NatureScot Scotland's Nature Agency
NàdarAlba Buidheann Nàdair na h-Alba

Isle of May NNR - Annual Report 2018

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BIOLOGICAL RECORDING

Introduction to breeding seabirds

NatureScot monitors breeding seabird populations as part of its management of the National Nature Reserve as well as to report on the Special Protection Area (SPA) qualifying species.

Further seabird monitoring is carried out by the Centre for Ecology and Hydrology (CEH), under contract to the Joint Nature Conservation Committee (JNCC). Data from this monitoring work is integral to JNCC's national system of long-term monitoring for seabird populations, as the island is one of four strategic monitoring sites in Great Britain. The other three sites are Skomer, Canna and Fair Isle.

NatureScot carries out the population monitoring of the cliff-nesting seabirds, gulls, eiders and terns. CEH monitors the breeding success, survival and food intake of the auks, shags, fulmar and kittiwakes. CEH along with the Isle of May Bird Observatory Trust (IOMBOT) provide numerous other pieces of data invaluable to this report, such as the dates of first eggs and chicks and sightings of migrant birds, cetaceans and lepidoptera.

Population monitoring of cliff-nesting seabirds

Sections and timings

The detailed AIC methodology for the five cliff-nesting bird species (guillemot, razorbill, kittiwake, fulmar and shag) is set out in the Isle of May Monitoring Handbook (NatureScot, 2001, revised 2002 and 2011). The island is divided into the same standardised count sections as have been used in previous years. All species are counted once during the first week in June to capture a snapshot of the populations. 2018 saw the addition of counts from the sea, to allow those birds nesting in caves and areas unseen from land to be included in the population counts. This will add a new section to the usual ones: Section O – West Cliffs from boat.

The majority of the all-island count was carried out by Bex Outram. In sections that were sensitive, data was provided by Mark Newell of CEH to avoid additional disturbance. The AIC was completed between 1st June and 5th June, with the boat count being completed on 7th June.

Cornerstone plot counts

The counts of individual razorbill and guillemot during the AIC are converted to estimates of pair numbers. The number of both razorbill and guillemot pairs breeding at the Cornerstone plot is monitored by CEH. A count of each species was made at the Cornerstone plot at the beginning of every count session.

For each species, the number of pairs known to be breeding at Cornerstone was divided by the relevant Cornerstone count, for every count session. This provided a "k" value which represents the difference between the number of individuals counted and the number of actual breeding pairs. By multiplying this "k-value" with the number of individual birds counted during a session, the number of pairs can be estimated for that session. Keeping raw counts to within a few hours of the Cornerstone plot count allows for the variation in attendance of adults on the cliffs.

Results of cliff-nesting seabirds

The overall 2018 counts for each of the five cliff-nesting species on the Isle of May are shown in Table 1.1. Counts from previous years are also shown for comparison. Table 1.3 shows the different section totals for each species. A comparison from the previous year, percentage change, is seen in Table 1.4. Breeding success and return rates are shown in Table 1.6 and Table 1.7 respectively.

Fulmar

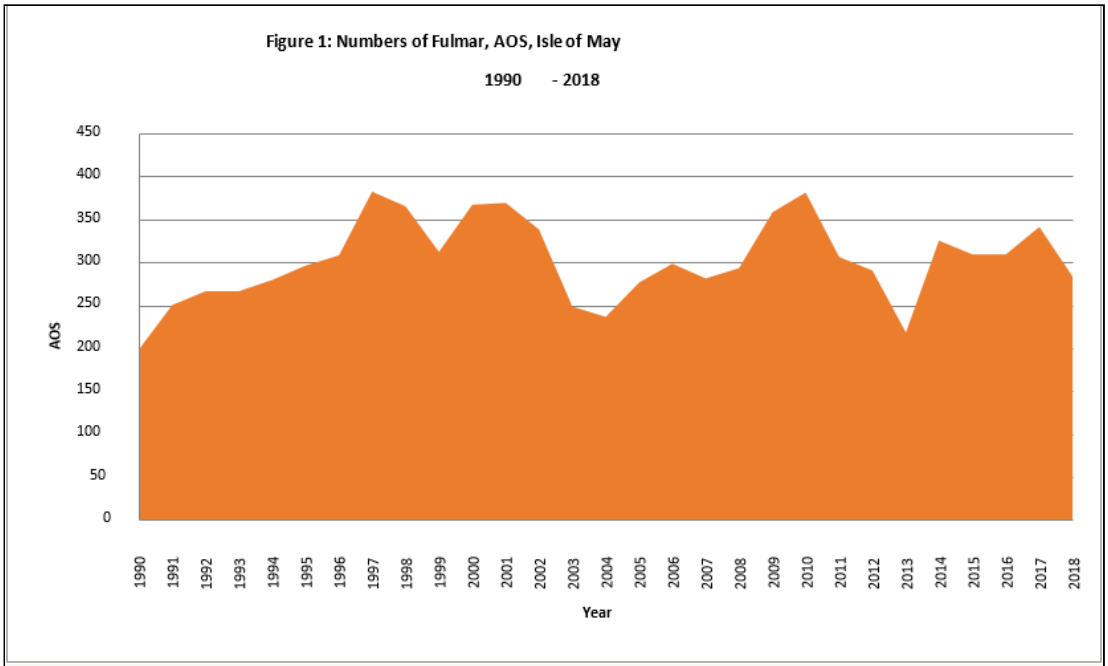

Figure 1: Numbers of Fulmar, AOS, Isle of May 1990 -2018
The number of Apparently Occupied Sites (AOS) was 283 pairs, a 17% drop from 2018 and the lowest count since 2013.

The first egg was seen on 13th May, the first chick was seen in early July, with the first fledged bird seen in late August. It has been an average breeding season, with 0.49 chicks from each breeding pair.

Shag

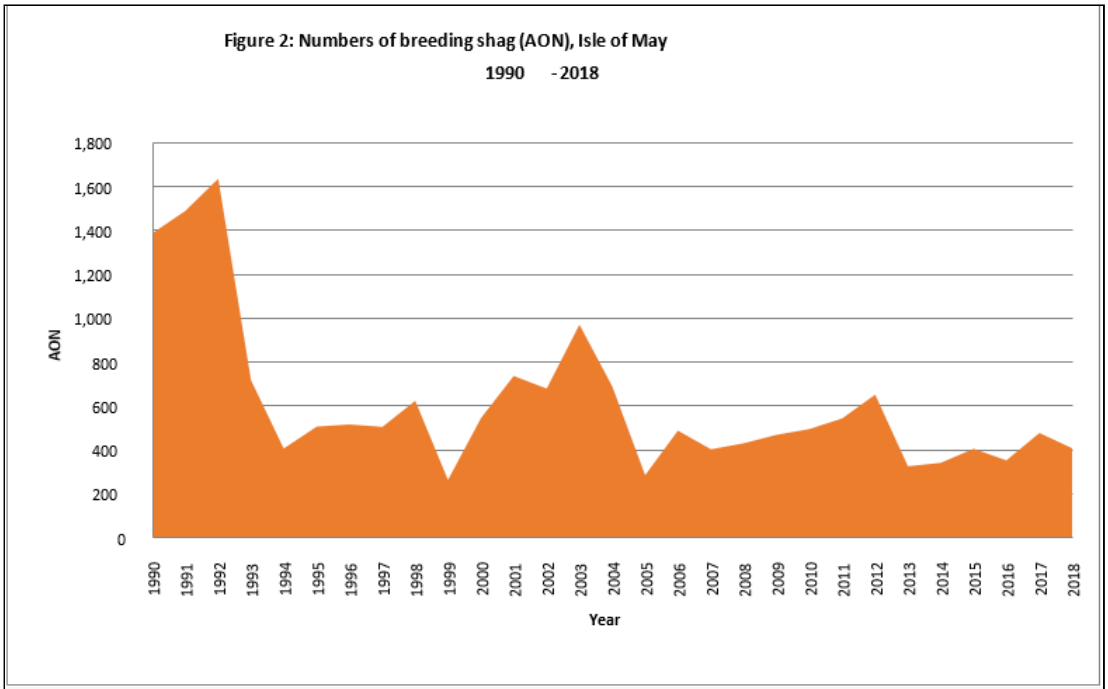

Figure 2: Numbers of breeding shag (AON), Isle of May 1990 -2018
The number of apparently occupied nests (AON) decreased this season, a decline of 15% to 404 pairs, still the second highest count since 2012 when 648 pairs bred.

The plots monitored by CEH showed a low return rate, 68%, the lowest since 2012. It has been a fairly successful season for shags, with an above average breeding productivity, 1.52 chicks fledging per breeding pair (long-term average 1.15).

The first shag egg was recorded on 29th April, 38 days later than last year (22nd March), and the first chick was seen on 3rd June.

Kittiwake

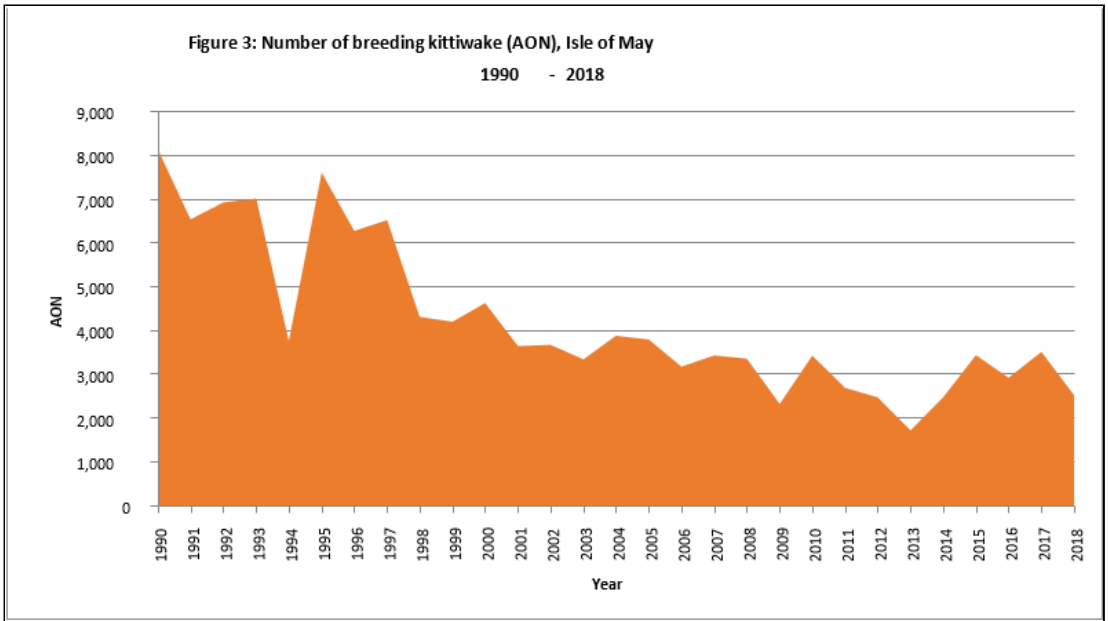

Figure 3: Number of breeding kittiwake (AON), Isle of May 1990 - 2018
After a 20% increase last season (3,507 AON), the Isle of May kittiwakes have dropped 30% to 2,516 breeding pairs. Although others were seen on cliff ledges, they sat on empty nests, indicating they have "taken a year off", and are perhaps in bad condition after a rough winter and saving their energy to breed the following season.

The kittiwakes experienced a high return rate, 87.6%, from the plots monitored, although these did not all breed. Kittiwakes had a slightly below average productivity, 0.56 chicks from the breeding pairs.

The first egg was seen on 21st May, twelve days later than 2017. The first chick was seen to hatch on 18th June.

Guillemot

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
No. of pairs at Cornerstone	198	191	198	201	205	195	193	194	220	229	232	228

Using the "k" value (see Table 1.6), the number of pairs has been calculated to 14,902, a 10% decrease on last year's count. During the beginning of 2018, the UK experienced several storms and many guillemots were found washed up dead along the coast of Scotland and North East England; this may have had an effect on the Isle of May population.

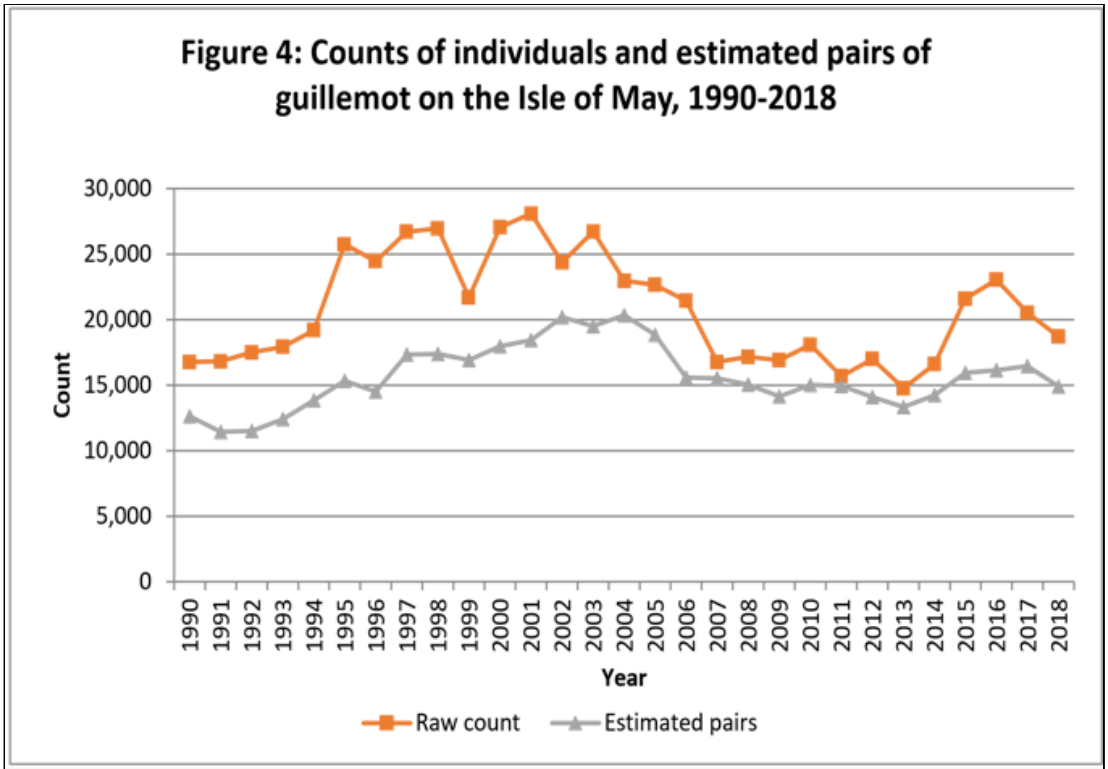

Figure 4: Counts of individuals and estimated pairs of guillemot on the Isle of May, 1990-2018

The total number of individuals was 18,705, a decrease of 9% on last year's total. To calculate the number of pairs breeding on the island, the 'K' value is used; to determine this factor, the number of pairs at the Cornerstone plot is required from Mark Newell, CEH. This year, the Cornerstone plot had decreased from last year (232) to 228 pairs.

The return rate of the marked individuals was 89.1%, an average year for the Isle of May guillemots. The guillemot breeding season was average, with each breeding pair producing 0.70 chicks. For the second year running, we have experienced a strong westerly storm during the breeding the season; this year, Storm Hector hit the island on 14th June and washed away low-lying eggs and chicks. This would not have been accounted for in the productivity rate as it not part of CEH monitoring plots.

The first egg was seen on 30th April, twelve days later than last year, and the first chick was seen on 2nd June. The first jumpling was noted leaving the cliffs on 25th June.

Razorbill

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
No. of pairs at Cornerstone	71	64	67	62	69	72	74	72	81	79	82	87

Using the 'k' value (see Table 1.6), the number of pairs of breeding razorbills had decreased by 4% to 3,738 pairs.

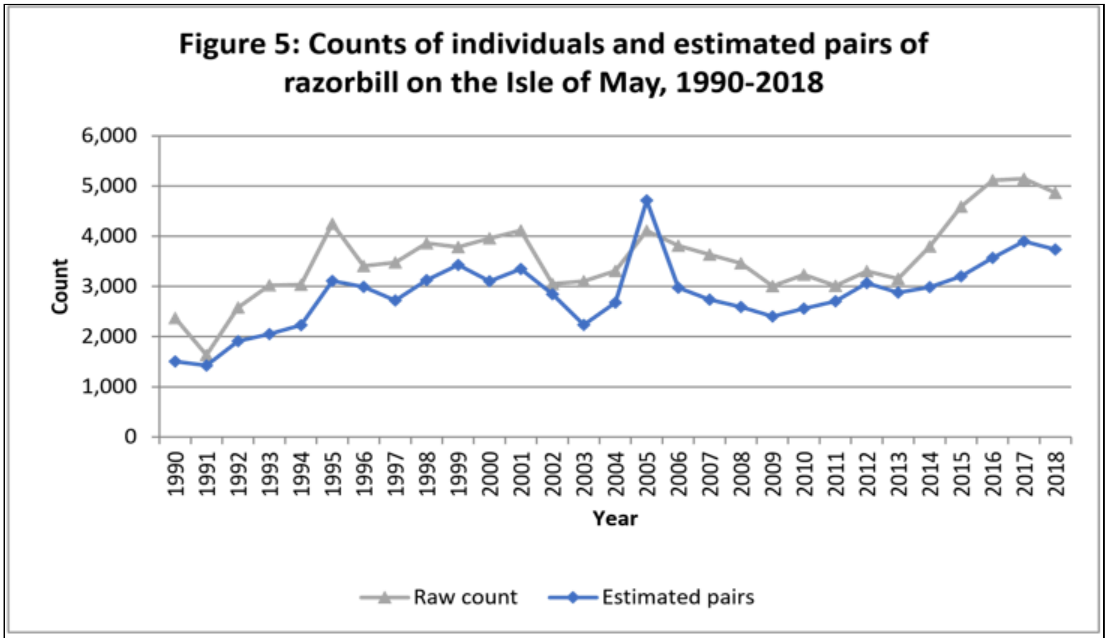

Figure 5: Counts of individuals and estimated pairs of razorbill on the Isle of May, 1990-2018

The number of individual razorbills had declined to 4,867. As with the guillemots, a 'K' value has to be established in order to calculate the number of breeding pairs on the island. This year, the number of razorbills breeding at the Cornerstone plot had increased to 87 pairs (provided by Mark Newell, CEH).

The return rate of colour-ringed individuals is 92.3%, above the long-term average. Razorbills had a poor breeding season, with monitored pairs producing 0.5 chicks.

The first egg was seen on 5th May, thirteen days later than last year. The first chick was seen on 12th June and the first fledged chick on 1st July.

Population monitoring of ground nesting seabirds

Puffin

The new method of puffin census was carried out this season. A survey team set up the plots and order lines in late March, with the NatureScot team placing more permanent markers for each plot in April. Bex Outram and David Steel surveyed all plots from 10th-12th May, completing Rona on 16th May. The number of occupied burrows for each plot was recorded along with percentage area of rock (unsuitable puffin habitat). This data was passed on to Megan Towers, NatureScot statistician. For a full account of the puffin census, please see the Census of Puffins on Isle of May, Scotland, 2018 report.

CEH undertook a puffin census in 2017, which resulted in a count of 39,200 occupied burrows with a 95% confidence level of between 32,200 – 46,300.

The first puffins carrying fish were seen on 22nd May; this indicates that the first chicks had hatched. The last puffin carrying fish was seen in late August; however, the majority of the colony had left earlier in the month.

The return rate of colour-ringed puffins was 95.2%, the highest on record. The puffins' breeding success was low, the lowest in six years, with 0.67 chicks per pair.

Herring and lesser black-backed gull

The first incubating herring gull was seen on the 23rd April and the first chick was noted on 25th May. The first lesser black-backed gull egg was seen on 27th April, six days earlier than the previous year; the chick was recorded on 1st May.

Nest count

The gull nest count took place from 25th May to 31st May, with some smaller sections being counted at the beginning of June. The count was carried out by the two reserve managers, long-term volunteers (Sally Reay and James Wilson) and NatureScot staff (Elspeth Christie, Sarah Eaton, Caroline Gallacher, Gavin Johnson, David Shepherd, Jeremy Squire, Neil Mitchell and Anthony Wetherhill). In sensitive areas in which activity would have caused disturbance to other nesting seabirds, the counts were carried out by CEH staff when they were doing their monitoring. Other small sections were counted during the AIC as these can only be accessed at low tide and also to minimise disturbance of other species.

The gull count was conducted in two teams, who counted each section of the island including the gull-free zones, recording the nest and its contents (Table 2.1). Immediately after, the counting efficiency and the species ratio of herring and lesser black-backed gull were completed (see Table 2.2 and Table 2.3 respectively). This was done by Bex Outram. Small sections and sensitive areas counted by CEH were not checked for counting efficiency and therefore the average percentage efficiency was applied to these areas.

Results

The estimated total number of herring gulls is 3,398 pairs, down 11%, and of lesser black-backed gulls is 1,684 pairs, down 13% (Table 2.5).

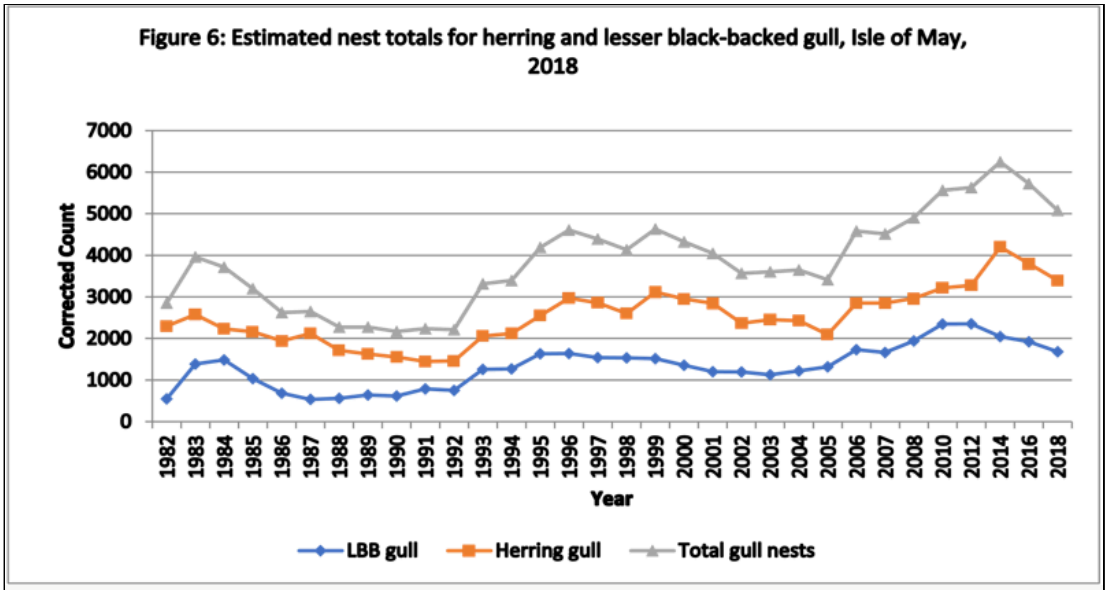

Figure 6: Estimated nest totals for herring and lesser black-backed gull, Isle of May, 2018

The total number of nests counted of both species was 4,891, down on 2016's 5,480 nests. To produce a more representative figure of the total number of nests, the counting efficiency for each section is applied and the total population of herring and lesser black-backed gull nests is 5,083, down 11% on the 2016 population figure of 5,724 nests; this is the lowest count since 2010.

No count of herring gull productivity was undertaken this year.

Gull management

The gull-free zones were maintained during 2018. These areas were North Plateau South to Lochside, East and West Braes, Beacon, St Andrew's Well, Cross Park and Tennis Courts, along with the 15m boundary around the tern colony at Kirkhaven. A total of 39 nests (89 eggs) were removed on 25th May and 12th June.

Specialist gulls that predated within the tern breeding colony were identified through tern watches and were removed; a NatureScot marksman came to the island and removed one adult lesser black-backed gull. More specialist gulls were identified, one herring gull pair at Jetty Rocks, but were not present when the marksman was present on the island.

Great black-backed gull

The first great black-backed gull egg was seen on 16th April and the first chicks were seen on Rona on 21st May.

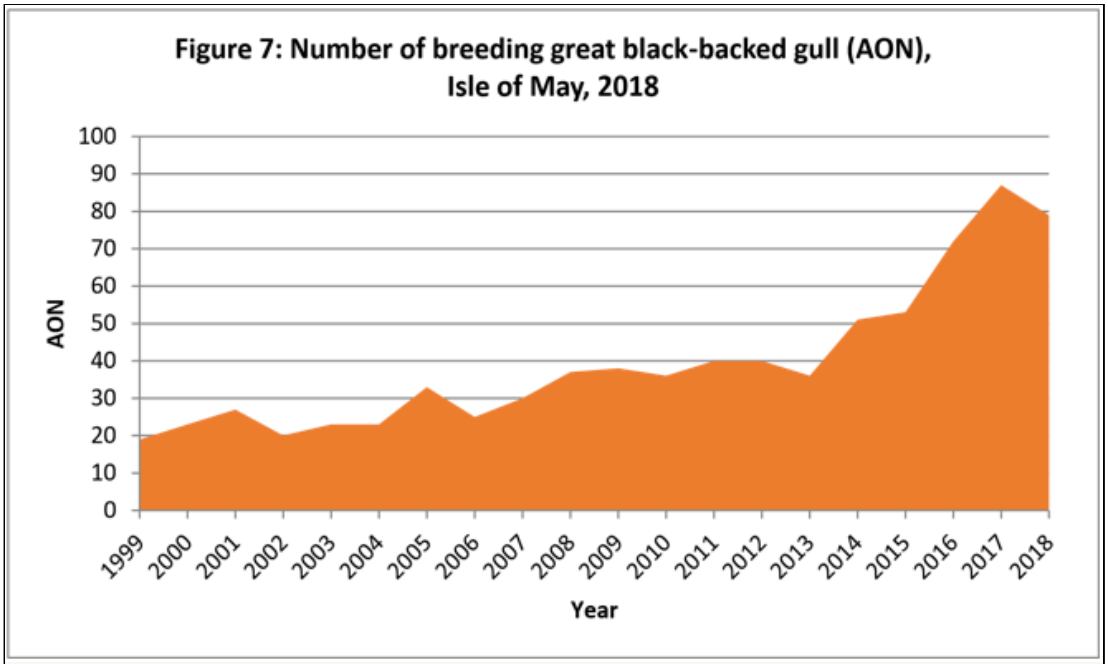

Figure 7: Number of breeding great black-backed gull (AON), Isle of May, 2018

Nest count After many years of increases in the great black-backed gull population, 2018 saw a decline, 9%, to 79 breeding pairs (87 pairs in 2017). As in most years, the majority of the pairs nest on Rona, with only twelve pairs breeding on the main area of the Isle of May.

Productivity

Forty-two nests were monitored on Rona to establish a breeding productivity. Numbered stakes were placed next to nests and with regular visits the number of eggs, chicks and fledged chicks were noted. The breeding success was 1.48, an average year.

With the help of the IOMBOT and Mark Oksien we were able to continue with the colour ringing scheme for the fourth year. This season the colour ring combination changed: yellow ring with five black digits, three digits, colon followed by M (eg. 001:M); these rings are attached to the birds' left leg whilst a BTO ring was attached to the right leg. A total of 63 BTO rings were deployed and 39 colour rings.

Great black-backed gull - Rona				
-	2018	2017	2016	2015
Nests monitored	42	51	45	28
Breeding attempts	42	51	45	28
Number of eggs	117	140	124	75

-	2018	2017	2016	2015
Average clutch size	2.79	2.75	2.76	2.68
Hatched eggs	78	117	91	57
Hatching success	0.67	0.84	0.73	0.76
Number fledged	62	88	32	33
Productivity	1.48	1.73	0.71	1.18

Terns

For previous population counts, see Table 1.2 and for how 2018 counts relate to the previous season, see Table 1.5. Information has been taken from the Isle of May NNR - Annual Tern Report 2018 (S Reay and J Wilson, 2018).

Roseate tern

No roseate terns attempted to breed this year. There were only a couple of sightings of roseate terns in the roost at Kirkhaven this season, less than in recent years, most likely due to the lack of a tern roost.

Sandwich Tern

No Sandwich terns attempted to breed this year. Several were seen overhead, circling the Beacon tern colony, but none landed.

Arctic and common tern

The first common tern egg was seen on 25th May at the Beacon tern terrace. Common terns had a protracted season with some chicks fledging in July and the last chick fledged mid-August.

The first Arctic tern egg was laid on 22nd May, and the first chick hatched 18th June in front of the Visitor Centre. The first fledged chick was seen flying at the Beacon on 18th July and the majority left the island on 1st August.

Breeding pairs

Each year, three weeks after the first egg laying date, all tern nests on the island are counted to get a measure of total tern nest occupation. This year, however, with the dramatic rate of predation, many nests had been predated by the time of the island-wide count, so, where appropriate, the peak numbers of nests were taken for each area from the monitoring plots along with a count made on 17th June. A total of 261 pairs of Arctic terns bred, a decline of 69%, and 17 common terns, a drop of 41%.

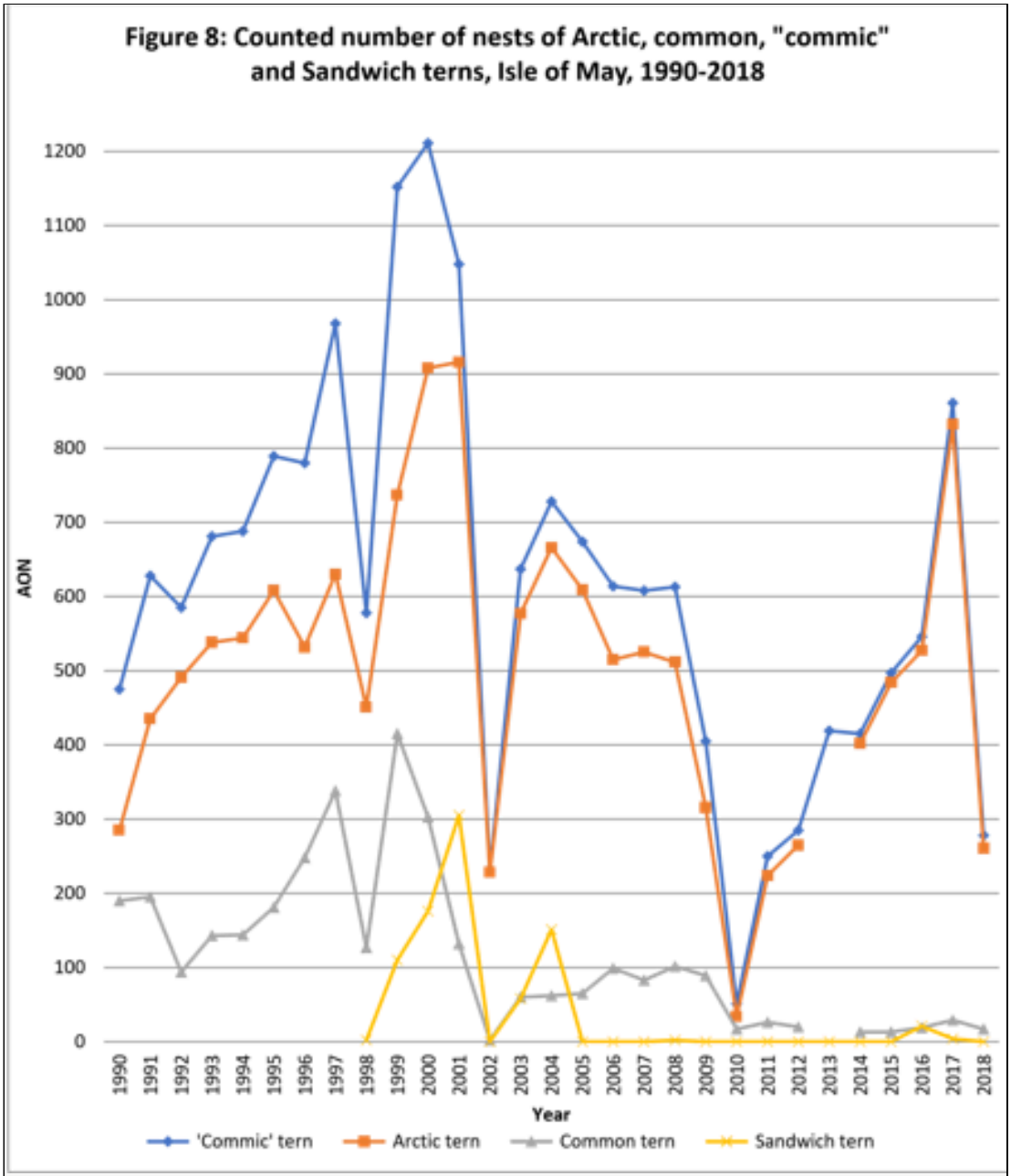

Figure 8: Counted number of nests of Arctic, common, "commic" and Sandwich terns, Isle of May, 1990-2018

Each year, three weeks after the first egg laying date, all tern nests on the island are counted to get a measure of total tern nest occupation. This year, however, with the dramatic rate of predation, many nests had been predated by the time of the island-wide count, so, where appropriate, the peak numbers of nests were taken for each area from the monitoring plots along with a count made on 17th June. A total of 261 pairs of Arctic terns bred, a decline of 69%, and 17 common terns, a drop of 41%.

Productivity

Six plots were chosen to monitor the breeding success of the Arctic terns this season. Each nest was marked and the number of eggs, chicks and fledged chicks noted. All chicks in these areas were ringed, helping keep track of the number of chicks that fledged from each plot. This was then used to calculate a productivity figure. The table below shows the different areas monitored and their productivity and the overall productivity that can be used to represent the whole colony. The overall productivity was 0.03 chicks fledging per pair, much lower than previous years.

Predation

Tern watches were conducted at both the Beacon and Kirkhaven Colony, with a total of 140 hours being conducted this year. A pair of lesser black-backed gulls was seen predating eggs in the Mouse House and wiped out the whole colony. One of the pair was removed; however, no terns re-laid in this area. A pair of herring gulls at Jetty Rocks was seen predating eggs and chicks in the same area and wiped out the rest of the colony, with predation from the resident kestrel also. Oystercatchers at the Beacon were also noted to have predated eggs on the tern terraces and the kestrel was also seen in this area, although no predation was witnessed.

Eider

The first sitting female was seen on 21st April, with the first brood of duckling seen on the Loch on 14th May.

-	Mouse House	Mouse House Terrace	Visitor Centre	Jetty Triangle	South Logan's	Beacon	Overall A. tern
Nests monitored	24	2	31	11	92	52	212
Breeding attempts	24	2	31	11	92	52	212
Eggs	24	2	48	18	137	83	312
Average clutch size	1	1	1.5	1.6	1.5	1.6	1.5
Number hatched eggs	0	0	2	0	34	16	50
Hatching success	0	0	0.04	0	0.2	0.19	0.16

-	Mouse House	Mouse House Terrace	Visitor Centre	Jetty Triangle	South Logan's	Beacon	Overall A. tern
Fledged	0	0	0	0	0	6	6
Productivity	0	0	0	0	0	0.12	0.03

Nest count

The eider population count was conducted in conjunction with the gull count; each sitting female and empty nest was recorded. To account for any errors, 100 numbered canes were randomly placed next to eider nests one week prior to the count. All numbered canes were noted when counting the nests; from this a counting efficiency could be produced to convert the raw count to a corrected estimate of breeding female eiders. This year, the counting efficiency was 90%, which allows the raw count (1,065 nests) to be converted to a final estimate of breeding females as 1,183, an increase of 5%. This is the third highest population of eiders.

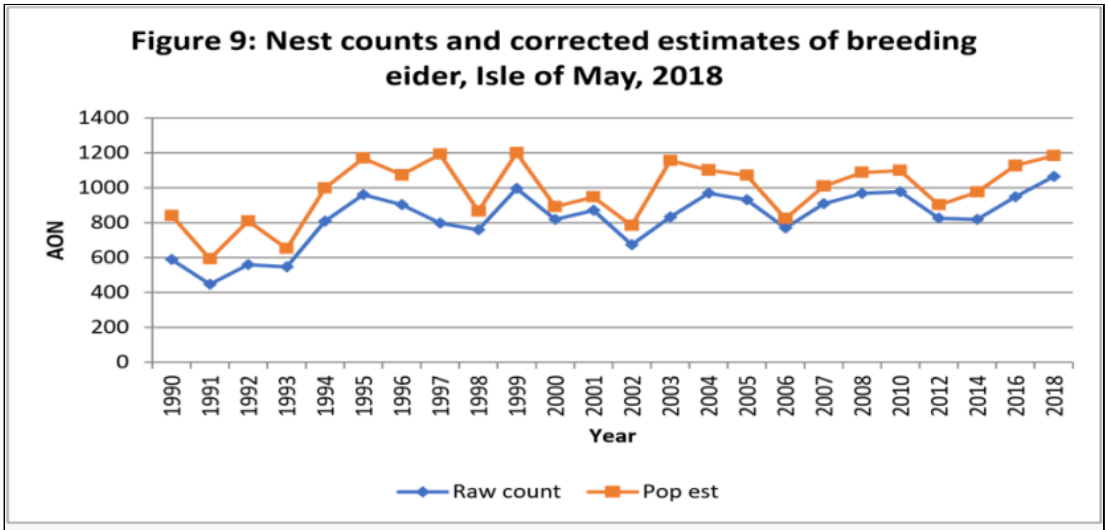

Figure 9: Nest counts and corrected estimates of breeding eider, Isle of May, 2018

The eider population count was conducted in conjunction with the gull count; each sitting female and empty nest was recorded. To account for any errors, 100 numbered canes were randomly placed next to eider nests one week prior to the count. All numbered canes were noted when counting the nests; from this a counting efficiency could be produced to convert the raw count to a corrected estimate of breeding female eiders. This year, the counting efficiency was 90%, which allows the raw count (1,065 nests) to be converted to a final estimate of breeding females as 1,183, an increase of 5%. This is the third highest population of eiders.

Eider management

No management specific to eiders was undertaken this year. Visitors were warned during their introductory talk that females would be nesting close to the path network and of the potential risk of coming across a female taking her ducklings to water, and advised to give them a wide berth. Some ducklings were found paralysed from nettle stings; these were kept in a box for an hour or so until they had recovered and then put with females and ducklings on the Loch, who took them into their crèche.

Other breeding birds

These are observations of numbers from around the island from NatureScot staff and volunteers, CEH and members of the Isle of May Bird Observatory.

Manx Shearwater (*Puffinus puffinus*)

Work by David and Margaret Thorne and Harry Urquhart, IOMBOT, identified nest activity on the island and identified one occupied burrow. After last year, when only the male was present for the whole season, he has now recruited a new female. Both have spent time in the burrow but no breeding attempts were made.

Shelduck (*Tadorna tadorna*)

Three pairs of shelduck nested on the island this season, on Rona, North Plateau and one at Ardcarran. One pair was seen with ducklings on the High Road and another (the Ardcarran pair) was seen with five ducklings swimming out of Kirkhaven on 5th June.

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Pairs	3 - 4	5	6	6	4 – 8	6	4	3-4	3-4	4	3-4	3

Mallard (*Anas platyrhynchos*)

No mallards bred this year; the last breeding pairs were seen in 2014.

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Pairs	2	0	0	0	0	0	2	3	0	0	0	0

Oystercatcher (*Haematopus ostralegus*)

This year, a total of 20 nests were identified. Although no monitoring of the nests was undertaken, several fledged chicks. One pair at the Beacon caused problems with tern predation, eating many eggs on the terraces. This could have been due to the dry weather making it hard for the adults to probe the ground.

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Pairs	19	19	17	17	14	16	9	20	19	24	13	20

Feral pigeon (*Columba livia* (domest.))

No specific counts were made of feral pigeons on the island. They nest on the island in burrows and rock crevices.

Swallow (*Hirundo rustica*)

Four pairs of swallow bred on the island in the following buildings: Bath House, Freezer Room, Wood Store and the Radar Room. The Bath House pair failed once again this year, with the others all successfully raising two broods.

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Pairs	0	0	0	0	0	2	3	3	6	4	4	4

Rock pipit (*Anthus petrosus*)

The numbers of rock pipit territories were up, with 23 pairs breeding on the island. Some fledglings were caught in the Heligoland traps and ringed.

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Pairs	8-9	9-10	12-14	15	13	23	18	24	24	20	15	23

Pied wagtail (*Motacilla alba*)

Pied wagtail territories were plotted on a map throughout the season and approximately ten pairs bred.

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Pairs	8	9	11	12	13	18	14	13	12	12	9	10

Carrion crow (*Corvus corone*)

One pair was noted for much of the spring, “Patch” and partner (Patch named after white patch on the chest, making this individual easily identifiable), the same individuals as the previous year. This pair built a nest at the top of the Main Light and to avoid predation of the seabirds, this nest was destroyed and the pair moved on briefly before returning and overwintering on the island.

Peregrine falcon (*Falco peregrinus*)

Every year a pair of peregrines is seen in early spring displaying but it has been eight years since they successfully raised young on the island (fledged three chicks in 2010). This year was no different, a pair was seen early in the season, but no breeding attempt was made.

Wood pigeon (*Columba palumbus*)

Two pairs have bred this season. Although elusive at times, they were seen with young on several occasions. Several nests were found at the Low Light bushes and water tank bushes and it appears that both pairs were successful in raising two broods.

Wader counts

Wader counts were undertaken weekly from the end of July onwards, once the breeding seabirds had departed from breeding sites. Below is a table of the peak counts per month.

Species	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Oystercatcher	-	12	27	-	-	-	28	35	61	-	-
Golden plover	-	-	-	1	-	-	4	2	17	-	-
Ringed plover	-	-	-	1	1	1	1	-	2	-	-
Whimbrel	-	-	2	2	1	2	5	2		-	-
Curlew	-	7	68	11	6	29	34	48	111	-	-
Turnstone	-	33	12	6	-	18	64	82	78	-	-

Species	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Knot	-	-	-	-	-		2	2		-	-
Dunlin	-	-	-	1	-	1	12	2	3	-	-
Purple sandpiper	-	2	19	21	-	45	87	58	33	-	-
Common sandpiper	-	2	-	1	1	3	2	1		-	-
Common redshank	-	5	30	-	-	3	15	22	32	-	-
Green sandpiper	-	-	-	-	-	1	2	-	-	-	-

Mammals

Grey seal

The number of adult seals started to increase throughout September and the first seal pup was born. However, there was an earlier stillborn pup, again on Rona.

Cetaceans

It proved to be a very productive season as the warm summer months produced ideal conditions for viewing as light winds and flat seas helped aid detection of cetaceans. It was also noticeable that good feeding, especially in September, was bringing more cetaceans into the Isle of May waters.

Harbour porpoise

A very good year possibly linked to the good weather and flat seas making recording easier. The early part of the season produced four on 12th March with a single off the north end on 20th April. Interestingly, three were seen 'logging' off the north end on 21st April, a behaviour not often recorded from the Isle of May. Gradually records increased, with singles on 9th, 21st and 23rd May and with 1-3 on 9th, 10th and 22nd June.

The summer months proved very productive, with 1-4 seen on twelve dates from 3rd-24th July, with a peak of seven recorded on 10th July. The month of August was quiet, with 1-3 on four dates, and peaking with four on 1st and 30th August. Although sightings in September were less frequent, the number of animals was more noticeable, with three on 4th, 7th and 29th September, with a peak of eight on 6th September, and with 1-2 noted on four dates. The good numbers continued into early October, with six off the south end together on 6th October and four on 24th October.

Minke whale

The first of the year involved a single noted surfacing three times off the north end on 7th June whilst another was seen off the east side of the island on 11th July. The most noticeable sighting of the year involved a single breaching at least five times off the east side on 26th July, close to the island in a strong north-west wind. This unusual behaviour is not noted very often from the island.

The month of August was quiet, with a single off the south end on 25th-26th August, but from early September a small number of animals became resident around the island. Between 5th September-8th October, at least 1-2 were seen feeding and deep diving off both the east and west side of the island on fourteen dates. This included one large adult and both animals put on an impressive feeding display off the south end for most of the afternoon of 6th October. These sightings were combined with some large seabird concentrations (especially gannets), which indicated good feeding in the area.

Bottle-nosed dolphins

The majority of bottle-nosed dolphin records involve animals seen hugging the Fife coast (often recorded from the visitor boats) and therefore just outside the Isle of May recording area. Records around the island are much scarcer and included three south on 29th March and eight off the east side on 16th April.

Mice

Lepidoptera

Butterfly

Records of butterflies were made by informal observations from members of Fluke Street and the IOMBOT residents throughout the season. Ten species were recorded throughout the year, with the first being sighted as residents moved on to the island on 26th March, single painted lady and small tortoiseshell. Small tortoiseshell was seen throughout the year, noted every month, whilst red admiral was the most numerous species. A single wall brown was recorded on 25th August and is the first record for the island. See Table 3 for full details of the records.

Moth

Moth trapping at Fluke Street was undertaken on most nights, when possible, by NatureScot staff, volunteers and CEH staff. The MV light trap was set up in the garden outside the principal keeper's cottage; the trap could be moved into the outdoor shelter during adverse weather and when puffins were leaving their burrows (to prevent them from being drawn towards the light). A second trap was available to those at the IOMBO, who had the trap running by the Low Light bushes. Trapping commenced on 5th April and continued throughout the season until 29th October.

Trapping was conducted on a total of 114 nights, with a total of 117 different macro species being recorded along with 36 micros; this is the most ever recorded in any one year. See Table 4.1 and 4.2 for the overall review of 2018 trapping data.

A total of six new species were recorded on the island this season: double-striped pug, fanfoot, juniper pug, pale November moth, streak and white-speck moth. A further seven species were recorded for the second time on the island: cloaked minor, common footman, shaded broad-bar, small dusty wave, straw dot, triple-spotted clay and turnip moth. A notable absence this season was cinnabar. Other highlights included a convolvulus hawkmoth found on the netting of the Bain trap on 19th August.

The most numerous moth caught was dark arches, with a total of 181 individuals being trapped on 19th July and on 51 different nights. However, silver Y is probably the most numerous species present on the island but they are more often seen flying during the day rather than being attracted by the light of the moth traps. These were recorded on 79 days throughout the season, with over 100 seen during the days in July and September.

VISITOR REVIEW

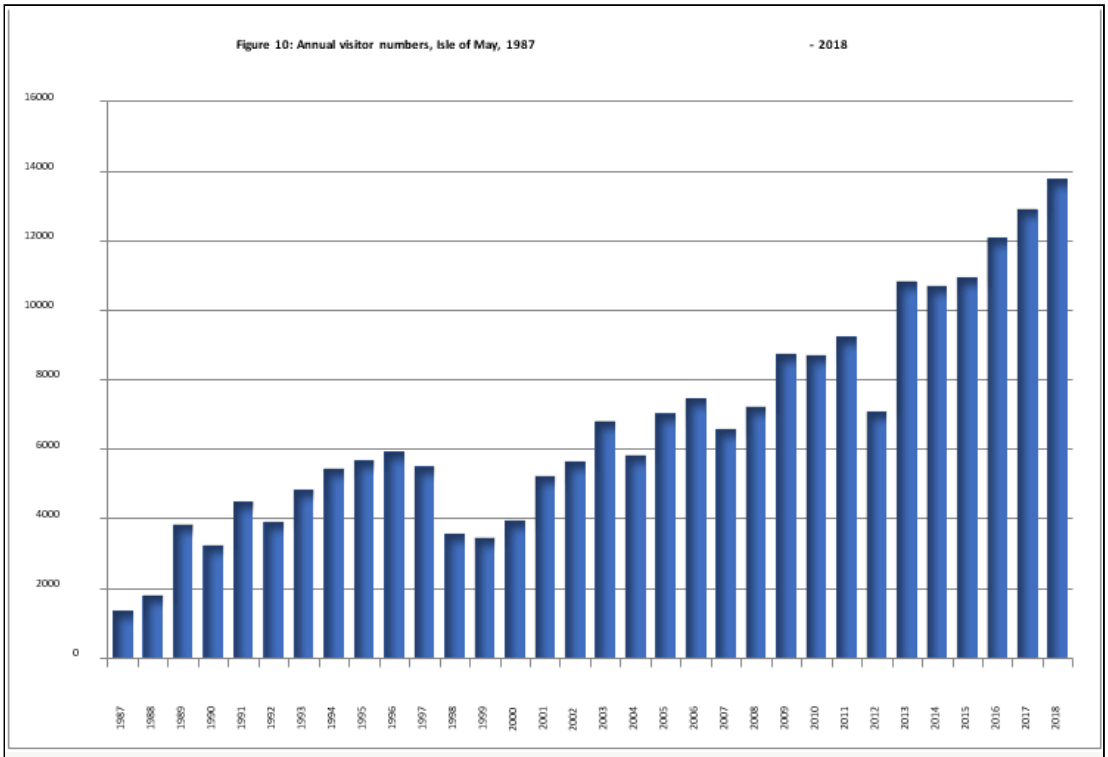

Figure 10: Annual visitor numbers, Isle of May, 1987-2018
The popularity of the Isle of May and the brilliant summer weather (one of the best on record) helped the island break its all-time visitor record for the fourth consecutive year. The island opened from 1 st April until 30th September. During that time, boats landed on 145 days (142 in 2017), with 21 official closed days (21 in 2017) and 17 days lost to bad weather (20 in 2017). As a result, a record number of visitors were welcomed to the island, with 13,754 people. This eclipsed the previous best year (the previous season), with 12,895, and was the fourth consecutive year the island has broken its visitor record.

Annual visitor numbers, Isle of May 2008-2017

2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008
13,754	12,895	12,064	10,929	10,676	10,809	7,070	9.220	8,728	7,208	6,566

Weather

Weather plays a key role in the Isle of May season and the superb summer resulted in plenty of calm seas and a good number of sailings. The period between May-August proved specifically productive, with the loss of only five days due to weather compared with eleven during the same months in 2017.

Number of days open/closed, Isle of May 2015-2018

-	Days sailed	Officially closed	Bad weather closure	Percentage bad weather closures May-August
2018	145	21	17	29%
2017	142	21	20	55%
2016	149	23	19	42%
2015	132	22	29	66%

Boats

As usual, boats departing from Anstruther brought the majority of visitors, with the *May Princess* bringing 11,112 (10,385 in 2017) whilst the fast RIB *Osprey* carried a further 1,373 (1,349 in 2017). During the season, boats travelled from the Lothian side of the Firth of Forth with the Seabird Centre RIB bringing 1,029 (798 in 2017). Overall, this resulted in all three boats breaking their own visitor records with the Seabird centre RIB being noteworthy. *Forthwild* brought a very modest 19 visitors (112 in 2017) from 1st August-30th September. Small private leisure craft and kayaks carried a further 221 (251 in 2017) visitors during the summer.

Visitor numbers on individual boats 2018

-	May Princess	Osprey RIB	Seabird RIB	Others	Total
April	920	140	94	10	1,164
May	2,245	276	214	22	2,757
June	2,243	260	250	44	2,797
July	2,852	341	299	75	3,567
August	2,281	277	154	53	2,765

-	May Princess	Osprey RIB	Seabird RIB	Others	Total
Sept	571	79	19	36	704
Total	11,112	1,373	1,029	240	13,754

VOLUNTEER REVIEW

During the season, both short and long-term volunteers made a valuable contribution to the day-to-day running of the Isle of May. Three long-term volunteers helped throughout the seabird breeding season, with Sally Reay helping from 18th April-22nd September, James Wilson from 23rd May-28th August and Daryl McLeod from 29th May-27th July. Their hard work and support ensured some excellent work was achieved on the island and overall, they contributed an impressive 282 working days.

In total, a further eight short-term volunteers helped at different times of the year, contributing a further 58 working days (346 days combined) to the island. These included (in order of the number of days contributed) Gus Routledge (16), Viv Hastie (12), Andy Denton (8), Ciaran Hatsell (8), Sacha Riley-Smith (5), Simon Ritchie (3), Beckie Lakin (3) and Sam Oakes (3).

Number of days worked for short and long term volunteers, 2018

-	March	April	May	June	July	Aug	Sept	Oct	Total
Sally Reay	-	13	20	25	24	26	22	6	136
James Wilson	-	-	9	26	30	26	-	-	91
Daryl McLeod	5	-	3	27	26	-	-	-	61
Gus Routledge	5	-	-	-	9	2	-	-	16
Viv Hastie	4	7	-	-	-	1	-	-	12
Andy Denton	6	2	-	-	-	-	-	-	8
Ciaran Hatsell	6	2	-	-	-	-	-	-	8
Sacha Riley-Smith	-	-	-	-	-	5	-	-	5
Simon Ritchie	3	-	-	-	-	-	-	-	3
Beckie Lakin	3	-	-	-	-	-	-	-	3
Sam Oakes	3	-	-	-	-	-	-	-	3

Setting Up

In late March, a team of eight spent over one week preparing the island for visitors, from Monday 26th March to Monday 2nd April. The team helped open the island, including preparations for visitors and getting various aspects of the island ready for the new season as well as constructing a new boardwalk along Holyman's Road. The total contribution was equal to 46 working days.

Events

The Isle of May provides a series of events during the summer months including Family Weekend (24th-25th July), Open Doors (1st-2nd September) and Seal Weekend (29th-30th September). There were also smaller events including an archaeological event with Peter Yeoman on 18th-19th August, and 'Meet the Artist' in the lighthouse on 25th-26th August. As well as events, we also had the biannual gull/eider counts, which were supported by staff. The preparation and support on these days is offered by several NatureScot staff including Caroline Gallacher, Sarah Eaton, Dave and Wendy Shepherd and a total of 43 working days are contributed by the various people (not included in the above totals)

Volunteering

Volunteering is valuable to the Isle of May and without the contributions of the volunteers the island could not function as it does. Overall, 26 different people helped contribute a total of 389 working days during the 2018 season (409 in 2017).

Table 1.1: Population estimates of cliff-nesting seabirds, 1980-2018

Year	Fulmar (AOS)	Shag (AON)	Kittiwake (AON)	Guillemot (Individual)	Guillemot (Estimated pairs)	Razorbill (Individual)	Razorbill (Estimated pairs)
1980	143	1,041	n/c	n/c	-	n/c	-
1981	n/c	1,163	n/c	16,300	-	2,086	-
1982	n/c	1,425	n/c	n/c	-	n/c	-
1983	101	1,567	6,115	22,550	-	2,220	-
1984	175	1,639	6,012	19,005	-	2,051	-
1985	156	1,524	5,510	18,390	-	1,825	-

Year	Fulmar (AOS)	Shag (AON)	Kittiwake (AON)	Guillemot (Individual)	Guillemot (Estimated pairs)	Razorbill (Individual)	Razorbill (Estimated pairs)
1986	150	1,310	4,801	19,151	-	1,864	-
1987	n/c	1,916	6,765	17,546	-	1,887	-
1988	n/c	1,290	7,638	16,791	-	2,128	-
1989	212	1,703	7,564	18,328	-	2,613	-
1990	198	1,386	8,129	16,778	12,632	2,368	1,508
1991	250	1,487	6,535	16,834	11,440	1,633	1,425
1992	266	1,634	6,916	17,512	11,511	2,581	1,909
1993	266	715	7,009	17,919	12,418	3,022	2,052
1994	279	403	3,751	19,186	13,843	3,034	2,227
1995	296	503	7,603	25,754	15,326	4,248	3,108
1996	308	512	6,269	24,468	14,500	3,405	2,989
1997	382	502	6,518	26,711	17,340	3,478	2,719
1998	365	621	4,306	26,963	17,384	3,859	3,126
1999	312	259	4,196	21,694	16,933	3,786	3,429
2000	367	541	4,618	27,045	17,979	3,958	3,105
2001	369	734	3,639	28,103	18,442	4,114	3,346
2002	338	676	3,666	24,369*	20,185*	3,050*	2,844*
2003	248	968	3,335	26,722*	19,519*	3,105*	2,233*
2004	236	687	3,876	22,970*	20,332*	3,313*	2,677*
2005	276	281	3,790	22,667*	18,858*	4,109*	4,713*
2006	298	485	3,167	21,444*	15,578*	3,811*	2,975*

Year	Fulmar (AOS)	Shag (AON)	Kittiwake (AON)	Guillemot (Individual)	Guillemot (Estimated pairs)	Razorbill (Individual)	Razorbill (Estimated pairs)
2007	281	399	3,424	16,770*	15,536*	3,635*	2,735*
2008	293	427	3,354	17,157*	15,036*	3,464*	2,591*
2009	358	465	2,316	16,888*	14,143*	3,008*	2,400*
2010	381	492	3,422	18,096	15,029	3,234	2,557
2011	306	540	2,685	15,691	14,955	3,012	2,705
2012	290	648	2,465	16,991	14,100	3,305	3,068
2013	218	322	1,712	14,764	13,349	3,155	2,879
2014	325	338	2,464	16,602	14,248	3,796	2,987
2015	309	401	3,433	21,598	15,945	4,590	3,202
2016	309	387	2,922	23,038	16,132	5,117	3,570
2017	341	474	3,507	20,531	16,468	5149	3,899
2018**	**283**	**404**	**2,516**	**18,705**	**14,902**	**4,867**	**3,738**

** including boat counts.

Table 1.2: Population estimates of ground nesting seabirds, 1980-2018

Year	Gulls LBB gull	Gulls Herring gull	Gulls GBB gull	Common tern	Arctic tern	Terns 'Commic' tern	Terns Sandwich tern	Terns Roseate tern	Eider
1982	550	2300	1	14	0	14	0	0	241
1983	1385	2578	0	29	0	29	0	0	545
1984	1488	2230	0	36	19	55	0	0	413
1985	1053	2165	1	80	87	167	0	0	520-550

Year	Gulls LBB gull	Gulls Herring gull	Gulls GBB gull	Common tern	Arctic tern	Terns 'Commic' tern	Terns Sandwich tern	Terns Roseate tern	Eider
1986	682	1943	3	22	128	150	0	0	557
1987	534	2117	3	76	126	202	0	0	735
1988	563	1711	3	50	200	250	0	0	600-700
1989	643	1629	3	NC	NC	312	0	0	680
1990	618	1551	3	190	285	475	1	0	841
1991	788	1447	4	195	435	628	0	0	592
1992	751	1462	8	94	491	585	0	0	810
1993	1259	2059	7	143	538	681	0	0	651
1994	1270	2122	6	144	544	688	0	0	998
1995	1635	2554	7	181	608	789	0	1	1169
1996	1641	2969	7	248	532	780	0	1	1075
1997	1540	2856	9	338	630	968	0	0	1191
1998	1533	2607	14	127	451	578	2	0	866
1999	1519	3115	19	415	737	1152	110	0	1200
2000	1442	3067	23	303	908	1211	176	0	892
2001	1203	2845	27	132	916	1048	305	0	947
2002	1198	2367	20	2	228	230	0	0	783
2003	1128	2451	23	60	577	637	58	0	1156
2004	1221	2428	23	62	666	728	151	0	1101
2005	1320	2094	33	65	609	674	0	0	1070
2006	1732	2851	25	99	515	614	0	0	823

Year	Gulls LBB gull	Gulls Herring gull	Gulls GBB gull	Common tern	Arctic tern	Terns 'Commic' tern	Terns Sandwich tern	Terns Roseate tern	Eider
2007	1665	2854	30	83	525	608	0	0	1009
2008	1944	2962	37	102	511	613	2	0	1088
2009	NC	NC	38	89	316	405	0	0	NC
2010	2348	3215	36	17	34	51	0	0	1099
2011	NC	NC	40	26	224	250	0	0	NC
2012	2352	3281	40	20	265	285	0	0	902
2013	NC	NC	36	-	-	419	0	0	NC
2014	2047	4200	51	13	402	415	0	0	975
2015	NC	NC	53	13	484	497	0	0	NC
2016	1924	3799	72	19	527	546	21	0	1128
2017	NC	NC	87	29	832	861	4	0	NC
2018	1,684	3,398	79	17	261	278	0	0	1183

Table 1.3: All-island count sections of cliff-nesting seabirds, 2018

Section	Fulmar AOSs	Shag AONs	Kittiwake AONs	Guillemot Ind	Guillemot Pairs	Razorbill Ind	Razorbill Pairs
A Rona (West)	11	35	100	615	517	165	99
B Altarstanes to Peregrine's Nest	33	28	296	1705	1207	802	502
C Greengates	33	4	488	2773	2451	679	597
D South Plateau	31	10	637	6155	4712	1291	922
E Cornerstone to Pilgrim's Haven	16	6	292	4375	3550	989	925

Section	Fulmar AOSs	Shag AONs	Kittiwake AONs	Guillemot Ind	Guillemot Pairs	Razorbill Ind	Razorbill Pairs
F Pilgrim's Haven to Lady's Cave	22	19	145	1096	903	218	164
G The Maidens	11	46	14	135	117	69	56
H South Ness to Lady's Bed	0	13	113	293	255	90	69
I South Ness to Colm's Hole	21	69	62	0	0	38	27
J Colm's Hole to Low Light	28	86	131	451	347	198	141
K Low Light to Tarbet	29	71	135	992	750	288	202
L Rona (North and East)	7	16	-	-	-	-	-
M Lochside (South)	31	-	-	-	-	-	-
N Lochside (North)	10	-	52	-	-	28	25
O West Cliffs from Boat	0	1	51	115	93	12	9
Total	**283**	**404**	**2516**	**18,705**	**14,809**	**4,867**	**3,738**

Table 1.4: Population change of cliff-nesting seabirds, 2017-2018

-	Fulmar (AOS)	Shag (AON)	Kittiwake (AON)	Guillemot Ind.	Guillemot Pairs	Razorbill Ind.	Razorbill Pairs
2018 total (AIC)*	283	403	2465	18590	14809	4855	3729
2017 total (AIC)	341	474	3507	20531	16468	5149	3899

-	Fulmar (AOS)	Shag (AON)	Kittiwake (AON)	Guillemot Ind.	Guillemot Pairs	Razorbill Ind.	Razorbill Pairs
Change 20172018	-58	-71	-1042	-1941	-1659	-294	-170
%age change 2017-2018	-17	-15	-30	-9	-10	-6	-4

*not including boat counts, so a comparison can be made with 2017.

Table 1.5: Population change of terns, 2017-2018

-	Common tern	Arctic tern	Sandwich tern
2018 total	17	260	0
2017 total	29	832	4
Change 20172018	-12	-572	-4
%age change 2017-2018	-41	-69	-100

Table 1.6: Breeding success of monitored seabirds, 2007-2018

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Puffin	0.29	-	-	0.74	0.72	0.57	0.7	0.68	0.75	0.76	0.87	0.67
Fulmar	0.21	0.2	0.44	0.34	0.36	0.13	0.47	0.56	0.52	0.39	0.40	0.49
Shag	1.07	1.9	2.02	2.04	1.54	1.18	1.20	1.58	1.91	2.1	1.67	1.52
Kittiwake	0.24	0.23	0.7	0.29	0.87	0.98	0.41	1.17	1.07	0.78	0.94	0.56
Guillemot	0.28	0.63	0.75	0.8	0.71	0.79	0.69	0.72	0.78	0.66	0.74	0.70
Razorbill	0.63	0.58	0.61	0.68	0.52	0.56	0.48	0.53	0.60	0.45	0.62	0.50
Arctic tern	-	-	-	-	-	-	-	-	0.59	0.65	0.11	0.03
GBB gull	1.75	-	1.57	-	-	1.6	1.38	1.34	1.18	0.71	1.73	1.48

Puffin, fulmar, shag, kittiwake, guillemot and razorbill data provided by CEH.

Table 1.7: Percentage return rates of colour-ringed seabirds, 2007-2018

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Puffin	56.9	59.4	84.7	90.9	87.9	89.7	85.4	83.4	89.8	72.3	89.3	95.2
Shag	60.8	70.6	89.6	91.5	93.0	93.0	43.0	77.7	87.9	88.9	93.9	68.0
Kittiwake	62.9	66.4	71.3	89.0	80.0	80.0	81.0	78.0	84.0	88.3	88.5	87.6
Guillemot	75.2	75.0	92.0	92.4	92.1	91.8	91.3	88.7	93.1	93.6	84.2	89.1
Razorbill	80.0	69.4	97.3	95.2	95.2	92.9	76.9	91.9	86.2	87.5	94.7	92.3

Data provided by CEH.

Table 1.8: Tern count sections, 2015-2018

*Sections counted together.

Table 2.1: Nest counts and contents of herring and lesser black-backed gulls, Isle of May, 2018

Section	0	1	2	3	4	Unknown	Total
Mars Rocks (1)	3	2	12	28	-	-	45
North Ness (2)	93	88	119	291	-	37	607
North Horn (3)	1	5	10	25	-	14	55
East Rona (4)	52	87	166	523	-	-	795
North Horn to Bridge (5)	4	1	11	25	-	102	143
Bridge to Altarstanes (6)	2	2	14	37	-	-	55
Altarstanes to Horsehole (7)	2	1	6	16	-	-	25
Horsehole (8)	-	-	-	-	-	12	12
North Plateau North (9)	27	76	118	320	-	-	541
North Plateau South (10)	-	-	1	4	-	-	5
Lighthouse (11)	-	-	-	-	-	-	0
North Lochside to Mill Door (12)	-	-	-	-	-	6	6

Section	0	1	2	3	4	Unknown	Total
South Mill Door (13)	-	-	-	-	-	-	0
North Lochside (14)	-	-	-	-	-	-	0
South Lochside (15)	-	-	-	-	-	-	0
St Andrew's Well (16)	-	1	2	1	-	-	4
Beacon (17)	-	-	-	-	-	-	0
West Braes (18)	-	-	-	-	-	-	0
East Braes (19)	-	-	-	-	-	-	0
Tarbet (20)	27	18	56	138	-	40	279
Tarbet to Low Light (21)	-	-	-	-	-	-	0
Low Light Rocks (22)	-	-	-	-	-	9	9
Burrian (23)	8	17	69	182	-	56	331
Colm's Hole (24)	2	2	10	37	-		51
Kettle to Colm's Hole (25)	61	71	130	415	-	69	746
Kirkhaven Rocks (26)	1	1	11	20	-	-	33
South Plateau (27)	13	21	39	144	-	-	217
South Plateau Cliffs (28)	-	-	-	-	-	1	1
Cornerstone to Pilgrim's Haven (29)	-	-	-	1	-	-	1
South Horn (30)	5	9	20	76	1	-	111
South Horn Cliffs (31)	-	-	2	2	-	-	4
Fields (32)	1	-	-	1	-	-	2
Ardcarron to Kirkhaven (33)	17	18	57	135	-	123	349
Ardcarron Rocks (34)	-	-	-	-	-	4	4
Lady's Bed (35)	19	17	52	158	-	58	302

Section	0	1	2	3	4	Unknown	Total
South Ness (36)	3	6	22	73	-	-	104
The Clett (37)	-	-	-	-	-	-	0
The Middens (38)	-	-	-	-	-	-	0
Pillow (39)	-	-	-	-	-	-	0
Maidens (40)	-	-	-	-	-	53	53
The Cleaver (41)	-	-	-	-	-	-	0
Lady's Bed Stacks (42)	-	-	-	-	-	1	1
Total	**341**	**443**	**927**	**2,652**	**1**	**585**	**4,891**

Table 2.2: Counting efficiency of gull nests, Isle of May, 2018

Section	Section total	Number missed	% accuracy
Mars Rocks (1)	45	3	93
North Ness (2)	607	32	95
North Horn (3)	55	8	85
East Rona (4)	795	24	97
North Horn to Bridge (5)	143	11	92
Bridge to Altarstanes (6)	55	1	98
Altarstanes to Horsehole (7)	25	1	96
Horsehole (8)	12	0	100
North Plateau North (9)	541	16	97
North Plateau South (10)	5	0	100
Lighthouse (11)	0	0	100
North Lochside to Mill Door (12)	6	0	100

Section	Section total	Number missed	% accuracy
South Mill Door (13)	0	0	100
North Lochside (14)	0	0	100
South Lochside (15)	0	0	100
St Andrew's Well (16)	4	0	100
Beacon (17)	0	0	100
West Braes (18)	0	0	100
East Braes (19)	0	0	100
Tarbet (20)	279	0	96
Tarbet to Low Light (21)	0	0	100
Low Light Rocks (22)	9	0	100
Burrian (23)	331	20	94
Colm's Hole (24)	51	1	98
Kettle to Colm's Hole (25)	746	26	97
Kirkhaven Rocks (26)	33	0	100
South Plateau (27)	217	12	94
South Plateau Cliffs (28)	1	0	100
Cornerstone to Pilgrim's Haven (29)	1	0	100
South Horn (30)	111	2	98
South Horn Cliffs (31)	4	0	100
Fields (32)	2	0	100
Ardcarron to Kirkhaven (33)	349	4	99
Ardcarron Rocks (34)	4	0	100
Lady's Bed (35)	302	10	97

Section	Section total	Number missed	% accuracy
South Ness (36)	104	0	100
The Clett (37)	0	0	100
The Middens (38)	0	0	100
Pillow (39)	0	0	100
Maidens (40)	53	0	100
The Cleaver (41)	0	0	100
Lady's Bed Stacks (42)	1	0	100
Total	**4891**	**171**	

Table 2.3: The corrected total number of nests using the % accuracy for each section and the average % accuracy where the counting efficiency was not made, Isle of May, 2018

Section	Section total	% accuracy	Corrected total
Mars Rocks (1)	45	93	48
North Ness (2)	607	95	641
North Horn (3)	55	85	64
East Rona (4)	795	97	820
North Horn to Bridge (5)	143	92	155
Bridge to Altarstanes (6)	55	98	56
Altarstanes to Horsehole (7)	25	96	26
Horsehole (8)	12	100	12
North Plateau North (9)	541	97	557
North Plateau South (10)	5	100	5
Lighthouse (11)	0	100	0

Section	Section total	% accuracy	Corrected total
North Lochside to Mill Door (12)	6	100	6
South Mill Door (13)	0	100	0
North Lochside (14)	0	100	0
South Lochside (15)	0	100	0
St Andrew's Well (16)	4	100	4
Beacon (17)	0	100	0
West Braes (18)	0	100	0
East Braes (19)	0	100	0
Tarbet (20)	279	96	291
Tarbet to Low Light (21)	0	100	0
Low Light Rocks (22)	9	100	9
Burrian (23)	331	94	352
Colm's Hole (24)	51	98	52
Kettle to Colm's Hole (25)	746	97	773
Kirkhaven Rocks (26)	33	100	33
South Plateau (27)	217	94	230
South Plateau Cliffs (28)	1	100	1
Cornerstone to Pilgrim's Haven (29)	1	100	1
South Horn (30)	111	98	113
South Horn Cliffs (31)	4	100	4
Fields (32)	2	100	2
Ardcarron to Kirkhaven (33)	349	99	353
Ardcarron Rocks (34)	4	100	4

Section	Section total	% accuracy	Corrected total
Lady's Bed (35)	302	97	312
South Ness (36)	104	100	104
The Clett (37)	0	100	0
The Middens (38)	0	100	0
Pillow (39)	0	100	0
Maidens (40)	53	100	53
The Cleaver (41)	0	100	0
Lady's Bed Stacks (42)	1	100	1
Total	**4,891**		**5,083**

Table 2.4: Head counts of individual herring gulls and lesser black-backed gulls (LBB), Isle of May, 2018

Section	Herring gull	LBB gull	Total	% Herring gull
Mars Rocks (1)	13	1	14	93
North Ness (2)	167	41	208	80
North Horn (3)	34	11	45	76
East Rona (4)	151	17	168	90
North Horn to Bridge (5)	6	125	131	5
Bridge to Altarstanes (6)	55	0	55	100
Altarstanes to Horsehole (7)	25	0	25	100
Horsehole (8)	12	0	12	100
North Plateau North (9)	100	114	214	47
North Plateau South (10)	2	3	5	40
Lighthouse (11)	0	0	0	0

Section	Herring gull	LBB gull	Total	% Herring gull
North Lochside to Mill Door (12)	6	0	6	100
South Mill Door (13)	0	0	0	0
North Lochside (14)	0	0	0	0
South Lochside (15)	0	0	0	0
St Andrew's Well (16)	0	4	4	0
Beacon (17)	0	0	0	0
West Braes (18)	0	0	0	0
East Braes (19)	0	0	0	0
Tarbet (20)	76	4	80	95
Tarbet to Low Light (21)	0	0	0	0
Low Light Rocks (22)	9	0	9	100
Burrian (23)	73	61	134	54
Colm's Hole (24)	21	0	21	100
Kettle to Colm's Hole (25)	110	106	216	51
Kirkhaven Rocks (26)	8	12	20	40
South Plateau (27)	67	25	92	73
South Plateau Cliffs (28)	1	0	1	100
Cornerstone to Pilgrim's Haven (29)	1	0	1	100
South Horn (30)	13	21	34	38
South Horn Cliffs (31)	0	0	0	0
Fields (32)	0	2	2	0
Ardcarron to Kirkhaven (33)	123	52	175	70
Ardcarron Rocks (34)	4	0	4	100

Section	Herring gull	LBB gull	Total	% Herring gull
Lady's Bed (35)	35	52	87	40
South Ness (36)	32	0	32	100
The Clett (37)	0	0	0	0
The Middens (38)	0	0	0	0
Pillow (39)	0	0	0	0
Maidens (40)	53	0	53	100
The Cleaver (41)	0	0	0	0
Lady's Bed Stacks (42)	1	0	1	100

Table 2.5: The corrected estimate number of herring gull and lesser black-backed gull (LBB), Isle of May, 2018

Section	Herring	LBB	Total
Mars Rocks (1)	45	3	48
North Ness (2)	514	126	641
North Horn (3)	49	16	64
East Rona (4)	737	83	820
North Horn to Bridge (5)	7	148	155
Bridge to Altarstanes (6)	56	0	56
Altarstanes to Horsehole (7)	26	0	26
Horsehole (8)	12	0	12
North Plateau North (9)	261	297	557
North Plateau South (10)	2	3	5
Lighthouse (11)	0	0	0

Section	Herring	LBB	Total
North Lochside to Mill Door (12)	6	0	6
South Mill Door (13)	0	0	0
North Lochside (14)	0	0	0
South Lochside (15)	0	0	0
St Andrew's Well (16)	0	4	4
Beacon (17)	0	0	0
West Braes (18)	0	0	0
East Braes (19)	0	0	0
Tarbet (20)	276	15	291
Tarbet to Low Light (21)	0	0	0
Low Light Rocks (22)	9	0	9
Burrian (23)	192	160	352
Colm's Hole (24)	52	0	52
Kettle to Colm's Hole (25)	394	379	773
Kirkhaven Rocks (26)	13	20	33
South Plateau (27)	167	62	230
South Plateau Cliffs (28)	1	0	1
Cornerstone to Pilgrim's Haven (29)	1	0	1
South Horn (30)	43	70	113
South Horn Cliffs (31)	0	4	4
Fields (32)	0	2	2
Ardcarron to Kirkhaven (33)	248	105	353
Ardcarron Rocks (34)	4	0	4

Section	Herring	LBB	Total
Lady's Bed (35)	126	187	312
South Ness (36)	104	0	104
The Clett (37)	0	0	0
The Middens (38)	0	0	0
Pillow (39)	0	0	0
Maidens (40)	53	0	53
The Cleaver (41)	0	0	0
Lady's Bed Stacks (42)	1	0	1
Total	**3,398**	**1,684**	**5,083**

Table 2.6: Counted and estimated numbers of eider nests, Isle of May, 2018

Section	Female	Hatched	Predated	Failed	Total	Corrected total
Mars Rocks (1)	-	-	-	-	0	0
North Ness (2)	43	19	1	-	63	70
North Horn (3)	12	3	1	-	16	18
East Rona (4)	48	12	1	-	61	68
North Horn to Bridge (5)	6	1	2	1	10	11
Bridge to Altarstanes (6)	2	1	-	-	3	3
Altarstanes to Horsehole (7)	6	-	-	-	6	7
Horsehole (8)	2	-	-	-	2	2
North Plateau North (9)	53	7	2	-	62	69
North Plateau South (10)	61	21	9	1	92	102
Lighthouse (11)	17	-	2	-	19	21

Section	Female	Hatched	Predated	Failed	Total	Corrected total
North Lochside to Mill Door (12)	-	-	-	-	0	0
South Mill Door (13)	1	-	-	-	1	1
North Lochside (14)	6	5	-	-	11	12
South Lochside (15)	2	1	-	-	3	3
St Andrew's Well (16)	26	1	4	-	31	34
Beacon (17)	46	5	3	-	54	60
West Braes (18)	62	7	5	1	75	83
East Braes (19)	31	2	1	-	34	38
Tarbet (20)	23	2	-	1	26	29
Tarbet to Low Light (21)	13	1	2	-	16	18
Low Light Rocks (22)	-	-	-	-	0	0
Burrian (23)	34	6	4	-	44	49
Colm's Hole (24)	6	1	-	-	7	8
Kettle to Colm's Hole (25)	57	9	9	-	75	83
Kirkhaven Rocks (26)	3	2	-	-	5	6
South Plateau (27)	66	23	4	-	93	103
South Plateau Cliffs (28)	-	-	-	-	0	0
Cornerstone to Pilgrim's Haven (29)	53	12	7	-	72	80
South Horn (30)	10	2	-	-	12	13
South Horn Cliffs (31)	2	-	-	-	2	2
Fields (32)	39	7	2	-	48	53
Ardcarron to Kirkhaven (33)	37	7	1	-	45	50

Section	Female	Hatched	Predated	Failed	Total	Corrected total
Ardcarron Rocks (34)	-	-	-	-	0	0
Lady's Bed (35)	10	1	-	-	11	12
South Ness (36)	2	1	-	-	3	3
The Clett (37)	43	19	1	-	63	70
The Middens (38)	-	-	-	-	0	0
Pillow (39)	-	-	-	-	0	0
Maidens (40)	-	-	-	-	0	0
The Cleaver (41)	-	-	-	-	0	0
Lady's Bed Stacks (42)	-	-	-	-	0	0
Total	**822**	**178**	**61**	**4**	**1,065**	**1,183**

Table 3: Butterfly sightings: first and last dates, the number of days and peak counts per

Species	First date	Last date	March Days	March Max	April Days	April Max	May Days	May Max	June Days	June Max	July Days	July Max	Augus Days
Large white	19/5	30/9	-	-	-	-	4	2	2	2	6	31	14
Small white	10/5	28/9	-	-	-	-	1	1	1	1	12	30	14
Green-veined white	8/5	4/9	-	-	-	-	1	1	-	-	5	20	3
White spp.	18/7	29/8	-	-	-	-	-	-	-	-	3	13	5
Peacock	5/4	15/9	-	-	8	2	5	2	-	-	1	6	18
Red admiral	25/5	-	-	-	-	-	4	2	15	5	24	25	23
Painted lady	26/3	10/10	1	1	-	-	1	1	9	6	7	7	14

Species	First date	Last date	March Days	March Max	April Days	April Max	May Days	May Max	June Days	June Max	July Days	July Max	Augus Days
Small tortoiseshell	26/3	10/10	1	1	14	6	20	3	5	5	19	47	10
Ringlet	29/5	-	-	-	-	1	1	-	-	-	-	-	-
Comma	18/7	10/10	-	-	-	-	-	-	-	-	1	1	-
Wall brown	25/8	-	-	-	-	-	-	-	-	-	-	-	1

Table 4.1: Macro-moth sightings: first and last dates, the number of days and peak count 2018

Species	First	Last	April Days	April Max.	May Days	May Max.	June Days	June Max.	July Days	July Max.	August Days	August Max.	S D
Angle shades	4/6	-	-	-	-	-	2	2	3	1	8	2	7
Antler moth	7/7	5/9	-	-	-	-	-	-	13	28	20	44	5
Barred straw	5/7	19/7	-	-	-	-	-	-	6	2	-	-	-
Beautiful golden Y	23/6	21/7	-	-	-	-	3	1	10	3	-	-	-
Black rustic	31/8	18/9	-	-	-	-	-	-	-	-	1	1	5
Brick	14/10	21/10	-	-	-	-	-	-	-	-	-	-	-
Bright-line brown-eye	14/5	18/9	-	-	5	6	16	10	13	13	3	2	9
Brimstone moth	22/7	5/8	-	-	-	-	-	-	1	2	1	1	-
Brown-line bright-eye	19/8	-	-	-	-	-	-	-	-	-	1	1	-

Species	First	Last	April Days	April Max.	May Days	May Max.	June Days	June Max.	July Days	July Max.	August Days	August Max.	S D
Brown-spot pinion	22/8	1/9	-	-	-	-	-	-	-	-	2	1	1
Burnished brass	30/6	14/8	-	-	-	-	1	1	13	10	3	8	-
Cabbage moth	20/8	28/8	-	-	-	-	-	-	-	-	2	1	-
Campion	18/5	19/8	-	-	3	1	10	6	4	1	6	4	-
Canary-shouldered thorn	14/8	-	-	-	-	-	-	-	-	-	1	1	-
Chamomile shark	5/4	19/5	3	1	2	2	-	-	-	-	-	-	-
Cloaked minor	22/7	-	-	-	-	-	-	-	1	1	-	-	-
Clouded drab	23/4	15/5	1	1	1	1	-	-			-	-	-
Clouded-bordered brindle	18/7	-	-	-	-	-	-	-	1	1	-	-	-
Common carpet	4/6	3/9	-	-	-	-	1	1	1	1	3	2	1
Common footman	6/7	16/7	-	-	-	-	-	-	3	1	-	-	-
Common marbled carpet	9/8	31/8	-	-	-	-	-	-	-	-	3	1	-
Common pug	9/5	24/6	-	-	1	1	3	2	-	-	-	-	-

Species	First	Last	April Days	April Max.	May Days	May Max.	June Days	June Max.	July Days	July Max.	August Days	August Max.	S D
Common Quaker	15/4	6/5	2	2	1	1	-	-	-	-	-	-	-
Common rustic	8/6	1/9	-	-	-	-	1	1	7	15	15	29	1
Common swift	1/6	6/7	-	-	-	-	10	37	2	3	-	-	-
Common wainscot	18/7	-	-	-	-	-	-	-	1	1	-	-	-
Convolvulus hawkmoth	19/8	-	-	-	-	-	-	-	-	-	1	1	-
Currant pug	6/7	25/7	-	-	-	-	-	-	3	1	-	-	-
Dark arches	21/6	6/9	-	-	-	-	7	4	18	181	21	32	5

Species	First	Last	April Days	April Max.	May Days	May Max.	June Days	May Max.	July Days	July Max.	August Days	August Max.	Se Da
Dark spinach	7/7	15/8	-	-	-	-	-	-	10	11	4	4	-
Dark sword-grass	19/8	18/9	-	-	-	-	-	-	-	-	1	1	1
Dart spp.	14/8	31/8	-	-	-	-	-	-	-	-	4	2	-
Dot moth	22/7	-	-	-	-	-	-	-	1	1			-
Dotted clay	3/8	-	-	-	-	-	-	-			1	1	-
Double square-spot	5/7	25/7	-	-	-	-	-	-	6	5	-	-	-
Double-striped pug	19/7	-	-	-	-	-	-	-	1	2	-	-	-

Species	First	Last	April Days	April Max.	May Days	May Max.	June Days	May Max.	July Days	July Max.	August Days	August Max.	Se Da
Ear spp.	2/9	-	-	-	-	-	-	-	-	-	-	-	1
Fanfoot	18/7	-	-	-	-	-	-	-	1	1	-	-	
Flame carpet	22/7	3/9	-	-	-	-	-	-	1	1	-	-	2
Flame shoulder	2/6	23/8	-	-	-	-	6	1	3	3	2	1	-
Flounced rustic	4/8	5/9	-	-	-	-	-	-	-	-	14	3	2
Foxglove pug	22/6	2/8	-	-	-	-	1	1	2	1	1	1	-
Frosted orange	28/8	1/9	-	-	-	-	-	-	-	-	2	1	1
Garden carpet	18/5	8/9	-	-	1	1	1	1	4	1	6	4	3
Garden dart	19/7	4/9	-	-	-	-			4	12	13	9	3
Garden tiger	30/6	31/7	-	-	-	-	1	2	18	33			-
Ghost moth	1/6	7/7	-	-	-	-	10	11	3	3			-
Green carpet	19/7	-	-	-	-	-			1	1			-
Grey chi	10/8	30/8	-	-	-	-					3	1	-
Heart and dart	8/6	22/7	-	-	-	-	2	2	1	1	-	-	-
Hebrew character	14/4	1/7	7	5	15	24	7	6	1	1	-	-	-
Hummingbird hawkmoth	4/10	-	-	-	-	-	-	-	-	-	-	-	-
Ingrailed clay	19/8	-	-	-	-	-	-	-			1	1	-
July highflyer	22/7	5/9	-	-	-	-	-	-	1	1	6	3	1

Species	First	Last	April Days	April Max.	May Days	May Max.	June Days	May Max.	July Days	July Max.	August Days	August Max.	Se Da
Juniper pug	18/7	2/9	-	-	-	-	-	-	1	1	2	1	2
Large yellow underwing	29/6		-	-	-	-	1	1	9	4	23	32	8
Lesser broad-bordered yellow underwing	4/8	19/8	-	-	-	-	-	-	-	-	11	9	-
Lesser treble-bar	5/8	-	-	-	-	-	-	-	-	-	1	1	-
Lesser yellow underwing	31/7	-	-	-	-	-	-	-	1	1	17	30	10

Species	First	Last	April Days	April Max.	May Days	May Max.	June Days	May Max.	July Days	July Max.	August Days	August Max.	Sept Days
Light arches	18/7	25/7	-	-	-	-	-	-	3	1	-	-	-
Lime-speck pug	8/6	8/9	-	-	-	-	5	2	5	2	11	4	4
Lunar underwing	30/8		-	-	-	-	-	-	-	-	2	1	13
Lunar yellow underwing	6/8	20/8	-	-	-	-	-	-	-	-	3	3	-
Lychnis	1/6	4/6	-	-	-	-	2	2	-	-	-	-	-
Magpie	4/7	-	-	-	-	-	-	-	1	1	-	-	-
Map-winged swift	6/7	-	-	-	-	-	-	-	1	1	-	-	-

Species	First	Last	April Days	April Max.	May Days	May Max.	June Days	May Max.	July Days	July Max.	August Days	August Max.	Sept Days
Marbled beauty	19/7	22/7	-	-	-	-	-	-	2	2	-	-	-
Marbled coronet	6/5	19/7	-	-	12	49	16	20	11	23	-	-	-
Marbled minor	7/7	-	-	-	-	-	-	-	1	1	-	-	-
Middle-barred minor	7/7	-	-	-	-	-	-	-	1	1	-	-	-
Mottled rustic	2/6	25/7	-	-	-	-	11	10	5	3	-	-	-
Mouse moth	5/8	18/9	-	-	-	-	-	-	-	-	10	2	5
Netted pug	1/6	6/7	-	-	-	-	7	2	1	1	-	-	-
Nutmeg	24/6	-	-	-	-	-	1	1	-	-	-	-	-
Pale November moth	21/10		-	-	-	-	-	-	-	-	-	-	-
Pine carpet	8/9	-	-	-	-	-	-	-	-	-	-	-	1
Plain golden Y	7/7	-	-	-	-	-	-	-	1	1	-	-	-
Red-green carpet	2/9	-	-	-	-	-	-	-	-	-	-	-	1
Riband wave	17/7	6/8	-	-	-	-	-	-	4	3	2	2	-
Rosy rustic	25/7	9/9	-	-	-	-	-	-	4	2	17	12	7

Species	First	Last	April Days	April Max.	May Days	May Max.	June Days	May Max.	July Days	July Max.	August Days	August Max.	Sept Days
Rustic	6/7	26/7	-	-	-	-	-	-	9	4	-	-	-
Sallow	6/8	1/9	-	-	-	-	-	-	-	-	1	1	1
Satellite	14/10	-	-	-	-	-	-	-	-	-	-	-	-
Scalloped oak	22/7	-	-	-	-	-	-	-	1	1	-	-	-
Setaceous Hebrew character	10/8	18/9	-	-	-	-	-	-	-	-	11	6	9
Shaded broad-bar	12/9	-	-	-	-	-	-	-	-	-	-	-	1
Shuttle-shaped dart	6/5	11/8	-	-	1	1	-	-	-	-	2	2	-
Silver Y	13/5	-	-	-	9	15	18	50	9	100	22	8	12
Silver-ground carpet	4/6	7/8	-	-	-	-	2	1	1	1	1	2	-
Six-striped rustic	6/8	-	-	-	-	-	-	-	-	-	1	1	-
Slender pug	2/8	6/8	-	-	-	-	-	-	-	-	2	3	-

Species	First	Last	April Days	April Max.	May Days	May Max.	June Days	May Max.	July Days	July Max.	August Days	August Max.	Sep Day
Small dusty wave	18/9	-	-	-	-	-	-	-	-	-	-	-	1

Species	First	Last	April Days	April Max.	May Days	May Max.	June Days	May Max.	July Days	July Max.	August Days	August Max.	Sep Day
Small phoenix	5/5	-	-	-	1	1	-	-	-	-	-	-	-
Small rivulet	19/7	-	-	-	-	-	-	-	1	1	-	-	-
Small square-spot	2/6	5/9	-	-	-	-	7	3	10	10	15	6	5
Small wainscot	7/7	3/9	-	-	-	-	-	-	3	3	1	1	2
Smoky wainscot	30/6	2/8	-	-	-	-	1	1	12	16	1	1	-
Snout	26/6	18/9	-	-	-	-	2	1	6	3	2	1	1
Spectacle	18/5	22/7	-	-	5	2	12	8	8	7	-	-	-
Spinach	6/7	-	-	-	-	-	-	-	1	1	-	-	-
Square-spot dart	6/8	15/8	-	-	-	-	-	-			3	1	-
Square-spot rustic	6/7	6/9	-	-	-	-	-	-	1	1	5	2	3
Straw dot	7/7	-	-	-	-	-	-	-	1	2	-	-	-
Streak	8/9	14/10	-	-	-	-	-	-	-	-	-	-	1
Svensson's copper underwing	19/8	28/8	-	-	-	-	-	-	-	-	3	1	-
Treble-bar	5/8	28/8	-	-	-	-	-	-	-	-	2	1	-
Triple-spotted clay	30/8	-	-	-	-	-	-	-	-	-	1	1	-

Species	First	Last	April Days	April Max.	May Days	May Max.	June Days	May Max.	July Days	July Max.	August Days	August Max.	Sep Day
Turnip moth	31/8	16/10	-	-	-	-	-	-	-	-	1	1	-
Twin-spot carpet	18/7	11/8	-	-	-	-	-	-	3	1	2	3	-
Water carpet	4/5	-	-	-	1	1	-	-	-	-	-	-	-
White ermine	2/6	30/6	-	-	-	-	5	1	-	-	-	-	-
White-speck	8/9	-	-	-	-	-	-	-	-	-	-	-	1
Willow beauty	26/7	14/8	-	-	-	-	-	-	1	1	6	15	-
Wormwood pug	5/7	26/7	-	-	-	-	-	-	7	2	-	-	-
Yellow-line Quaker	2/10	-	-	-	-	-	-	-	-	-	-	-	-
Yellow shell	22/7	25/8	-	-	-	-	-	-	1	1	1	1	-

Table 4.2: Micro moths: first and last dates, number of days and peak count per month, Is

Species	First	Last	April Days	April Max.	May Days	May Max.	June Days	May Max.	July Days	July Max.	August Days	August Max.	S I
Acleris aspersana	3/8	1/9	-	-	-	-	-	-	-	-	1	1	1

Species	First	Last	April Days	April Max.	May Days	May Max.	June Days	May Max.	July Days	July Max.	August Days	August Max.	S
Acleris variegana – Garden rose tortrix	1/9	-	-	-	-	-	-	-	-	-	-	-	1
Aethes cnicana	18/7	-	-	-	-	-	-	-	1	1	-	-	-
Aethes rubigana	26/7	-	-	-	-	-	-	-	1	1	-	-	-
Agapeta hamana	18/7	5/8	-	-	-	-	-	-	4	2	2	5	-
Agonopterix Spp.	21/4	6/8	1	1	-	-	-	-			2	1	-
Agriphila straminella	1/7	-	-	-	-	-	-	-	1	1			-
Agriphila tristella	17/7		-	-	-	-	-	-	4	2	5	4	-
Amblyptilia acanthadactyla - Beautiful plume	18/7	-	-	-	-	-	-	-	1	1	-	-	-
Anania hortulata – Small magpie	18/5	22/7	-	-	2	2	16	9	10	5	-	-	-
Aphelia paleana – Timothy tortrix	19/7	-	-	-	-	-	-	-	1	1	-	-	-
Aphomia sociella – Bee moth	18/7	22/7	-	-	-	-	-	-	2	1	-	-	-
Catoptria margaritella	17/7	-	-	-	-	-	-	-	1	1	-	-	-

Species	First	Last	April Days	April Max.	May Days	May Max.	June Days	May Max.	July Days	July Max.	August Days	August Max.	S
Celypha lacunana	18/7	-	-	-	-	-	-	-	1	2	-	-	-
Cochylis atricapitana	19/5	1/9	-	-	2	2	3	1	2	2	10	5	1
Crambus perlella	17/7	-	-	-	-	-	-	-	1	5			-
Despressaria radiella - Parsnip moth	6/8	31/8	-	-	-	-	-	-	-	-	7	3	-
Elophila nymphaeata - Brown china-mark	5/8	-	-	-	-	-	-	-	-	-	1	1	-
Endothenia quadrimaculana	18/7	-	-	-	-	-	-	-	1	1	-	-	-
Endrosis sarcitrella - White-shouldered housemoth	4/9	-	-	-	-	-	-	-	-	-	-	-	1

Species	First	Last	April Days	April Max.	May Days	May Max.	June Days	May Max.	July Days	July Max.	August Days	August Max.	S
Epiphyas postvittana - Light brown apple moth	16/9	-	-	-	-	-	-	-	-	-	-	-	1

Species	First	Last	April Days	April Max.	May Days	May Max.	June Days	May Max.	July Days	July Max.	August Days	August Max.	S D
Eucosma campoliliana	18/7	-	-	-	-	-	-	-	1	1			-
Eudonia pallida	18/7	15/8	-	-	-	-	-	-	2	1	1	1	-
Eudonia Spp.	19/7	31/8	-	-	-	-	-	-	2	2	5	5	-
Evergestis forficalis - Garden pebble	5/8	-	-	-	-	-	-	-	-	-	1	1	-
Hofmannophila pseudospretella – Brown house-moth	17/7	1/9	-	-	-	-	-	-	4	4	-	-	1
Hypsopygia glaucinalis	22/7	5/8	-	-	-	-	-	-	1	1	1	1	-
Metzneria lappella	1/7	-	-	-	-	-	-	-	1	1	-	-	-
Pleuroptya ruralis – Mother of pearl	5/8	31/8	-	-	-	-	-	-	-	-	2	2	-
Plutella xylostella - Diamond-back moth	1/6	5/8	-	-	-	-	1	1	3	2	1	4	-
Udea lutealis	5/8	-	-	-	-	-	-	-	-	-	1	2	-
Udea prunalis	19/7	25/7	-	-	-	-	-	-	2	1	-	-	-
Yponomeuta evonymella - Bird-cherry ermine	18/7	19/7	-	-	-	-	-	-	2	2	-	-	-

Table 4.3: The number of days moth trapping occurred per month on the Isle of May, 2018

Month	Number of trapping days
April	13
May	16
June	17
July	18
August	24
September	16
October	10
Total	**114**

APPENDIX 1

Isle of May research reports for 2018 season

Foraging behaviour of shags

Y Yonehara[1], K Sato[1],M Newell[2], S Burthe[2] & F Daunt[2]

[1]Department of Marine Biological Sciences, Graduate School of Fisheries Sciences, Hokkaido University, Minato-cho, Hakodate, 041-8611 Japan. [2]CEH Edinburgh, Bush Estate, Penicuik, Midlothian, EH26 0QB.

The fine scale foraging behaviour of shags is poorly understood, especially in terms of effort to reach feeding sites. By attaching accelerometers to adult shags we are able to calculate energy expenditure and how this varies with wind speeds and direction. This project aims to obtain fine scale data on the interaction between shags and the environment. Two types of loggers will be used, providing a wealth of novel behavioural data.

We achieved 32 successful deployments of GPS loggers simultaneously with accelerometers. Flight recorders were deployed on 8 shags. The detailed analyses of these data will take place over the winter. The aim of the work is to fine tune our method of estimating the amount of food captured from wing beat frequency by accounting for the effect of wind, which also affects wing beat frequent Long term studies of breeding seabirds on the Isle of May M Newell, M Harris, S Burthe, C Gunn, S Wanless & F Daunt CEH Edinburgh, Bush Estate, Penicuik, Midlothian, EH26 0Q

After a fairly cold but benign winter, early spring blasted in with strong onshore winds when the 'Beast from the East' hit in early March, to be followed over the next month by its subsequent diminishing relatives. This resulted in over 2,500 dead seabirds washing up along the Scottish east coast, although most were immature birds. The result of a month of rough sea conditions was a late breeding season for most species and a drop in the numbers making a breeding attempt.

The 2018 season proved a mixed year amongst the main study species. With CEH present on the island continually for three and a half months, the cliff-nesting seabirds are monitored on a daily basis, identifying just when any failures occur and establishing the effects of any extreme weather. The Isle of May was hit by a westerly gale in early June but it had minimal effect on the breeding success of any of the study species; otherwise, it was an extraordinarily calm season.

With the exception of European shag, the average or above-average return rate for the other study species indicated that the seabird mortality during March and April largely affected immature birds rather than the breeding population which were either still offshore or able to seek foraging in less turbid sea areas. However, it clearly affected condition as all species except fulmar commenced laying much later than average and significant numbers of individuals did not attempt to breed even though they returned to the colony. The numbers of pairs nesting in the plots showed a decrease from 2017 for all species and this was reflected in a decrease in the all-island counts carried out by NatureScot.

Breeding success

- Common guillemot breeding success at 0.70 chicks per pair laying was average.
- Razorbill breeding success at 0.50 chicks per pair laying was one of the poorest on record.
- Atlantic puffin breeding success at 0.67 chicks per pair laying was the lowest for 6 years
- Black-legged kittiwake breeding success at 0.56 chicks per completed nest was slightly below average.
- European shag breeding success at 1.52 chicks per incubating nest was well above the long-term average (1.15) for the 11th consecutive year.
- Northern fulmar breeding success at 0.49 chicks per incubating nest was above average.

Return rates

- Common guillemot return rate at 89.1% was average.
- Razorbill return rate at 92.3% was above average.
- Atlantic puffin return rate at 95.2% was the highest on record.
- Black-legged kittiwake return rate at 87.6% was above average with only five higher years.
- European shag return rate at 68.0% was below average and the lowest since 2012.

Sandeels (*Ammodytes sp.*) remained the main food of young puffins, shags and kittiwakes. The diet of razorbills and guillemots was dominated by clupeids.

We are grateful to Caroline Gallacher, David Steel and Bex Outram of Scottish Natural Heritage for logistical and occasional fieldwork support on the Isle of May. Jude Barbour, Maria Bogdanova, Lila Buckingham, Alice Carravieri, Ruth Dunn, Jon Green, Olivia Hicks, Rich Howells, John Harrison, Sam Langlois-Lopez,

Heather Lowther, Daryl McLeod, Polly Philpott, Sally Reay, Sheila and Debbie Russell, James Wilson and

Yoshinari Yonehara all helped with fieldwork. We are grateful to Alex Gardner and the crew of the May

Princess and Roy Giles with RIB Osprey for providing transport to and from the Isle of May throughout the season.

Over-wintering foraging ecology of seabirds

M. Newell, M Harris, S Burthe, S Wanless & F Daunt

CEH Edinburgh, Bush Estate, Penicuik, Midlothian, EH26 0QB

This project aims to obtain fine scale data on movements and foraging behaviour of seabirds in winter, by attaching specially designed loggers to European shags, Atlantic puffins, black-legged kittiwakes, razorbills and common guillemots. The loggers record daily location and foraging effort. Detailed data on location-specific foraging effort of seabirds will enable patterns of distribution and behaviour in relation to season and breeding status to be analysed.

The work on shags is a continuation of work commenced in 2002. A total of 24 geolocator loggers were retrieved from shags with a further 23 deployed which we plan to retrieve in 2019.

In 2018, 14 retrievals of geolocator loggers were made from guillemots with a further 30 deployments. In 2018, 12 geolocator loggers were retrieved from razorbills with a further 30 deployments. In 2018, 27 loggers were deployed on puffins with 22 retrieved from previous deployments. Of these, one was retrieved from a dead puffin which had been predated by great black-backed gulls in an area of over one hundred predated puffins. These deployments will be targeted for retrieval in 2019.

A total of 14 loggers were retrieved from kittiwakes in 2018 which had been deployed in previous years. A further 23 new deployments were made.

Quantifying the Impact of Parasites on Seabirds

Sarah Burthe[1], Mark Newell[1], Carrie Gunn[1], Emma Cunningham[2], Francis Daunt[1], Jon Green[3], Mike Harris[1] & Sarah Wanless[1]

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The role parasites play in driving seabird population dynamics has been largely ignored, despite the fact that seabirds are hosts to a wide variety of endo- and ectoparasites that reach high densities in most colonies and can act as disease vectors. The ultimate aim of this project is to evaluate how parasites impact their seabird hosts, particularly focussing on the European shag (*Phalacrocorax aristotelis*).

Nematode infections in shags

This research builds on previous work from 2010-2017 which significantly advanced our understanding of the role parasites play in this host. Endoscopy was developed as a novel and extremely useful way of measuring natural parasite loads in shags and also evaluating drug efficacy. We found that there was significant variation in parasite loads between individual birds and, importantly, that parasites are having significant impacts on shags. We have found that shag chicks experimentally treated with ivermectin show different responses to treatment in terms of behaviour and growth depending on their position in the brood hierarchy (shags hatch asynchronously), with the youngest chick in a brood responding the most to altered parasite load (now published in Ecology and Evolution: Granroth-Wilding, H.M.V., Burthe, S.J., Lewis, S., Reed, T.E., Herborn, K.A., Newell, M.A., Takahashi, E.A., Daunt, F. & Cunningham, E.J.A. (2014) Parasitism in early life: environmental conditions shape within-brood variation in responses to infection. *Ecology and Evolution, doi: 10.1002/ece3.1192*). There are also interesting effects of parasites on adults - parents of shag chicks treated to remove parasites were found to spend less time foraging during the winter (a period when shag mortality is high) and to subsequently come back and breed earlier on the colony (journal manuscript currently in the final stages of writing).

One of the aims now is to establish, by monitoring over a number of years of variable environmental conditions, whether parasites tend to be more prevalent in some years (which may be indicative of environmental differences between years, e.g. diet, etc.). We also want to know whether individual shags' worm burdens vary between years or whether individuals can be consistently classed as having low or high burdens, and to establish whether individuals with higher burdens have reduced breeding success or increased probability of mortality. In order to do this, we are planning to measure parasite burdens in a number of individual shags each year, particularly targeting birds that have previously been assessed. We have now successfully built up 8 years of data from 2011-2018, where we have measured burdens across naturally parasitized shags and obtained repeated measures from individuals. We sampled a total of 44 adults successfully in 2018.

Bacterial gut communities and parasites

In conjunction with this long-term work on parasite loads and implications for the host, we aimed to build on this work and to try and investigate how parasite burdens may be linked to gut microbiomes (bacterial communities within the gut). Recent literature suggests that the microbiome of individuals can be linked to differences in diet, and also potentially to variation in parasite loads. Since 2013 we have successfully measured parasite loads and obtained swab samples of gut bacteria from the endoscope and from faecal samples to investigate this, with 44 adult shags sampled in 2018. Samples will processed and sequenced by colleagues at CEH Wallingford.

In conclusion, 2018 was a highly successful field season, in which we achieved all of our aims. Sampling of adults to investigate microbiomes went smoothly and it is hoped that this will lead to interesting results and build on results obtained in previous years. We built on our successful development of endoscopy as a method for quantifying endoparasites in live, wild seabirds and obtained vital data for exploring variation in natural parasite burdens. This will prove crucially important for achieving our ultimate aim of quantifying the impact of parasites on seabird hosts and we hope to develop this work further in 2019.

Effects of contaminants on seabirds – an energetics approach A. Carravieri, S. Burthe, F. Daunt, J. Green

Increasing quantities of contaminants are found in marine food webs, exposing seabirds to high doses of them through food ingestion. Contaminants have direct and indirect negative effects in vertebrates, but the energetic consequences of exposure are largely unknown, in particular in combination with other stressors such as disease. Our aim is to quantify the effects of natural (mercury, Hg) and man-made (perfluorinated compounds, PFCs) contaminants on the energy expenditure and reproductive output of the European shag, which frequently suffers from severe infections of gastro-intestinal parasites.

A total of 44 individual shags (18 females, 26 males) were captured at their nests during early chick-rearing in July 2018. They were endoscoped to quantify their parasite loads, and blood sampled (approximately 2ml). Of these birds, 36 were also fitted with data loggers: 32 with Technosmart Axytrek accelerometers, and 4 with a combination of IgotU GPS recorders and Little Leonardo accelerometers.

We centrifuged blood in the field, in order to perform the following, and ongoing, laboratory analyses:

1. bulk stable isotopes of carbon and nitrogen, and amino acid specific stable isotopes of nitrogen

(proxies of feeding habitat and trophic position) – in red blood cells

2. mercury – in red blood cells
3. perfluorinated compounds – in plasma

Ongoing analyses on data retrieved from loggers will enable us to calculate:

1. foraging habitat and diving behaviours
2. energy-related parameters, such as activity-specific costs and daily energy expenditure

Together, these measures will make it possible to:

1. understand the trophic drivers of contaminant and parasite exposure
2. quantify the relationship between contaminant and parasite loads
3. calculate the interactive effects of contaminant and parasite loads on energy expenditure.

Preliminary bulk stable isotopes results indicate a strong sexual difference in diet, which will likely result in significant differences in contaminant exposure. Preliminary results on perfluorinated compounds in plasma indicate that these contaminants are present in the population, some of them at high concentrations (Perfluorooctanesulfonic acid, PFOS).