later on the Isle of May, 239km ESE. Indeed, other than this all recoveries of adults lie at a mean distance from Lunga of 14.8 ± 5.2 km (n = 6) during May – July. First year birds, as would be expected, have been recovered further out (mean = 42 ± 12.8 km, n = 5); Shags do not breed until aged two or more (Lloyd *et al.* 1991).

Table 3. A summary of first year dispersal of Shags from Lunga based on ringing recoveries

	Mean distance (standard error) in km	Maximum distance	Minimum distance	No. of first year recoveries
July	0 (0)	0	0	5
August	27 (10.7)	86	0	9
September	60 (18.4)	147	0	8
October	50 (20.6)	138	9	5
November	-	31	-	1
December	71 (25.9)	165	16	5
January	66 (39.6)	145	21	3
February	82 (44.4)	166	15	3
March	-	141	25	2
April	-	158	-	1

Storm Petrel *Hydrobates pelagicus*

Up until the end of 1999, 340 recoveries had been received relating to 327 birds ringed or controlled on the Treshnish Isles. All birds ringed on the Treshnish Isles have been captured by mist netting at a variety of colonies at night on Lunga and more recently Fladda. Mist netting has also generated all the recoveries of this species whether at or away from the Treshnish Isles. TIARG has provided a substantial contribution to both the numbers of Storm Petrels ringed and the recoveries this has generated in Britain and Ireland (Table 4)

Wintering areas

An adult from the Treshnish Isles was recovered in early March at sea in the Agulhas Basin, off South Africa, this within the species main wintering area from where movement northwards begins during March/April (Harrison 1983). This is the only recovery of a bird from either the winter period and/or the species wintering area.

Migration routes

Outside of north-west Europe, all four recoveries of passage birds have been from the Algarve, Portugal, in June when immatures are moving through this region to join already breeding adults in more northern latitudes (Harris *et al.* 1993, Fowler & Hounscome 1998). Two of these presumed immatures were rapidly recaptured on the Treshnish Isles, 11 and 14 days after ringing in Portugal. A third was apparently recruited into the Fladda breeding population 3 years later, a brood patch being recorded on recapture. The final recovery involves a Treshnish ringed bird being controlled 2 years afterwards on the Algarve in mid June, presumably still a non-breeding immature. The species begins breeding from its 4th calendar year (Scott 1970, Del Hoyo *et al.*

1992) arriving at northern latitude colonies from May whereas the prospecting immatures arrive mostly from July and August (Harris *et al.* 1993, Fowler & Hounscome 1998).

Table 4. The percentage of Storm Petrels ringed by TIARG and those recoveries referring to the Treshnish Isles, of the annual totals for Britain and Ireland for the years 1981 - 1998.

Year	Nos. ringed in UK*	Nos. ringed by TIARG	% of U.K. & Eire total ringed by TIARG	Nos. recovered in UK*	Nos. of TIARG recoveries	% of U.K. & Eire total that were TIARG recoveries
1981	15160	0	0	247	3	1.2
1982	?	0	0			
1983	12613	0	0	124	0	0
1984	12675	203	1.6	205	8	3.9
1985	7148	0	0	186	0	0
1986	?	800	?	?	?	?
1987	6904	0	0	358	0	0
1988	7602	0	0	368	1	0.3
1989	7719	411	5.3	324	8	2.5
1990	9096	0	0	392	2	0.5
1991	10939	975	8.9	442	55	12.4
1992	10094	0	0	434	3	0.7
1993	10551	75	0.7	538	5	0.9
1994	14489	440	3.0	787	3	0.4
1995	10884	536	4.9	494	52	10.5
1996	14576	331	2.3	518	21	4.1
1997	14781	1104	7.5	575	57	9.9
1998	10940	741	6.8	566	50	8.8

* Data from the annual report of the British Trust for Ornithology's Ringing Scheme e.g. Clark *et al.* (2000)

Breeding season recoveries

The remaining 322 recoveries refer to birds captured between June and September within northwest Europe; specifically the U.K., Isle of Man, Eire and Norway. The vast majority of birds when ringed or recovered away from the Treshnish Isles have been captured in mist nets by tape luring, a technique which attracts selectively the fraction of non-breeding immatures in the population (Fowler *et al.* 1982). On the Treshnish Isles, tape luring whilst mist netting is not necessary as a night's catch within a large breeding colony regularly numbers over 700 individuals in 36-54 metres of four-shelf netting. Only two recoveries have not been birds controlled (captured & released) by ringers; a bird found dead after hitting wires inland in Co. Westmeath, Eire, and another having done likewise elsewhere but surviving the experience.

Only 37 of the 335 recoveries under review are of birds ringed on the Treshnish Isles and then recovered at sites elsewhere within northwest European waters. The remainder of recoveries are of birds ringed elsewhere in northwest European waters prior to capture on the Treshnish Isles. An explanation for this imbalance in recovery movements to and from the Treshnish Isles (approx. 285:37 respectively) is that the majority of birds caught at the latter site are breeding adults faithful to the one colony (Amengual *et al.* 1999) and rarely lured in by tape to other sites as are prospecting immatures (Fowler *et al.* 1982). This hypothesis is supported by most birds captured exhibiting a heavily vascularised brood patch indicative of a breeding adult. Though non-breeding immatures do frequent breeding colonies (Ratcliffe *et al.* 1998), the main influx of wandering immatures into northwest European waters does not occur until late July (Fowler & Hounscome 1998) after the cessation of ringing activities on the Treshnish Isles. Ratcliffe *et al.* (1998) found

nest site attendance by non-breeders to increase as the breeding season progressed, with an overall probability of 15%.

Those few non-breeding immatures that are initially ringed on the Treshnish Isles are likely to have generated most of the recoveries received from elsewhere, all lured in by tape. 21 of these 37 recoveries are within season movements and 31 within two years. This is consistent with most having been ringed as prospecting immatures wandering between colonies (table 5). Breeding adults are highly philopatric, being faithful within and between years to a colony (Amengual *et al.* 1999). There have been comparatively few inter-colony retraps within the Treshnish Isles given the numbers ringed (Willis, end papers), as also documented for the colonies amongst the Balearic Islands (Amengual *et al.* 1999). All north-west European recovery sites of the 37 birds initially ringed on the Treshnish Isles have been between Shetland and Dyfed, 13 being from the adjacent colonies on Sanda (figure 3). The one exception is a bird caught at Tynemouth, north-east England, 15 days after ringing on Lunga. One of 37 recoveries being to the east coast is comparable to the ratio of east coast birds recovered on the Treshnish Isles, 23:309, further supporting the theory that both populations sampled are the same, non-breeding immatures on ringing.

Table 5. The number of years between ringing and recovery of Storm Petrels ringed at the Treshnish Isles

No. of years	No. of recoveries
0	21
1	5
2	5
3	1
4	2
5	1
7	1
10	1
Total	37

The distribution of the immatures later to be recruited into the Treshnish Isles population show a wide dispersal during July – September across most of the known breeding range within northwest European waters. Some immatures recruited in a subsequent year into the Treshnish breeding population frequent the east coast of mainland Britain (figure 4). Most of the recoveries however refer to birds ringed along the Irish, west Scottish, Shetland and Orkney coasts, all these coastlines supporting substantial breeding colonies that immatures will visit prospecting for breeding sites. The small number of Norwegian recoveries are also from the vicinity of breeding colonies. Interestingly, no recoveries exist from either Iceland or the Faeroe Islands where large numbers breed. The sole recovery for the Treshnish Isles of a bird ringed in northern European waters outside of July to September is from Dyfed, south Wales in June.

The probability of immatures within the same year first being ringed elsewhere and then recovered on the Treshnish Isles is low given most petrel ringing occurs from late July in northwest Europe. In fact only one such recovery exists, a bird ringed on the Isle of Man and controlled on Fladda 7 days later.

No first-summer birds are likely to be amongst northwest European recoveries as immatures are generally considered to remain south of the region until their third calendar year (Harris *et al.* 1993). Of the small number of birds examined in detail on the Treshnish Isles and elsewhere in the U.K. by RMW, none have been aged as first summer birds as according to Bolton (in press). Of the few birds recovered on the Treshnish Isles after being ringed and subsequently retrapped elsewhere, the latter time interval for over 90% has not exceeded four years (table 5)

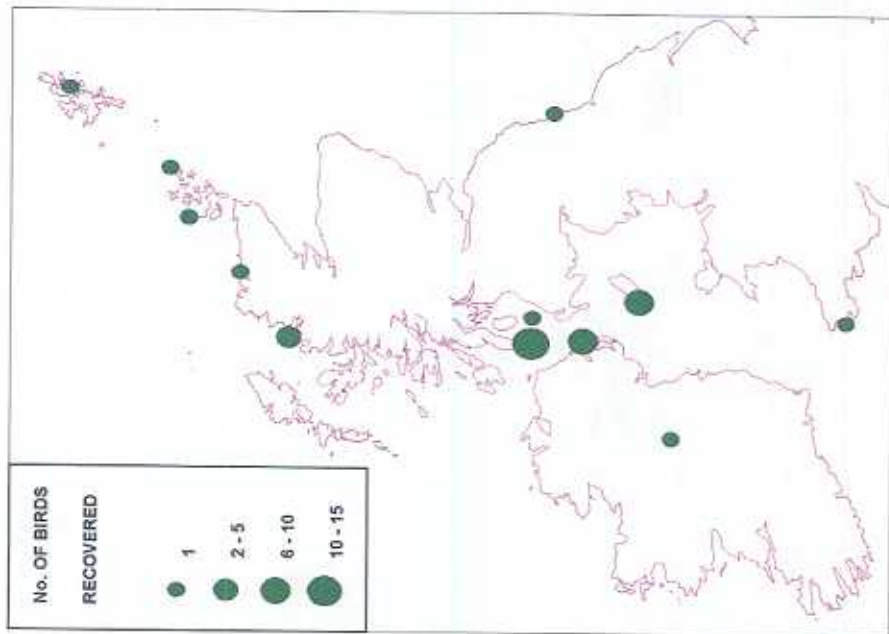


Figure 3. Recovery locations of Storm Petrels ringed on the Treshnish Isles (late June - early July) and recovered in N.W. Europe, June - September.

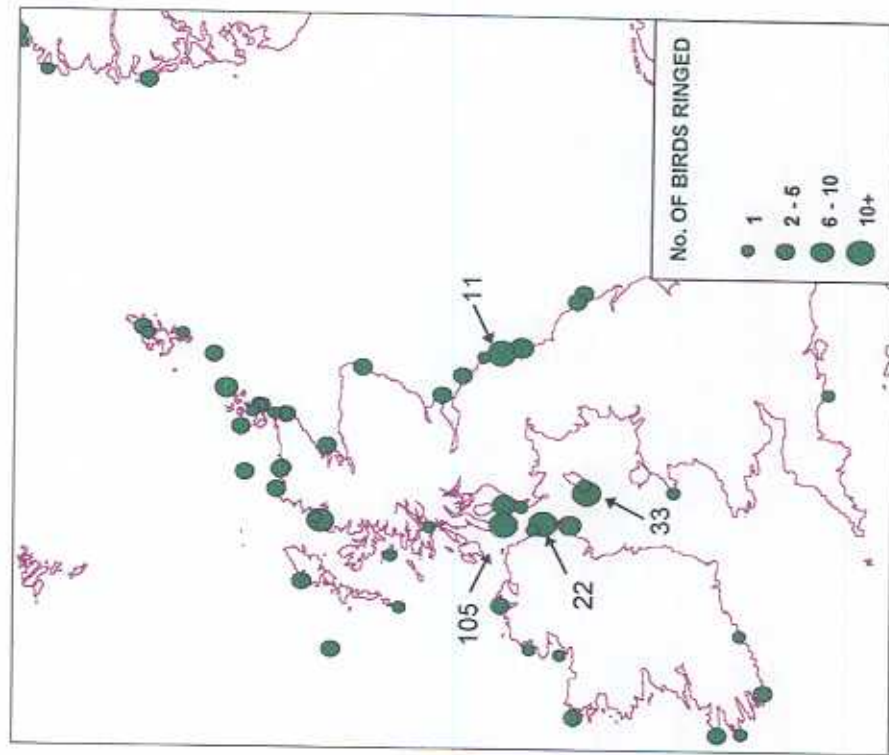


Figure 4. Localities where Storm Petrels were ringed in N.W. Europe (June - September) that were later recovered on the Treshnish Isles in early June - late July.

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as expected if prospecting immatures are involved; the species first breeds when four or five years of age.

Of the 340 recoveries, the only bird ringed as a pullus was from Mousa, Shetland and controlled four years later on Lunga. Few recoveries on the Treshnish Isles of birds ringed as pullus elsewhere would be expected, the species shows a high degree of philopatry (Amengual *et al.* 1999). Mousa is one of only two sites in the U.K. where pulli have been regularly ringed, albeit in small numbers.

Table 6 provides a summation of the number of years between ringing & recovery of Storm Petrels either ringed or controlled on the Treshnish Isles.

Table 6. Number of years between ringing & recovery of Storm Petrels either ringed or controlled on the Treshnish Isles.

Year difference	No. birds recovered
0	22
1	51
2	39
3	34
4	31
5	18
6	12
7	15
8	11
9	6
10	6
11	3
12	3
13	3
14	2
15	3
16	2
17	3
18	3
19	1
21	1
Grand Total	269

Herring Gull *Larus argentatus*

National ringing recoveries show British breeders to disperse from the colonies to winter near local feeding areas with young birds generally moving the furthest (Lloyd *et al.* 1991). Most birds remain on the coast and estuaries, frequenting rubbish tips that lie beside urban areas.

Five of 381 pulli ringed on the Treshnish Isles (Lunga) up to and including 1999 have been recovered, all having moved southwards. The furthest recovery was of an adult (8 years old) in May beside the Firth of Forth Bridge at Inverkeithing, a 193km movement. The only recovery involving a bird in its first year of life is a bird recovered at Culmore Point, Londonderry, Northern Ireland. All remaining recoveries (5), including the only two ringed birds to be found on the Treshnish Isles, are of adults ringed (2 birds) or recovered (3 birds) within the Firth of Clyde and the Glasgow area, and encompassing all seasons.

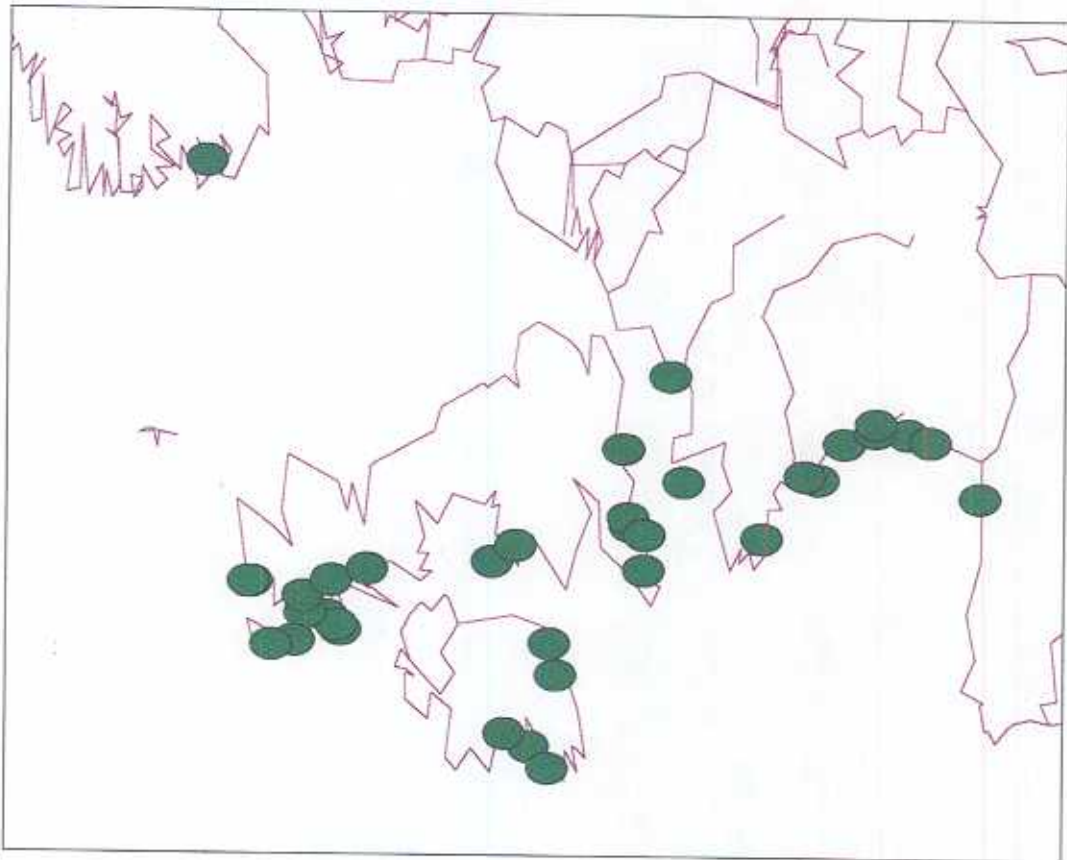


Figure 6. Winter recoveries (August - April) of Guillemots ringed as adults on the Treshnish Isles (late June - early July)

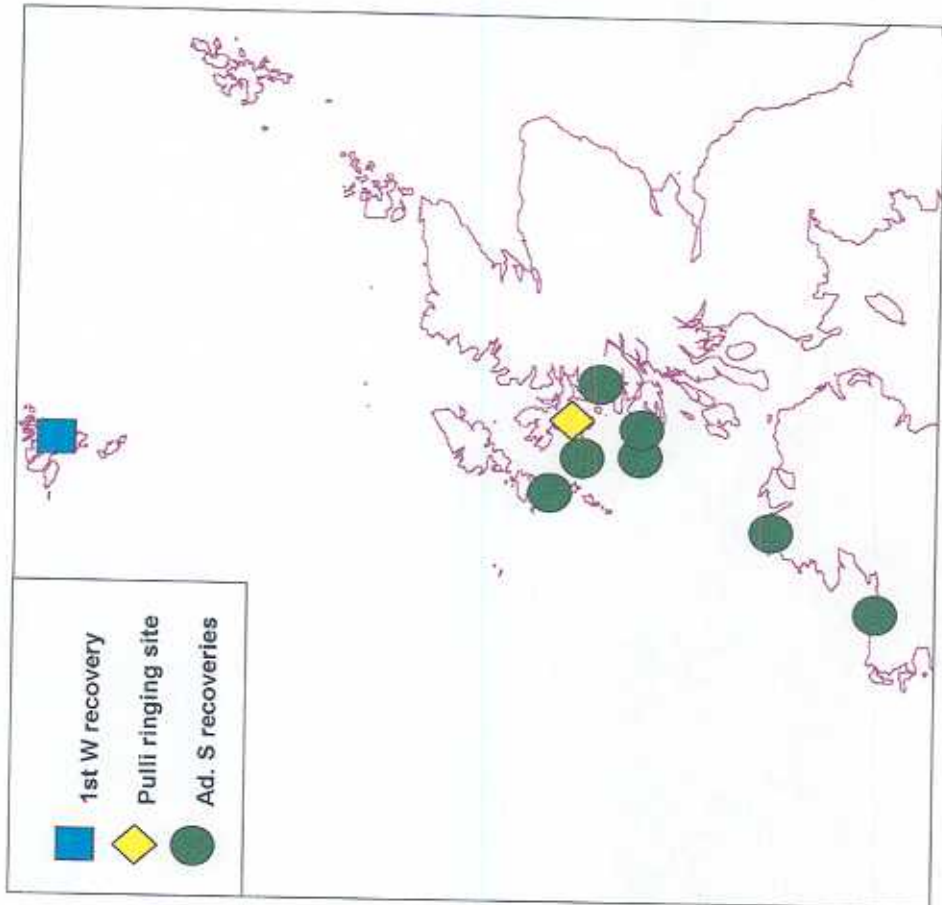


Figure 5. Guillemot recoveries:
 - adult summer (May -July) recoveries of birds ringed on the Treshnish Isles;
 - 1st winter recovery, ringed as pullus on the Treshnish Isles;
 - origin of adults recovered on the Treshnish Isles, ringed as pulli.

Great Black-backed Gull *Larus marinus*

Of 263 pulli ringed on the Treshnish Isles up to and including 1999, only three recoveries have been reported. Two birds were recovered within 100 km of Lunga on South Uist and beside Loch Linnhe in their first and third summers respectively. Most birds remain within 100 km of their natal colony throughout the year (Harris 1962 cited in Lloyd *et al.* 1991) with the third recovery being one of the exceptions located 164km southeast of Lunga as a first summer bird inland of Ayr.

Kittiwake *Rissa tridactyla*

The only TIARG recovery of 142 birds ringed on the Treshnish Isles has been the field sighting (ring read by a birdwatcher) of an adult two years later on the Dutch coast in early July. As typically young do not fledge before early July, this bird, an adult (Euring code 6) on ringing, was either wandering after failing to breed successfully or was actively breeding within a North Sea colony.

Guillemot *Uria aalge*

Only 11 of the 57 recoveries relating to the Treshnish Isles are of birds controlled by ringers, the remainder referring to birds found dead or in a weak condition (Table 7). Of those birds controlled, all relate to interchanges between the breeding colonies on Lunga and the nearby Isle of Canna, one of the few other localities where extensive ringing of Guillemots occurs (figure 6).

Many birds from Scottish colonies move soon after fledging to the southern Norway coast and Kattegat to winter, whilst birds from Irish Sea colonies often move south in their first winter to the Bay of Biscay and the English Channel (Harris & Tasker 1999, Lloyd *et al.* 1991). Only one recovery exists of a bird ringed as a pulli on the Treshnish Isles to be recovered later within its first year, this individual shot by hunters in the Faeroe Islands during December. All remaining recoveries of birds ringed as pulli have been either of birds aged between 2 – 8 years controlled on Lunga having originated from colonies on Canna (7 birds) or of adults found dead in winter along the Devon (1 bird) and north-west Scottish coast (1 bird).

Table 7. The finding circumstances on recovery of Guillemots ringed on the Treshnish Isles.

Finding circumstances	No. of recoveries							Total
	Faeroe	Norway	Scotland	England & Wales	Ireland	France	Spain	
Controlled by ringer			11					11
Alive, bird oiled, later released				2			1	3
Alive, poor condition					1	1		2
Dead, bird found			14	2	3	6		25
Dead, bird oiled			2	3		2		7
Dead in fishing net		1	3		3	1		8
Dead, shot	1							1
Total	1	1	30	7	7	10	1	57

The occasional bird ringed on Lunga resembles a first-summer bird (Baker 1993) but none have knowingly been recovered subsequently. The vast majority of fledged birds ringed on Lunga are two or more years old though not necessarily active breeders as immatures will visit colonies prospecting. The species first breeds when four or more years old (Hudson 1979). Winter recoveries (August – April) from this cohort of birds (figure 6) closely matches the recovery pattern described by Lloyd *et al.* (1991) for birds from colonies around the Irish Sea, i.e. wintering between the Bay of Biscay, the English Channel and within vicinity of the breeding colony. Though recovery patterns of Scottish birds show that many winter along the coasts of southern Norway and Kattegat (Harris & Tasker 1999), the only Treshnish Isles ringed bird recovered from North Sea coasts or further east is of one recovered in February from southern Norway. Thus the recovery pattern would indicate breeding birds of the Treshnish Isles to have a dispersal pattern mostly closely akin to that described for the Irish Sea populations.

The only birds not already mentioned that have been recovered on the Treshnish Isles have come from other Scottish west coast colonies on the Isles of Canna and Colonsay.

The tabulation of finding circumstances (table 7) show a higher percentage of Guillemots (14%) being drowned in fishing nets, when the cause of death is identified, than the other two auk species, Razorbill (5%) and Puffin (0%). Winter and passage distribution of the three species undoubtedly explains much of this, with most west coast breeding Puffins, in contrast to the other two auk species, wintering in the open ocean (see below).

Razorbill *Alca torda*

Three of the 45 recoveries for this species refer to birds ringed elsewhere and recovered on the Treshnish Isles. One bird was ringed on the Isle of Canna, Highland Region, as an adult. The other two birds were ringed as pulli on the Isle of Canna and Isle of May, Fife, subsequently controlled in the colony on Lunga at five and four years of age respectively, the age at which most individuals are recruited to the breeding population (Lloyd & Perrins 1977). In common with birds from colonies in the North and Irish Seas, young birds from the Treshnish Isles would be expected to move south and west to winter in their first year from the Bay of Biscay south to Morocco, western Mediterranean, the Azores and even southwest Greenland (Lloyd *et al.* 1991).

All remaining 42 recoveries are of adult birds (Euring age code 4 or 6), all but one ringed on Lunga, the latter on Fladda. Those recoveries referring to the winter (November to February) and spring (March – April) periods, show birds widely distributed from the Irish Sea and western North Sea coast, south and west as far as Portugal (figure 7), as expected from the published literature (Lloyd *et al.* 1991). By the breeding season, most adults have been recovered within the vicinity of Treshnish Isles (9 recoveries; figure 8), though three have also been controlled within other north Scottish colonies, on the Isle of Canna (1) and along the Sutherland coast (2); whether these birds were breeding at one or both colonies frequented is unknown. An unusual mid summer occurrence was of a bird found dead along the German coast. The only autumn recoveries to date are of two birds within the vicinity of the Treshnish Isles, the exact whereabouts of the moulting grounds unknown. However, adults from northern Scottish colonies are known to disperse in early autumn to form large moulting flocks to the east of the Orkney Islands and in the Outer Moray Firth (Lloyd *et al.* 1991).

The finding circumstances on recovery of birds ringed on the Treshnish Isles are presented in table 8. An event not evident from the recoveries of Puffin, Guillemot or Shag, is a significant mortality of birds (5 recoveries) along the British east coast (Lincolnshire to Lothian) during February 1983, apparently the consequence of rough seas. As with the other auk species, many birds are found oiled when dead but the proportion of these deaths attributed to either poisoning through consumption or breakdown in plumage waterproofing by the oil is unknown.

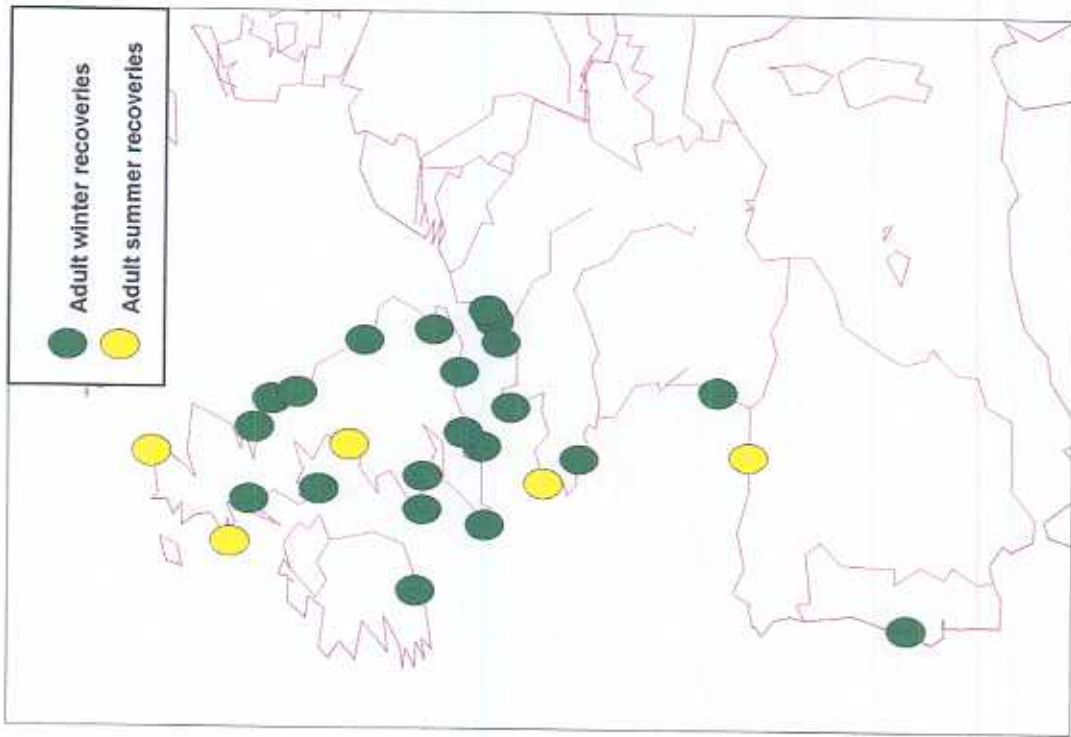


Figure 7. Winter (Nov - Mar) and spring (Mar - Apr) recoveries of Razorbills ringed as adults on the Treshnish Is.

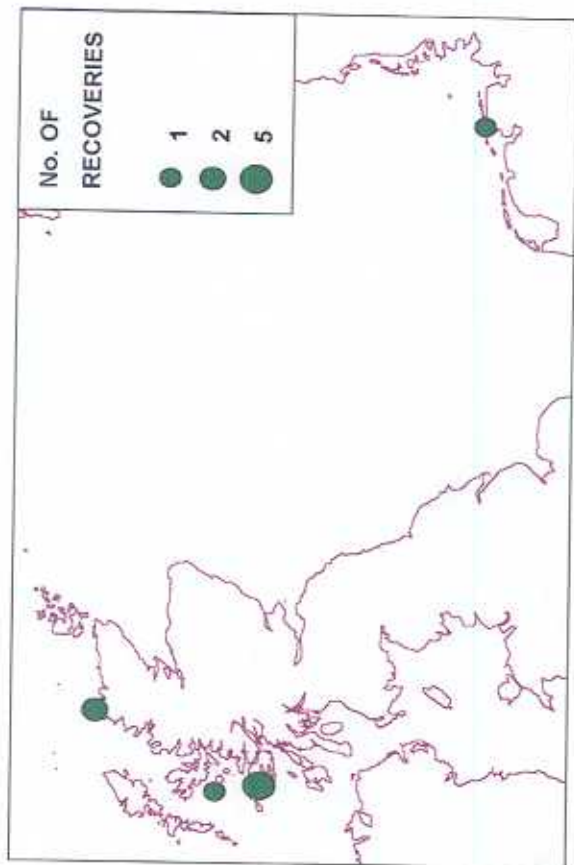


Figure 8. Breeding season recoveries of Razorbills ringed as adults on the Treshnish Isles.

Table 8. The finding circumstances on recovery of Razorbills ringed on the Treshnish Isles.

Finding circumstances	No. of recoveries							Total
	Scotland	England & Wales	Ireland	Germany	France	Spain	Portugal	
Controlled by ringer	3							3
Alive, bird oiled, later released		1						1
Found on ship, bird released		1						1
Accidentally trapped & released	1							1
Dead, bird found	10	4		1	2	1	1	19
Dead, bird oiled		2			5			7
Dead in fishing net		1	1					2
Dead, taken by bird	1							1
Dead, poor condition	1							1
Dead, victim of poor weather	3	3						6
Total	19	12	1	1	7	1	1	42

Puffin *Fratercula arctica*

Most Puffins remain faithful to their natal colony but some young birds move to nearby colonies whilst immatures and a few adults sometimes visit other colonies (Harris 1984). Three birds ringed at colonies elsewhere have been recovered on the Treshnish Isles, all within the breeding season (figure 9). Single pullus ringed on Sule Skerry and Dun, St Kilda, were recovered 15 and 4 years later respectively, the former found dead. The third bird was colour-ringed as a breeding adult (Euring code 6) within the Isle of May colony and controlled 3 breeding seasons later on Lunga. Only one recovery exists of an adult having travelled from the Treshnish Isles to another colony, this bird was fleyged 21 days after ringing on the 19th July by hunters at a Icelandic colony. Otherwise three dead birds have been recovered during the breeding season on the islands of Coll and Canna both of which support breeding colonies.

The recovery rate of Treshnish Isles ringed Puffins (0.3%) is considerably below that of the other principal seabird species. This is in accordance with the recovery rates obtained for the U.K. and Eire as a whole and attributed to Puffins spending much time out at sea or when on land, in burrows (Harris 1984). In fact, only one Treshnish Isles ringed bird has been recovered outside of the breeding season, a bird found dead (cause unknown) on the Portuguese coast in December. The review of British and Irish recoveries by Harris (1984) shows most birds from the west coast of the British Isles to leave north European waters in the winter, though to exactly where is still unclear. Certainly some birds winter in the Mediterranean, off Newfoundland, Greenland and along the Atlantic coast from France to the Morocco/Spanish border. The majority of birds are believed however to winter far out in the open ocean hence a paucity in recoveries.

A summering ground for immature Puffins lies off the north and west coast of Ireland (Harris 1984). The recovery along this coastline in late June/early July of two birds ringed as adults on the Treshnish Isles suggests these individuals to be either non or failed breeders or alternatively

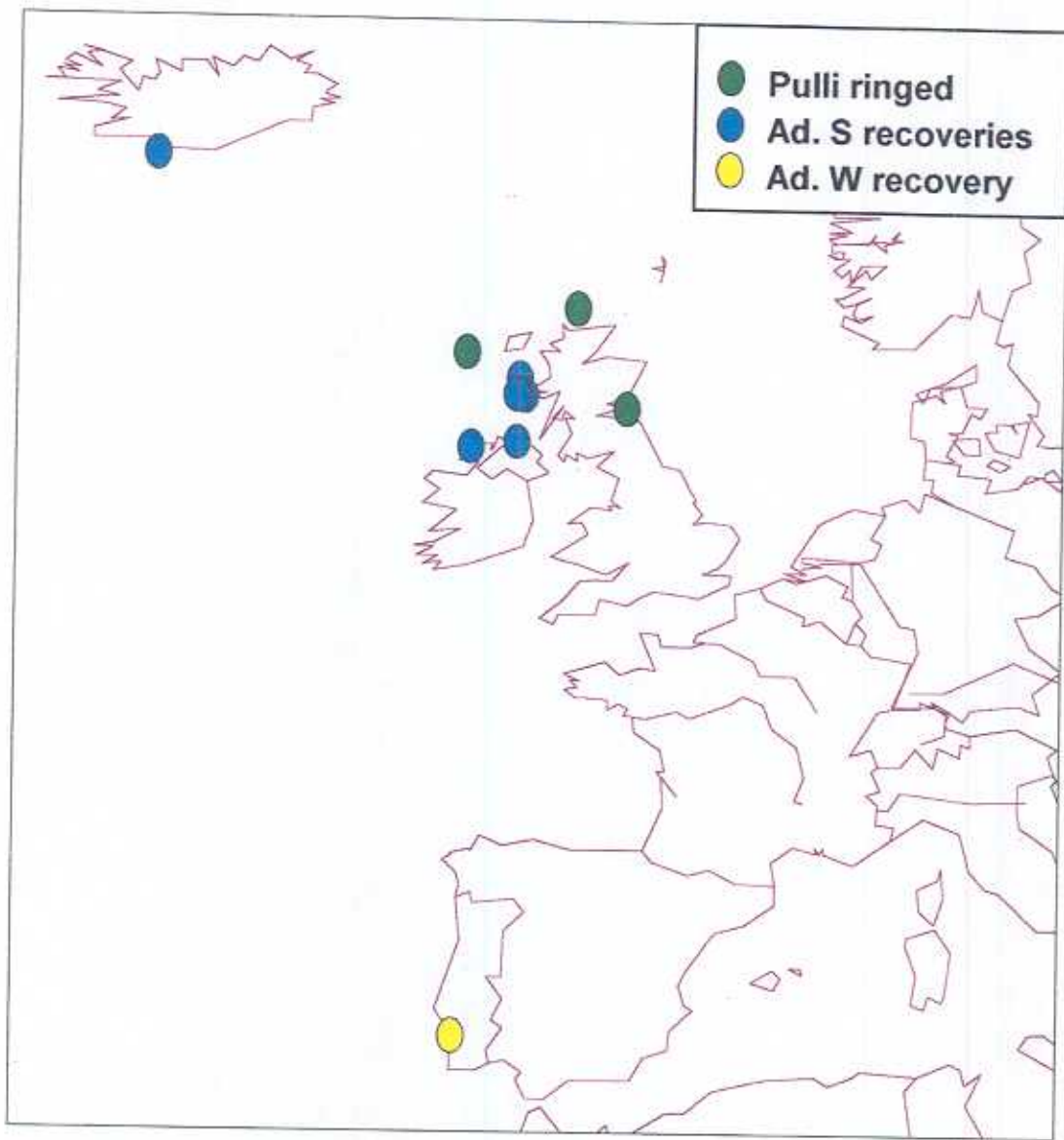


Figure 9. Puffin recoveries:

- adult summer (May -August) recoveries of birds ringed on the Treshnish Isles;
- adult winter recovery, ringed as adult on the Treshnish Isles;
- origins of adults recovered on the Treshnish Isles, ringed as pulli.

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breeders from the northern Irish colonies. Breeding Puffins forage fairly close to their colony e.g. within 15km of the Skomer colony (Harris 1984). Finally, the remaining three of nine Treshnish Isles birds recovered elsewhere, were found dead between late June and early August on the adjacent islands of Coll and Mull.

Table 9 provides a breakdown of Puffin recoveries in terms of finding circumstances, these including 18 adults ringed and recovered on the Treshnish Isles. Other than man, Great Black-backed Gulls are the only other important predator of adult Puffins, with individuals specialising in this prey (Harris 1984). Gull predated Puffins, their skins having been turned inside out, are regularly encountered by TIARG across the Treshnish Isles, as is the sight of aerial attacks by Great Black-backed Gulls intending to directly attack or panic breeding Puffins. It is likely that some of the kills attributed to raptors/owls by the public are in fact the work of Great Black-backed Gulls.

Table 9. The finding circumstances on recovery of Puffins ringed on the Treshnish Isles.

Finding circumstances	Nos. of recoveries					Total
	Iceland	East Scotland	West Scotland	Ireland	Portugal	
Controlled by ringer		1				1
Dead, bird found			19	2	1	22
Dead, raptor/owl kill			3			3
Dead, killed by bird			2			2
Dead, bird trapped by hunter	1					1
Total	1	1	24	2	1	27

Seabird longevity

Table 10 provides TIARG longevity records for ten seabird species, as extracted from recoveries 1927 – 1999. TIARG's retrap data has yet to be examined for longevity records.

Table 10. TIARG longevity records for ten seabird species, as extracted from recoveries 1927 – 1999*

	Age at ringing	Longevity record:	
		TIARG	Nat. Ringing Scheme Years-months-days**
Fulmar	Adult	3 yrs 349 days	40 - 11 - 16
Great Black-backed Gull	Pullii	10 yrs 358 days	23 - 10 - 4
Guillemot	Pullii	19 yrs 276 days	27 - 7 - 20
Herring Gull	Pullii	12 yrs 193 days	27 - 9 - 0
Kittiwake	Adult (Euring code 6)	2 yrs 9 days	28 - 6 - 5
Manx Shearwater	Adult	16 yrs 308 days	35 - 8 - 20
Puffin	Pullii	14 yrs 340 days	29 - 11 - 16
	Adult	14 yrs 23 days	
Razorbill	Adult	12 yrs 4 days	28 - 7 - 16
Shag	Pullii	30 yrs 216 days	23 - 1 - 4
Storm Petrel	Adult	20 yrs 340 days	31 - 11 - 9

* TIARG retrap data have yet to be examined for longevity records.

** Data extracted from Annual Reports of the BTO ringing scheme e.g. Clark *et al.* (2000)

Table 11. Number of recoveries relating to the Treshnish Isles from a given year of ringing for seven seabird species

Year of ringing	GBBGU	GUILLE	HERGU	PUFFI	RAZOR	SHAG	STOPE	Grand Total
1927						15		15
1928						7		7
1930						4		4
1931		1						1
1953						1		1
1954						1		1
1958						1		1
1962						1		1
1971						3		3
1972					1	4		5
1973				1		1		2
1975					1			1
1976					2	1		3
1977	1						1	2
1978				1			1	2
1979			1		1			2
1980			1	1	2	4	13	21
1981		3	1		2	1	3	10
1982		3	1			2	2	8
1983		1	2	2	5	2	2	12
1984	2	3	3	4	3	5	8	28
1985		1			3	2		6
1986		6	1	2	6	1	2	18
1987	2	2						4
1988		3			1		1	5
1989		3		1	1		8	13
1990		12		1	5		2	20
1991		1		3		1	55	60
1992		3	1	1		1	3	9
1993		2		1	1	1	5	10
1994		1			1		3	5
1995		2		2	2		52	58
1996		2		4	2	2	21	31
1997	1	1	1	4	4	3	57	71
1998		4			2	2	50	58
1999	1	3		2		2	53	61
Total	7	57	12	30	45	68	340	559

Note: The species code used above are: GBBGU = Great Black-backed Gull, GUILLE = Guillemot, HERGU = Herring Gull, PUFFI = Puffin, RAZOR = Razorbill, SHAG = Shag, STOPE = Storm Petrel

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SHORT REPORT

Effects of disturbance by ecotourism on breeding distributions of Shag *Phalacrocorax aristotelis*, Puffin *Fratercula arctica* and Fulmar *Fulmarus glacialis* on the Treshnish Isles, Argyll, UK

S.G.WILLIS

INTRODUCTION

The breeding seabirds of the Treshnish Isles, Strathclyde, UK (56°29'N, 06°26'W), have been monitored over the last 30 years by the Treshnish Isles Auk Ringing Group (TIARG). During the period of monitoring there has been a steady increase in the use of the islands by day-trippers, arriving mainly by organised boat-tours which depart almost daily during the breeding season from nearby inhabited islands such as Mull. The Treshnish Isles themselves have been uninhabited since 1834 (Boyd & Boyd 1990) but were grazed by livestock brought from neighbouring islands until relatively recently.

Day-trippers land on the main island of Lunga, usually for a period of 2-3 hours, during the middle of the day and are concentrated along well-worn pathways to the main seabird colony located at Harp Rock (Figure 1). The present work was undertaken to determine the effects, if any, of this increase in visitor pressure on the islands breeding seabirds.

The island chain is an important seabird breeding colony (Heath *et al.* 2000), listed as an SPA (Stroud *et al.* 1990) and playing host to around 23,000 pairs of nesting seabirds during the breeding season (Table 1).

The charadriiformes, and the alcids in particular, have been shown to be particularly sensitive to disturbance at the nest site (Gotmark 1992). However, much of the work relating to the disturbance of alcids and other seabirds has assessed the effects of investigator disturbance, usually involving direct nest disturbance (e.g. Ollason & Dunnett 1980; Rodway *et al.* 1996; Harris & Wanless 1984; Harris 1984; Ashcroft 1979; Hull & Wilson 1996). By contrast, the somewhat less intrusive disturbance of site visitation by e.g. tourists has been somewhat less studied, particularly in the species considered here.

Several papers have related the effects of ecotourism on penguin species (Hull & Wilson 1996), which have been shown to demonstrate stress responses to simple human presence when not accustomed to seeing them but to tolerate humans when visitation levels are high (Fowler 1999). Studies on colonies of burrow-

Table 1. Breeding numbers of selected seabirds on the Treshnish Isles based on census work undertaken in 1999 and 2000 by TIARG. Storm Petrel estimate from Gilbert & Hemsley (1996).

Species	Count unit	Estimated population
Fulmar	AON	1078
Manx Shearwater	AOB	1280
Storm Petrel	AOB	5040
Shag	AON	601
Kittiwake	AON	786
Arctic Tern	IND	153
Razorbill	IND	1232
Guillimot	IND	9566
Puffin	AOB	1788

AON, AOB and IND refer respectively to apparently occupied nests, apparently occupied burrows and individuals.

nesting penguins have shown that increased visitor pressure can cause burrows to collapse (Simeone & Schlatter 1985); of relevance to the Puffins of Treshnish, which nest mainly in burrows in the skeletal soil of the cliff tops. Nest-site disturbance at Puffin colonies has also been shown to affect chick productivity (Rodway *et al.* 1996).

Disturbance-induced displacement of seabird colonies is thought to be rare but has been observed in colonies of one relative of the Shag, the Double-crested Cormorant *Phalacrocorax auritus* (Cairns *et al.* 1998).

Given the proximity of visitors to the nests of Shag and Puffin, we would hypothesise Shag (with their open nest) to be most disturbed, then Puffin (burrow nesting) and the cliff-nesting Fulmar to be least affected.

METHOD

On the main island of Lunga, it was possible to make a comparison of changes in colony sizes for the three species in both disturbed and relatively undisturbed survey zones of the island: colony size here refers to birds breeding in a particular census zone rather than discrete colonies – though the zones are designed to encompass distinct colonies.

The visitors, by dint of the most popular route around the island to the auk colony, spend most of their time in only three of the twelve survey zones (Figure 1). By comparing changes in populations of the three species in these disturbed areas with colonies in the other "undisturbed" areas, it is possible to determine any differences in population growth between the two categories.

Census work followed the methods of Walsh *et al.* (1995) and Gilbert *et al.* (1998), though counts were undertaken only once in late June. Wherever possible individual nests were counted, though for inaccessible sites estimates were made based on the number of birds present.

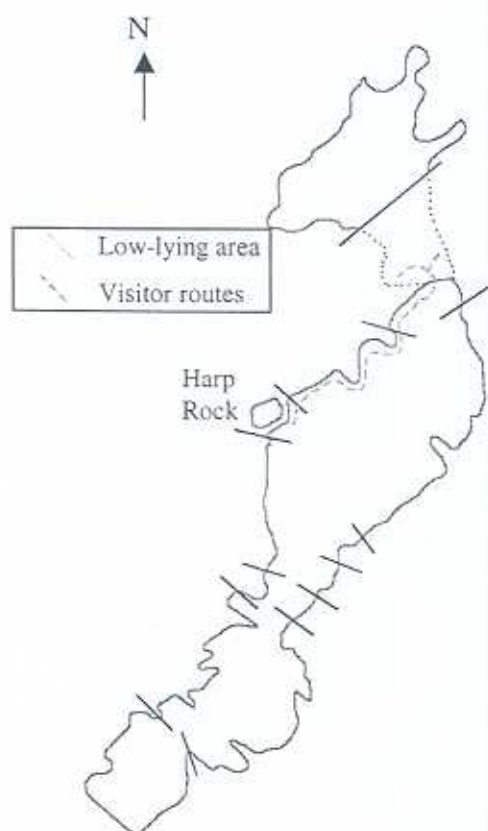


Figure 1. Outline of the main island of Lunga highlighting the disturbed and undisturbed survey zones. Zone boundaries are indicated by thin black lines. Main visitor route is shown as a dashed line along the cliff-top.

To make zones with colonies of different sizes comparable, all counts were converted to index values standardised to the number of nests in any particular zone in 1976 (Table 2) – the time of the first breeding survey which systematically recorded breeding birds using the adopted zoning system.

Table 2. Population size of the study species on Lunga in 1976.

	Population size in 1976 (AON/AOB)		
	Undisturbed areas	Disturbed areas	Total
Fulmar	300	120	420
Shag	84	81	168
Puffin	444	1032	1476

A comparison was made between index values of disturbed and undisturbed zones over the six-year period 1994-99. This period coincides with the recent period of relatively high visitor pressure, when any changes would be expected to be most apparent. These data were examined using a general linear model, with the index value as the dependent variable, year as a covariate and disturbance as a factor. For the analysis of Puffin indices, one outlier was excluded, this being a initial population in an undisturbed zone of only 2 or 3 pairs that had recruited several more pairs, producing an index of population change far-exceeding that of any of the other populations.

RESULTS AND DISCUSSION

Changes in the population indices over time (Figure 2) demonstrate quite different responses of the three species in the disturbed and undisturbed areas.

Fulmar colonies showed no variation that could be accounted for by either year or disturbance during the 6 year period (Year: $F=0.163$, *N.S.*; Disturbance: $F=0.441$, *N.S.*)

By contrast, and somewhat surprisingly, Puffin colonies indexes in disturbed areas were greater than those of their counterparts in undisturbed areas over the six-year period; disturbance being the only significant factor in the GLM model (Year: $F=0.034$, *N.S.*; Disturbance: $F=5.802$, $P<0.05$). Shag colonies showed a reverse trend to that demonstrated by Puffin colonies, disturbed colonies having lower mean index values than undisturbed colonies (Disturbance: $F=13.48$, $P=0.001$). The effect of year was also a significant component of the model, highlighting increases over time in the undisturbed zones (Year: $F=4.78$, $P<0.05$). Shag colonies in disturbed areas are on average now only 20% of the size they were in 1976. The increase in Shag nests in undisturbed areas has, however, more than compensated for losses in disturbed areas. In such areas the population has rapidly grown over the last 20 years, only being curtailed during the early 1990's, a period when increased winter Shag mortality and reduced

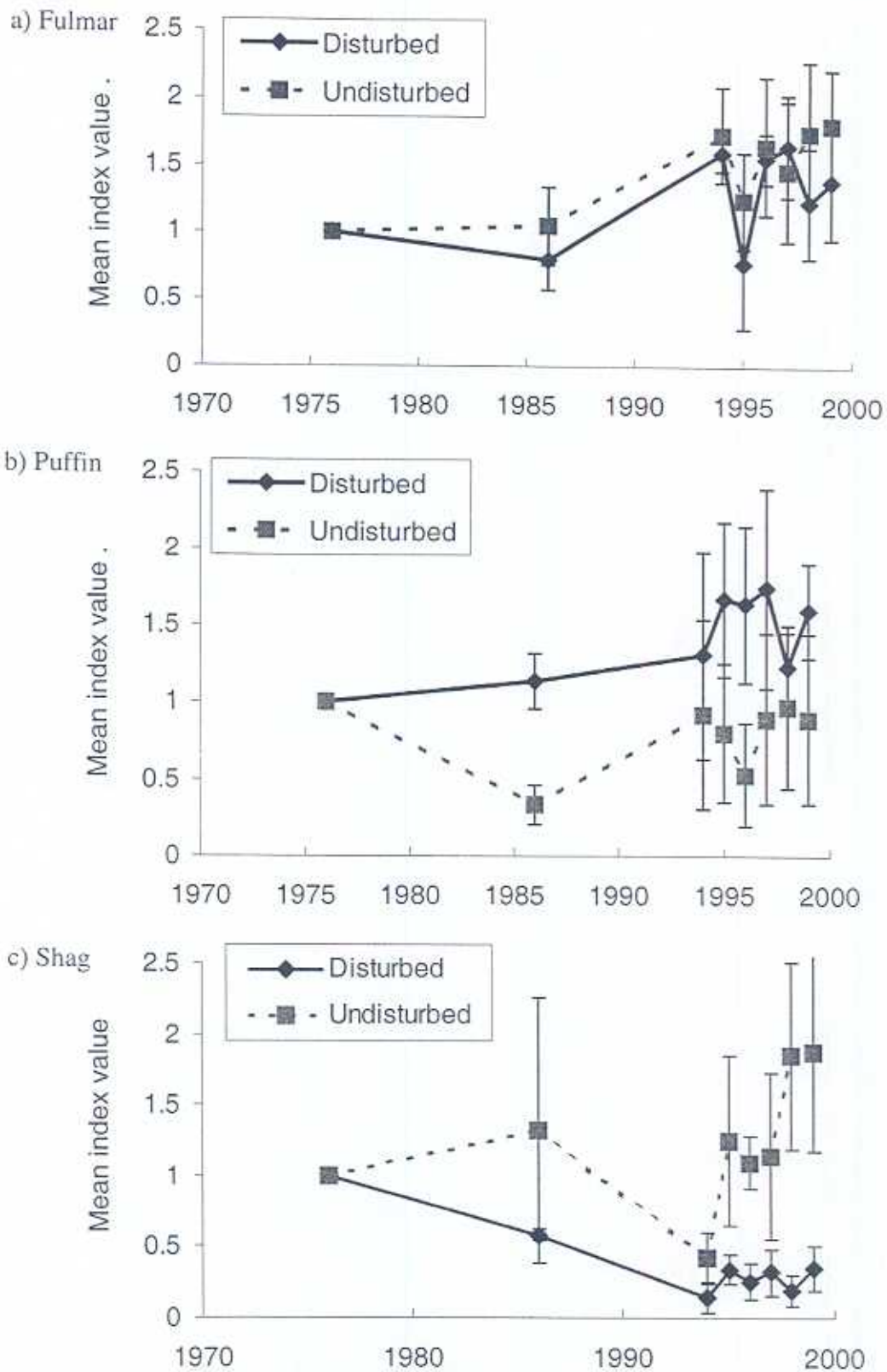


Figure 2. Mean index of breeding numbers of a. Fulmar, b. Puffin and c. Shag in the disturbed and undisturbed zones over the period of monitoring. Population indexes are relative to the population size in 1976 (the period of earliest comparable monitoring).

breeding was widely reported (Walsh *et al.* 1995; Harris & Wanless 1996).

A lack of variation in Fulmar population indexes between areas is to be expected as this species nests on the cliff face or towards the base of the cliffs, whereas the visitors use the cliff-top paths. One Fulmar nest close to the path was abandoned early in the season in 2000, suggesting a local disturbance effect. The increase in Puffin indexes is more perplexing, though several explanations can be offered. Due to the cessation in grazing of the islands, much of the vegetation is becoming increasingly rank, perhaps to the detriment of Puffins, who favour the short turf. The visitor walkways, in combination with prevailing westerly winds, may maintain the cliff-tops in a

close-grown state, possibly encouraging Puffins and also potentially rabbits, which would serve to further reduce sward height as well as creating nesting burrows.

Numbers of the two species for which changes have been demonstrated are both however stable or increasing at the level of Lunga as a whole (Figure 3) and also within the island chain. It therefore seems that any losses caused by visitor pressure simply result in nest site translocation. At present it seems there are still sufficient nesting sites for shags, such that the population is unaffected by local disturbance. Nest sites have similarly been shown to be non-limiting elsewhere (Olsthoorn & Nelson 1990).

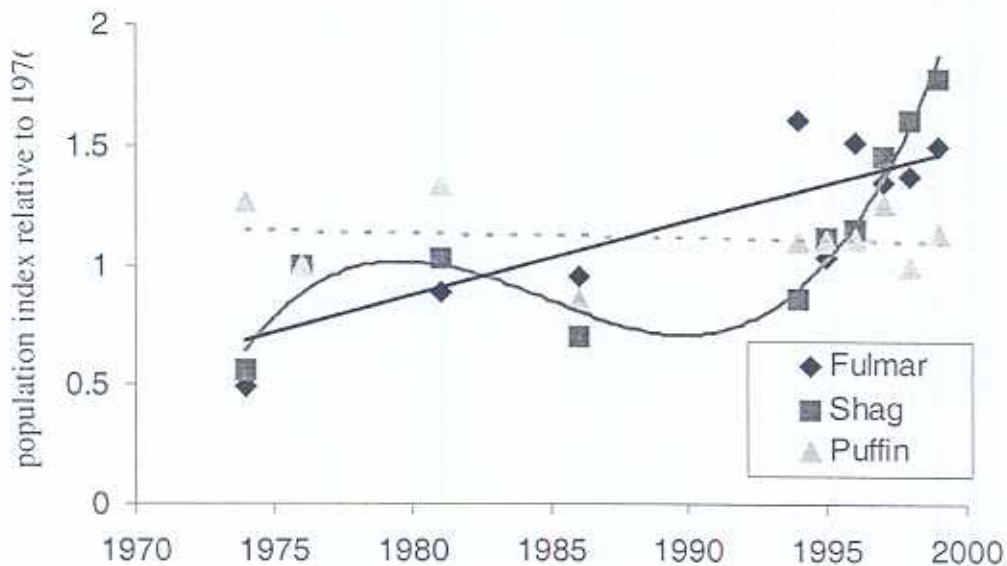


Figure 3. Indices of the populations of the three species breeding on the whole of Lunga relative to the population in 1976. Linear regressions are fitted for Fulmar and Puffin. Shag has a second order polynomial line fitted to depict the non-linear population growth. Fulmar: $r^2=0.716$, $F=20.2$, $P<0.01$; Shag: $r^2=0.954$, $F=41.7$, $P<0.001$; Puffin: $r^2=0.013$, $F=0.105$, *N.S.*

With regards management of the island for visitors it therefore seems that, in terms of population sizes alone, the current visitor pressure has no serious detrimental affect on the three species in question. The timing of visitors may also be of importance, with the birds being less likely to desert nests later in the season, when visitor numbers are greater. Factors such as chick rearing success may be affected, however, as has been shown for other well-visited seabird colonies (Rodway *et al.* 1996). Disturbance could potentially also affect the recruitment of new birds to colonies.

These findings are timely as the Treshnish Isles have recently been purchased by the Hebridean Trust, who are at present formulating a management plan for the islands, which may result in altered visitor pressure. It would seem that increased visitor pressure to the entire island may be detrimental to the

breeding species but current levels are tolerable.

The effects of disturbance shown here for the Treshnish Isles are also of wider relevance, showing that disturbance tolerance varies between species and is partly dependent upon species ecology. The findings highlight the importance of retaining undisturbed areas and suggest that ecotourism and nature conservation can be compatible if correctly managed.

Acknowledgements

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The Storm Petrel, *Hydrobates pelagicus*, on the Treshnish Isles: population estimates and movement of birds

S.G. WILLIS

SUMMARY

Disparity between three population estimates of a boulder beach Storm Petrel colony and between the estimates and the number of birds caught by mist-netting was investigated. A repeat of an earlier playback survey technique yielded similar response rates of birds to tape (33% vs. 36%). Population estimates from a playback census in June 2000, suggested a colony size of around 1,200 pairs, compared to an earlier playback census estimate of 350 pairs and a crude initial survey of 1,700 pairs. The possibility of the difference between the initial and the 1996 playback estimates arising due to nocturnal influxes of wandering immatures or birds from nearby larger colonies was discounted.

The area occupied by the colony as detected from the recent playback census tallied very well with the area occupied during the crude initial survey, suggesting no decline in area of the colony. The difference in colony size between the two playback censuses may indicate either large fluctuations in colony size, as has been shown elsewhere, or some parts of the colony being overlooked in the 1996 survey. The use of both diurnal playback and also nocturnal searches to locate actual colonies is suggested.

Introduction

The storm petrel, *Hydrobates pelagicus*, is virtually endemic to Europe, with the British Isles harbouring a sizable proportion of the European population (Heath *et al.* 2000). It is a species of conservation concern mainly due to its localised breeding populations. The actual size of the British population is difficult to estimate due to the inaccessibility of many breeding sites and also the previous uncertainty in population estimation. Population estimates for the population of the British Isles are currently between 20-150,000 pairs (Lloyd *et al.* 1991), suggesting that, even using the highest estimate, the Treshnish Isles hosts at least 3% of the British population (5,040 AOSs, Gilbert *et al.* 1998).

The Treshnish Isles (Figure 1) are a chain of small, uninhabited islands off the coast of Mull in Argyll, Scotland. They are designated a Special Protection Area due to their important seabird populations, which along with Storm Petrels includes a large auk colony (predominantly Guillemot, *Uria aalge*) and a scattered colony of Manx Shearwater, *Puffinus puffinus*, as well as numerous other common breeding seabirds. The islands are also an important wintering site for Barnacle Geese, *Branta leucopsis* (Heath *et al.* 2000).

An initial survey of numbers of storm petrels on the Treshnish Isles (Walker & Cooper 1996) crudely estimated a population of approximately 1,700 birds in the large boulder beach on Lunga alone. More recently, playback techniques have been used to produce an estimate of 5,040 pairs on the entire island chain (Gilbert *et al.* 1998). Of this population, only 350 pairs were estimated over the same boulder beach area surveyed by the Treshnish Isles Auk Ringing Group (TIARG) and given in Walker & Cooper (1996). This large disparity between the two estimates could be explained simply by the crude nature of the initial survey. However numbers of birds captured annually in mist nets on the storm beach in late June (up to 1,200) also suggest a more substantial population than the estimate of Gilbert *et al.* (1998).

Gilbert & Hemsley (1996) assigned the over-estimation of Walker & Cooper to the movement of birds at night, an influx of non-breeding birds or the proximity of the larger colonies on Fladda. It was possible to test these various hypotheses and this paper presents the results of our further investigations.

Methods

Surveying

i) Previous surveys

The initial survey in Walker & Cooper (1996) involved calculating the area of occupied boulder beach (48x16m and 190x5m) and multiplying this area by an approximate bird density of 1 bird/m², giving an estimate of 1,700 apparently occupied sites (AOSs).

The survey of Gilbert & Hemsley (1996) was based on the playback technique developed by Ratcliffe *et al.* (1996, 1998a,b) and detailed in Gilbert *et al.* (1998, 1999). The technique involves the marking of permanent quadrats, containing approximately 50 apparently occupied sites (AOSs), which are surveyed using diurnal tape-playback for a continuous period of 7-10 days to allow estimation of the average response rate per night at any AOS. Suitable areas can then be sampled during the day and the calculated correction factor applied to give a population estimate.

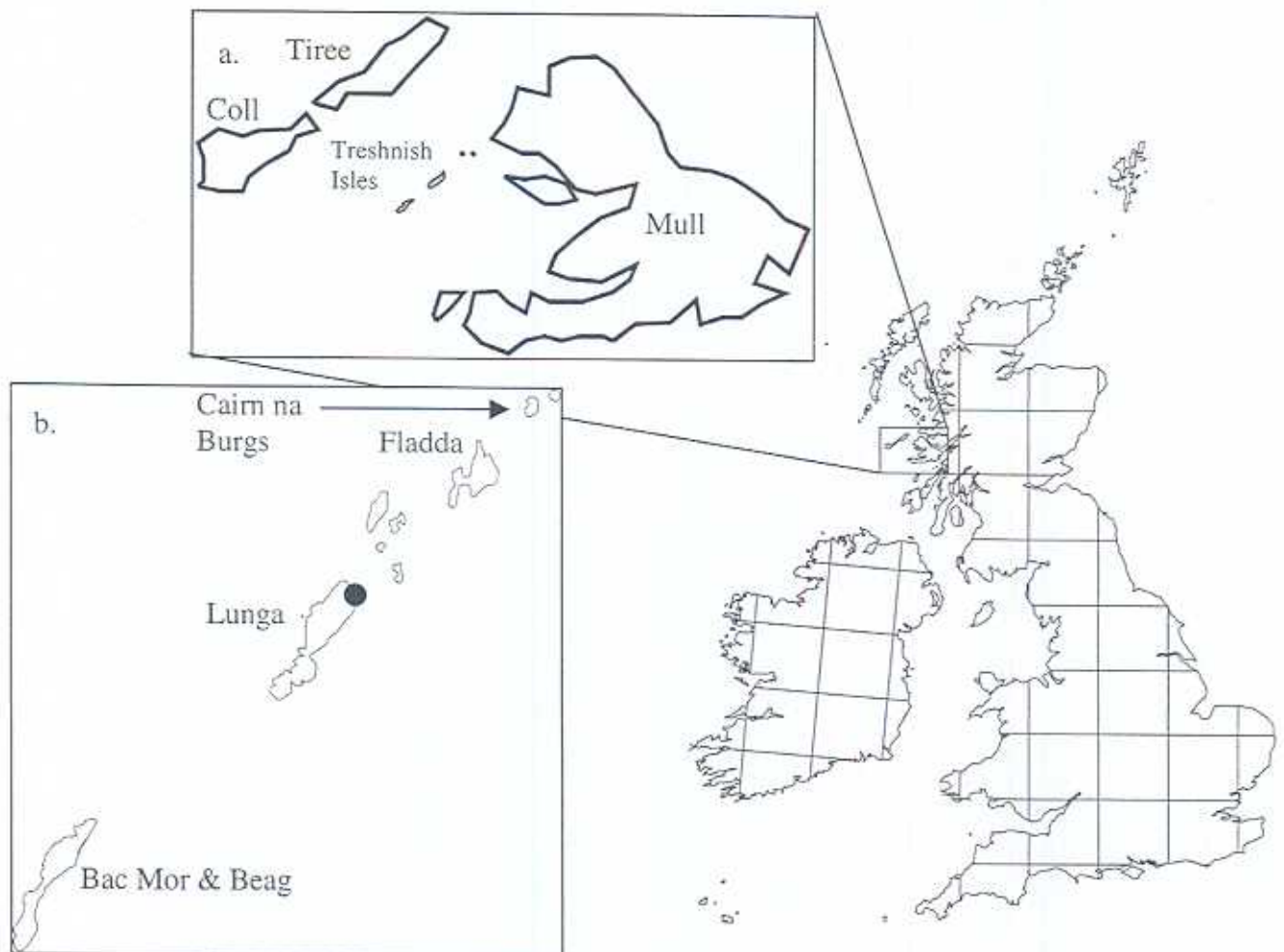


Figure 1: Location of the Treshnish Isles in the British Isles, with (a) their position in the Inner Hebrides and (b) location of the larger islands in the chain with the boulder beach Storm Petrel marked on the north end of Lunga.

ii) 2000 survey

The survey undertaken during late June 2000, was very similar to that of Gilbert & Hemsley (1996) but employed transects down the shore, which could then be used to interpolate numbers between transects. An initial calibration quadrat was constructed, of approximate dimensions 7.5x8.5m, so as to contain approximately 15 responses during the initial playback (Ratcliffe 1998b). The location of responding birds was marked on rocks using durable tape and labelled using waterproof marker pen. The area was then resampled using daily playback over a seven day period and additional responding bird locations marked, responses from birds at any of the marked sites being noted.

Twenty, 2m wide, transects were marked running perpendicular to and down to the shore, every 10m along the length of the boulder beach. Within each transect, the call of a storm petrel from the nearby island of Mousa was played twice in the centre of 2m² quadrats along the transect, once facing seaward and once landward. Numbers of responses were then noted in each quadrat. Mean densities were then calculated for each transect, and values of adjacent transects used to estimate the densities of the intervening area, using a linear interpolation. Several additional transects were also marked in suitable habitat, consisting of vegetated rocks, behind the boulder beach proper.

Boulder size was recorded in twenty-five areas of the boulder beach, including areas both with and without petrels to see if there was a consistent difference in beach characteristics. At each site the approximate diameter of ten boulders nearest the centre of a 2m² quadrat were recorded and the presence or absence of petrels in the quadrat tested using tape playback. For a selection of the transects, the vertical distance was measured between the beach surface above the lowest occupied section of beach and the dried strand limit; the latter assumed to be the spring tide/regular storm tide limit.

Mist-netting

Mist-netting of storm petrels at night has been regularly undertaken by TIARG during their June visits to the island over a number of years. Length of nets used and exact location of nets has varied from year to year but usually consists of 2-3 18m mist nets set on the flat upper talus beach with no tape-lure. Nets are set parallel to the shoreline, so as to catch mainly birds coming in or out of nests. Between year catches cannot be directly compared due to variation in net length, location and catch-effort but always only cover a small length of the colony. An expected catch was calculated for several sites based on the populations as estimated by Gilbert & Hemsley (1996) and the area of a colony covered by nets, assuming that the birds to be equally spread along the length of a colony, that the proportion of nightly incubation changeovers was 0.33 (Bolton 1996) and that all of the mobile birds would be caught.

In recent years, samples of birds have been examined in the hand during sessions and the presence of a brood-patch recorded, to estimate the proportion of non-breeders caught in the colony. Brood patches were classified as either heavily vascularised, partial or absent. Those recorded as absent however may include some birds that were not examined for brood patch during busy periods but were later classified as absent based on a lack of any brood patch record.

In order to assess the hypothesis that many of the birds caught at the Lunga colony originated from the larger colonies of nearby Fladda, four trips were made to the larger Fladda colonies to capture birds there. On each occasion 2-3, 18m mist-nets were erected within a colony during one night, different colonies being visited in different years. From these data it was possible to examine interchange between colonies both within Fladda and also between Fladda and Lunga. Similarly movement of birds between the two catching sites on Lunga (the village and the storm beach) were also compared.

Results

i) Census comparisons

Calibration Quadrat

When the calibration quadrat was constructed, 14 birds responded initially to diurnal playback. During the following days the total number of responses increased to produce 51 different response locations after 7 days. In an area of 62.05m², this gave an average density of 0.82 AOS m⁻², slightly less than the

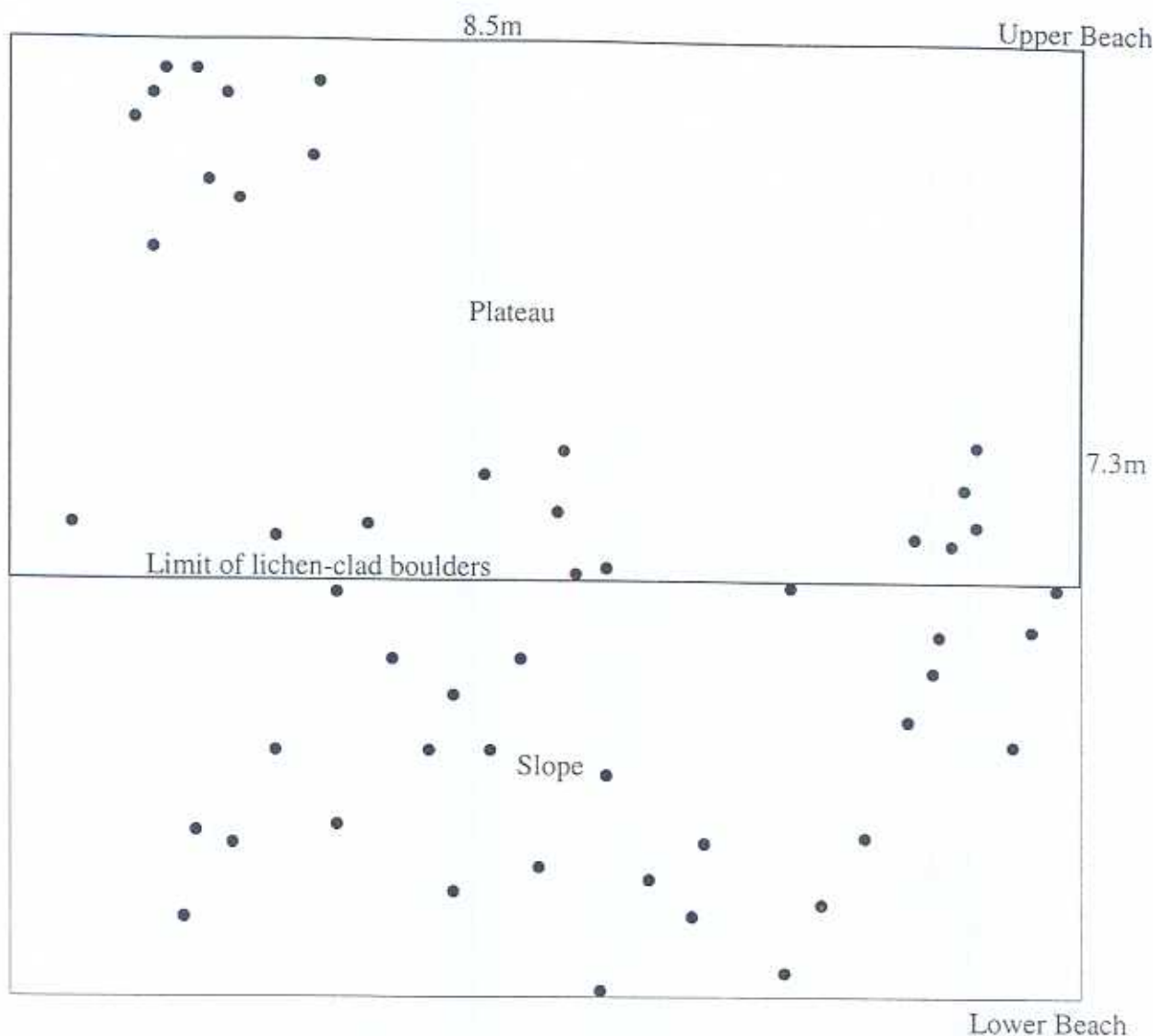


Figure 2. Spatial distribution of storm petrels on a section of the storm beach on Lunga. All birds responded to diurnal playback over a seven day period and were considered to be in distinct locations.

estimate of 1 AOS m^{-2} suggested by Walker & Cooper (1996). The average response rate of birds in the quadrat was 0.33, giving a correction factor of 3.0 for diurnal tape playback. This is very similar to the response rate of 0.36 and correction factor of 2.78 calculated by Gilbert & Hemsley (1996) and the response rate of 0.31 found by Ratcliffe *et al.* (1998).

Sampling bird density at a resolution of $1m^2$ sub-quadrats within the calibration quadrat (Figure 2) gives a variance:mean ratio of 1.10, suggesting that at this resolution the birds were dispersed in an almost random fashion. If the plot is resampled at a $2m^2$ resolution, the variance:mean ratio rises to 2.31, suggesting a marked aggregation of nests. We can interpret this as suggesting that at a small resolution the birds are randomly distributed, never being aggregated due to territorial behaviour but also not uniformly distributed due to the varying nature of the terrain. At a larger resolution, the birds are obviously clumped as a result of the variable suitability of the boulder beach, even over a small spatial area.

An examination of boulder size at 25 sites on the boulder beach, both with and without petrels revealed a significantly greater proportion of boulders with a diameter less than 15cm in areas from which petrels were absent ($t_{23} = 4.32$, $P < 0.001$, on arcsine transformed proportion data). Birds were recorded down the storm beach to areas approximately 1.5m (1.43 ± 0.25 , $n=6$ responding birds) vertically above the spring tide strand line.

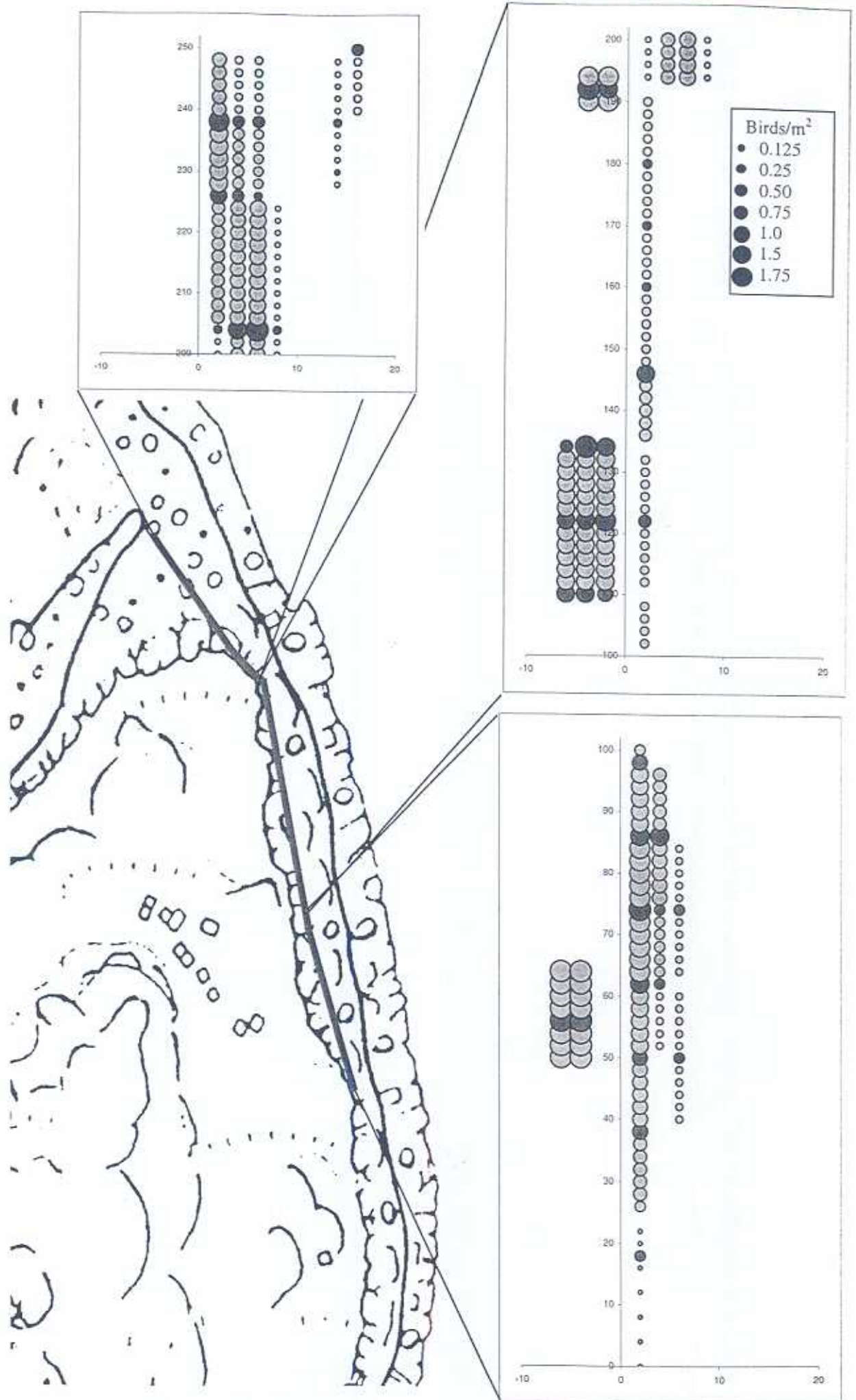


Figure 3. Distribution and density of the Storm Petrel colony along the boulder beach on Lunga. Red dots are actual playback responses, blue dots are interpolated estimates. Dot sizes represent densities as in the key. The x-axis represents distance seaward (+ve) or landward (-ve) from the edge of the boulder beach.

ii) Colony size and Distribution

Distribution of birds along the boulder beach was found to be highly variable (Figure 3), probably as a result of birds aggregating in areas with suitable rock crevices.

The transects undertaken during June 2000, indicated the greatest congregation of birds to occur in the high talus to the north end of the beach (Figure 3), with the colony along much of the remaining beach limited to the top 4 metres, though extending back into the vegetated boulders for a distance of 1 metre or more. The dimensions of the colony along the beach were approximately 190m x 2-6m at the south end of the colony and 55m x 16m on the high beach to the north. Three other colonies were also recorded above the storm beach proper. The northern-most was situated in an area of block scree also occupied by Razorbill, *Alca torda* and Puffin, *Fratercula arctica*, though the petrels occurred mostly in areas unoccupied by the former two species. The two larger colonies set back from the beach occurred in areas of rocks with sparse vegetation at the base of the cliff. These three colonies away from the boulder beach proper can be seen to hold petrels at a greater density than the beach itself.

Mist-netting Results

The results from mist-netting birds at several colonies appear to disagree with the colony estimates as calculated by Gilbert & Hemsley (1996). Annual mist-netting at two main sites on Lunga, the boulder beach and the village, catches an average of 290 and 190 birds respectively, with only a small interchange between the two sites despite their close proximity. Over the last three years, 1,128 birds have been caught at these two sites. Of these, 118 retraps could be assigned to being originally ringed at one of the two sites and of these 5 were subsequently caught at a different site from that at which they were originally ringed. Similarly, of 2,409 birds ringed at 4 colonies on Fladda, only 6 records occur of birds being re-caught at a different location to the site of ringing (Figure 4). The higher percentage of birds moving between the village and beach on Lunga (4.2%), compared with movement between Fladda colonies (0.25%) is probably a result of the boulder beach lying almost directly below and seaward of the village, with birds from the village being caught on the beach as they come in off or head out to sea. The low interchange between the Fladda colonies is notable, as three of the four colonies are in direct sight of each other and all are less than 100m apart. There is also very little exchange between the Fladda and Lunga colonies. Over five years of ringing only 9 birds out of almost 6,000 (0.15%) have been recaptured on a different island to that on which they were originally ringed. These findings discount the suggestion of Gilbert *et al.* (1998) that the large catches on the boulder beach are a result of mobile local birds, or are due to catching birds from the large colonies of Fladda. Wandering non-breeders might also be expected to move between islands. The low inter-island exchange therefore shows that wandering birds are not making a substantial contribution to catches.

To estimate the proportion of non-breeders in catches, 646 birds were checked for a brood patch in 1998 and 1999. Of these, 81% (525) had fully vascularised brood patches and a further 8.5% (56) had slightly feathered brood patches, with a maximum of 10.5% (65) having no brood patch. This suggests that a maximum of 10-19% of birds caught at the colony were non-breeders.

At all of the Fladda colonies except the largest (colony 2), the number of birds caught was much greater than expected from the colony estimates of Gilbert & Hemsley (1996), often double the total number of colony birds (Table 1). This is despite the fact that birds were only caught on one night and nets usually cover only a small proportion of the colony. From Table 1 it can be seen that the numbers caught are always much greater than the calculated expected catch. The catches of birds on the boulder beach on Lunga are an order of magnitude greater than the expected catches, though these values are based on an even distribution of birds in the colony, which has been shown not to be the case. Nets covering between 15-30% of the colony length for one evening catch between 30-75% of the estimated entire colony. Even allowing for 5% of the catch originating from the village colonies, this is still far greater than expected. Similarly the catches around the village on Lunga are also an order of magnitude greater than expected, catching 2-3 times the predicted number of birds in the entire colony. It is notable that there was no decline in catch size on the boulder beach in 1996, when the RSPB census was undertaken. In fact, the catch is almost double the usual catch size, though this is a result of increased catch effort that year. Catch rates (in terms of bird per net-hour) are consistent between years at the village and boulder beach sites, though the village catch rates are always lower than those of the boulder beach, which in turn are lower than those of the Fladda colonies. Catch rates of birds at the Treshnish

colonies (Table 1) are considerably higher than at other colonies where trapping is undertaken without tupe-luring. The low rates of around 15 birds/net-hour at the village and 40-80 at Fladda colonies compare to values of 2-6 birds/net-hour on St. Kilda (Furness & Baillie 1981).

Table 1 also compares estimated catches derived from three different population estimates for the boulder beach colony with the number of birds caught. Using the whole-colony estimate of Gilbert *et al.* (1998) it appears that on average, nets covering 17% of the colony catch 43% of the population. This falls to 12% of the population using the census data of this survey, or, using the current estimate for the North end of the boulder beach only, 30% of the northern part of the colony is caught when nets cover 75% of this colony. Comparing the actual and expected catch numbers indicates that using the northern colony estimate gives by far the best prediction of catch (200 birds compared to the actual catch of 236 birds). If 15% of birds are assumed to be non-breeders (from Ratcliffe 1999), the actual number of breeders in the catch falls to 200 birds, as predicted by the simple model.

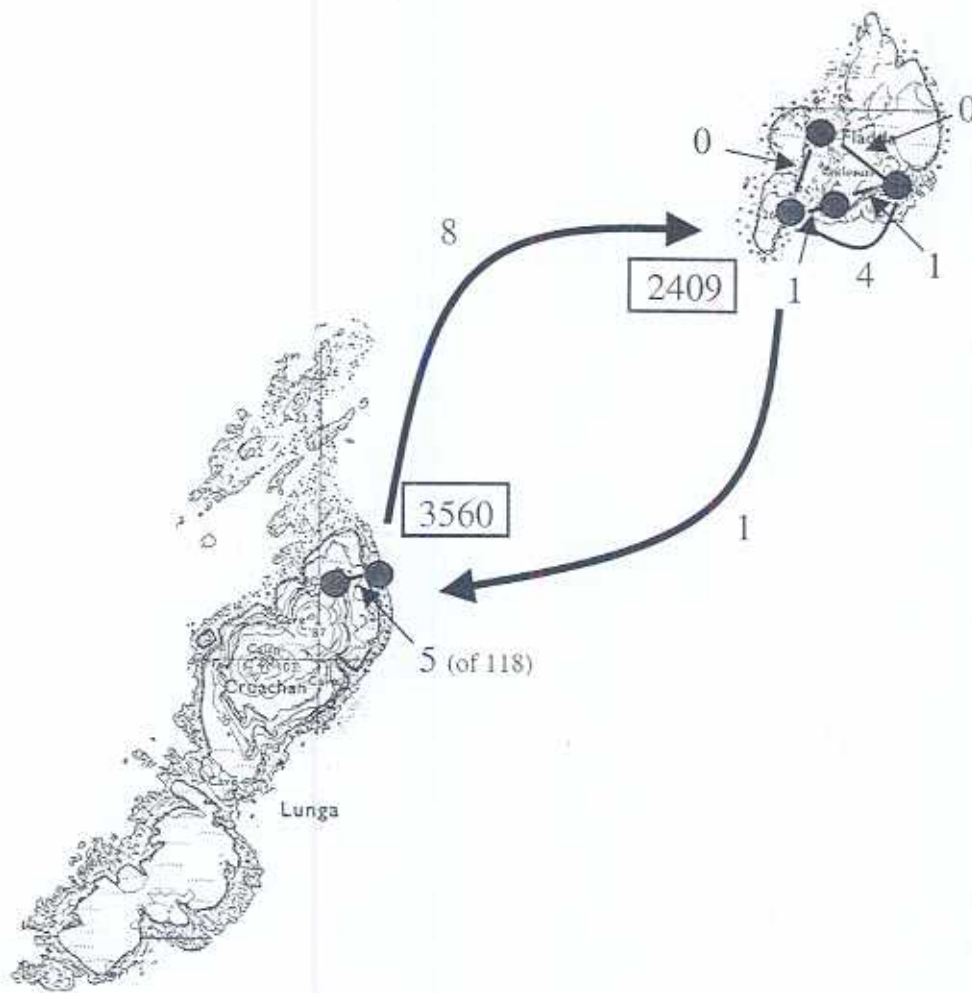


Figure 4 Movement of birds, as measured by mist-nest recaptures, between colonies both within Fladda and between Lunga and Fladda. Summary for captures over a 5-year period. Boxed numbers represent total birds ringed on each island over the period. Boxed numbers are the totals of birds ringed on Lunga (red) and Fladda (blue). Other numbers refer to interchange between colonies.

	Year	Colony	Responses	Colony estimate	No. of birds	Mist-net catch	Net length (m)	Net-hours	Catch rate (birds/net-hour)	Colony length (m)	Proportion of colony covered	Estimated catch	Proportion of colony caught
Fladda	2000	15	61	169.6	339	598	54	15	39.866	300	0.18	20	1.76
Fladda	1999	14	21	58.4	116	328	36	10	32.8	30	1.20	47	2.81
Fladda	1998	17	51	141.8	283	612	54	15	40.8	100	0.54	51	2.16
Fladda	1997	2	435	1209.3	2418	871	36	10	87.1	175	0.21	166	0.36
Lunga-BB	2000	4 and 5	12	336.7	673	187	36	8	23.375	248	0.15	33	0.28
Lunga-BB	1999	4 and 5	12	336.7	673	300	36	12	25	248	0.15	33	0.45
Lunga-BB	1998	4 and 5	12	336.7	673	220	36	10	22	248	0.15	33	0.33
Lunga-BB	1997	4 and 5	12	336.7	673	235	36	10	23.5	248	0.15	33	0.35
Lunga-BB	1996	4 and 5	12	336.7	673	508	36	20	25.4	248	0.29	65	0.75
Mean -BB 96-00 ^a		4 and 5	12	336.7	673	290	36	12	23.855	248	0.17	39	0.43
Mean -BB 96-00 ^b		4 and 5	-	1199	2398	290	36	12	23.855	248	0.17	138	0.12
Mean -BB 98-00 ^c		4 and 5	-	400	800	236	36	12	23.458	48	0.75	200	0.30
Village	2000	52,53,38,39	12	33.4	66	158	54	12	13.166	120	0.45	10	2.37
Village	1999	52,53,38,39	12	33.4	66	263	54	14	18.785	120	0.45	10	3.90
Village	1997	52,53,38,39	12	33.4	66	149	54	9	16.555	120	0.45	10	2.20

Table 1 Size of storm petrel colonies sampled by mist-netting and associated catch statistics. Colony and responses values are from Gilbert & Hemsley 1996. Colony estimate is derived by multiplying responses by 2.78 (Gilbert *et al.* 1998); numbers of birds is simply double the AOS value. Net hours is the number of 18m nets multiplied by the number of hours they were used. Catch rate is the catch divided by the number of net-hours. Colony lengths are derived from Gilbert & Hemsley 1996. Estimated catch is the number of bird multiplied by the proportion of colony covered by nets and multiplied by the mean daily incubation change rate (0.33). Proportion of colony caught is the catch in relation to the estimated number of birds in a colony.

a - is the mean of catches on the boulder beach from 1996-2000 and using the colony estimate for the whole beach calculated by Gilbert & Hemsley (1996)

b - is the mean of catches on the boulder beach from 1996-2000 and using the colony estimate for the whole beach calculated in this study

c - - is the mean of catches on the boulder beach from 1998-2000 and using the colony estimate for the North end of the beach only, as calculated in this study

Discussion

The dimensions of the colony on the boulder beach, as estimated using playback techniques is remarkably similar to the initial dimensions estimated in Walker & Cooper (1995), derived from nocturnal examination, which would suggest that the colony has not changed in extent over the intervening period. The census results of Gilbert & Hemsley (1996) however indicate that some fluctuation in population size had occurred between the initial estimate and their estimate. The south end of the colony was estimated by Gilbert & Hemsley to contain 318 AOSs compared to an estimate of 450 AOSs during the current survey. The two figures are not too dissimilar, allowing for the errors made in extrapolating the transects of the current survey and inter-annual variation. The major discrepancy lies in the different estimates of the high northern end of the beach and the omission of the vegetated rocky areas behind the boulder beach in the former survey. Of the areas included by Gilbert & Hemsley in their estimate of the colony size were several patches of vegetated boulders that were not surveyed in the present survey. It seems therefore that the survey of Gilbert and Hemsley either omitted to survey some of the densest areas of the colony or that areas of the colony had been deserted for some reason at the time of their census. The area is one of the sites used annually to catch birds with mist-nets and usually produces several hundred birds in a night, which substantiates the current census estimates. Four areas surveyed by Gilbert & Hemsley (their colonies 3,4,6 & 7) were definitely not surveyed during the present survey and a fifth (5) may have been above the boulder beach proper and therefore also not surveyed. If we assume the latter to have been included during the present survey (the dimensions fit the top edge of the high beach) but not the former four, then we can reasonably add these to our estimate for the area. This would add another 22 AOSs to the population estimate for the boulder beach, suggesting a population of around 1,780 AOS: compared to the estimate of 1,089 AOSs for the whole island by Gilbert and Hemsley.

The high density of birds occurring in the areas of partly vegetated rocks, compared to densities in areas of bare boulder beach, agrees with the findings of Gilbert *et al.* (1998) from sampling over the whole island chain.

By calculating calibration coefficients based on only 7 days playback, estimates of response rates may be slightly higher than if playback had continued for the recommended 10 days, though the rate of decline in finding new AOSs after five days suggests almost all were detected. The period of the current census work, i.e. late June, is slightly earlier than the recommended time for maximising responses (mid July, Ratcliffe *et al.* 1998b; Gilbert *et al.* 1998). Using the Gaussian response curve calculated by Ratcliffe *et al.* (1998b; equation 1 below), the probability of a bird attending a nest during the mid-period of the current census (26th June) is only 0.71, compared to a corresponding value of 0.85 at the mid period of Gilbert & Hemsley's census (19th July).

$$P = \frac{1}{1 + e^{-(0.31t - 0.002t^2 - 10.29)}} \quad \text{equation 1}$$

where P is the probability of attendance and t is the number of days after 30th April.

We would therefore expect our census estimates to be somewhat less than those of Gilbert *et al.* (1998), as attendance by birds would be lower and responses might also be expected to be lower. The timing of the current survey also minimises the proportion of visiting immatures to the colony. According to the logistic regression of Ratcliffe *et al.* (1998b), on the 26th June the probability of non-breeder attendance is about 0.12, i.e. the probability of a nest being occupied by a non-breeder on any day is about 12%, compared to a rate of around 0.20 at around 19th July. However, as the probability of detecting a non-breeder during diurnal census is extremely low (0.004), this should not affect the census comparison. Discrepancies between the current estimates and those of Gilbert *et al.* (1998) are therefore opposite to expectations and appear not to arise from differing non-breeder attendance at the colony. Ratcliffe *et al.* (1998a) also found substantial differences in colony size estimates between years, which may suggest large inter-year variation in breeding numbers or colony location.

It seems, if the population estimates are correct, that mist netting is often capturing more birds than contained in an entire colony, and certainly more birds than expected, based on the length of colony covered by nets. The explanation offered by Gilbert *et al.* (1998) for this phenomenon, for the boulder beach on Lunga, was that mist-netting is catching mobile birds, non-breeders and birds from the large Fladda colonies. The low recapture rate of birds from adjacent colonies on Fladda is therefore surprising, though this agrees with findings on Skokholm (Scott 1970), where breeders were seldom caught more than 200m from the burrow and were assumed to take the shortest route from the sea to the nest. Similar results have also been found with storm petrels in the Mediterranean (Amengual *et al.* 1999) The low recapture rate (0.15%) is much less than the values of around 7% recorded in Shetland by Fowler *et al.* (1982), who were using tape lures and were therefore catching predominantly wandering birds. This suggests that attraction of birds from adjacent colonies is an unlikely explanation of the large catches. Even on Lunga, where there is a greater proportion of exchanges, possibly due to the boulder beach lying on the route of birds from the village to the sea, numbers are not sufficient to explain the difference between captures and population estimates. Nocturnal visits by non-breeders may explain some of the discrepancies but it is generally recognised that the main influx of "wanderers", non-breeders prospecting for nest sites (Mainwood 1976), do not arrive in Scottish waters until mid-July (Fowler *et al.* 1982, Fowler & Hounscome 1998). As all mist-netting on the Treshnish Isles takes place without tape-lure, it is unlikely that catches will consist of a large proportion of wanderers (Furness & Baillie 1981). The large number of birds that regurgitate food when caught is also suggestive of breeding birds (Furness & Baillie 1981; Scott 1970). It is possible that some non-breeders are occupying nests-sites in the colony and it is these birds that contribute to the imbalance. Ratcliffe *et al.* (1998b) predict attendance by non-breeders to be around 15% in late June, which may account for some of the discrepancy, as non-breeders are unlikely to respond to diurnal playback (Ratcliffe *et al.* 1998b). However, as most birds were noted to possess a heavily vascularised brood patch, it is likely that the majority of birds were breeding adults rather than non-breeding birds occupying nests.

The consistency of catches on the boulder beach between years does not indicate a sudden population decrease, as the various censuses would suggest. Given that the large numbers of birds on the boulder beach have been shown not to originate from Fladda and that immatures cannot explain the catch discrepancies, some other explanation must be offered. The possibility of birds travelling to sea from colonies above the boulder beach and being caught on passing cannot entirely be discounted but seems unlikely given that only small colonies exist away from the village and the village itself does not contribute a large number of birds to the boulder beach catches.

The most realistic prediction of catch was derived from the estimate of the population local to the area of ringing, using the current census estimates. By assuming that only one third of birds are active on any evening and assuming 15% of birds caught are immatures from the colony, the predicted catch was identical to the actual catch. If this is a valid predictive model of catch, then it suggests it is possible to capture almost all of the local breeding birds that are mobile on any one evening. However, given that a small percentage of birds may originate from the adjacent village colony and other smaller local colonies and also that a proportion of the birds will be wandering non-breeders, the catch success will be somewhat less than 100% efficient. Nevertheless it appears that a large proportion of mobile birds local to the catch area are captured. It could be that mist-netting is catching more than just the birds local to the net area. Birds in the net could attract others from the local colony as they return. Therefore, even a small number of nets may catch a large proportion of the mobile fraction of a colony.

Based on the limited data currently available, it would appear that mist-netting at colonies without tape-lures may provide a means of estimating breeding population early in the season but many other factors need to be considered. An ability to discriminate between breeders and non-breeders, and between movement of non-breeding birds is fundamental if such methods were to provide reliable estimates of population sizes. Because of these problems and confounding effects such as estimating the extent of colonies and movement of other local breeders, it is suggested that playback techniques are still the most useful means of colony size estimation, though mist-netting may be a useful means of detecting overlooked colonies.

One explanation for the imbalance between colony estimates is that there was some error in the original surveying of Gilbert & Hemsley (1996) or that there was massive breeding failure in the year of their census but the birds remained in the vicinity of the colony. Their estimates for the village proper (~12 AOB) seem reasonable, judging by the number of birds heard at night but those for the ledges and boulders behind the village seem low (~24 AOB). It might be that populations are underestimated in areas of block scree and vegetated rocks due to difficulties in undertaking tape playback, or perhaps omitting to recognise areas of suitable habitat hidden below vegetation when using diurnal playback alone. Diurnal playback will also make it much easier to overlook entire colonies if areas are not sampled. It would therefore be preferable to use nocturnal searches to pinpoint the distribution of colonies and then diurnal playback to produce an accurate census of AOBs.

It has been suggested that current estimates of breeding storm petrels may be much lower than actual numbers, based on birds at sea (der Meer & Leopold 1995). Recapture techniques used to estimate population size of the Mediterranean sub-species have also found discrepancies between estimates of breeding populations (Amengual *et al.* 1999). The present work suggests that diurnal playback estimates, assumed to be the most accurate measures of population size, might also underestimate populations and that a compromise between nocturnal colony detection and diurnal censusing would produce best estimates.

Priorities for future study of the Treshnish storm petrels include an assessment of the within colony movement of birds, as a possible explanation of large mist-net catches. Further tape playback censusing of other colonies for which unusually high mist-net catches have been recorded should also be undertaken, to determine whether the previous diurnal census has overlooked areas of other colonies. A resurveying of the storm petrel population on the boulder beach will also give a better understanding of between-year population changes. From such work it should be possible to further clarify which factors are responsible for the large disparity between separate population estimates and between nocturnal catches and population estimates.

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Manx Shearwater Survey 2000

Damian Offer

In May 2000, three members of TIARG (Damian Offer, John Hodson & Dennis Cooper) visited the islands for a week to carry out a survey of the breeding Manx Shearwater *Puffinus puffinus* population. The survey was conducted as part of work undertaken by the group for Seabird 2000, a national project to census seabird populations in the UK that follows up on a previous survey run 10 years ago.

The data were collected according to the methodology provided under the Seabird 2000 guidelines. A taped male shearwater call was played from a tape player at the entrance to potentially occupied burrows. If present, a male shearwater would be expected to respond to the tape very quickly (usually within 10-15 seconds). Females would not respond. Previous work developing this method has established that a reliable population figure is given by multiplying the number of responses by 1.98.

Rather than attempt to locate results on a map in the field, a Garmin GPS was used to record the location of each group of burrows where responses were detected. These 'groups', which form parts of larger colonies were determined using topographic features (e.g. large rocks, gullies, bluffs etc.) to enable efficient working in the field. The use of GPS has enabled us to plot the results and superimpose them over a map of Lunga to show the relative distribution of pairs around the island (see accompanying map).

Prior to this survey, the population had been estimated at around 600 pairs located mainly in the vicinity of Shearwater Gully on the eastern side of Lunga. Our survey has established that the current Manx shearwater population is 1283 pairs, extrapolated from 648 responses. No suitable habitat was found on Dutchman's Cap, Fladda or other islands in the Treshnish group and further investigation confirmed the absence of shearwaters where burrows were found (these were likely to be rabbit or puffin burrows).

The survey has show that there are colonies located on just about every suitable part of the island. The key factors seem to be sufficient soil depth for burrows and topography that allows birds to take off when leaving the colony. All colonies are located on slopes or above bluffs and flat areas even with burrows are not utilised. Frequently we found evidence that nearby boulders also served as 'launching' sites for the shearwaters.

Summarising the results of the survey and combining the data into colonies gives the following distribution of colonies for the island:

Colony Location	No. Pairs
Cottages	54
North Cliffs	124
North Bluffs (above cottages and well gully)	244
Shearwater Gully	321
Shag Alley	70
East Cliffs (between Shag Alley and Shearwater Gully)	77
Flanks of Cruachan and lower peak	82
Harp Rock Amphitheatre	69
West Cliffs	105
South slopes of Cruachan	117

While Shearwater Gully contains by far the largest concentration of Manx Shearwaters, it is clear that the birds are utilising the whole of Lunga. There is a bias towards the north and east, which are perhaps the more sheltered parts of the island given predominantly south-westerly winds. Other small groups of pairs ('satellite colonies') were found at locations around the island that could not sensibly be allocated to any of the colonies listed above.

The survey was very enjoyable and rewarding and hopefully makes a valuable contribution to our knowledge of the birds of the Treshnish Isles.

