Manx Wildlife Trust
Treisht Bea-Feie Vannin

Calf of Man Seal Survey

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Grey Seals – (Halichoerus grypus)

Classification, distribution and abundance

The grey seal consists of two subspecies; Atlantic grey seal (*Halichoerus grypus)* and the Baltic Sea population (*Halichoerus grypus macrorhynchus).* The subspecies' are separated geographically and in terms of differences in breeding seasons (Rice, 1998). Although distributed throughout the north Atlantic, approximately 45% of the world's grey seals breed around the UK coast; of which 90% occur in Scotland (Carter *et al*., 2001; Sharples *et al*., 2012). Historically, UK grey seal populations were maintained by sustenance hunting (Summers, 1978). During the early 1900s, over exploitation led to a severe decrease in population, which was met with increased protection from legislation (Lambert, 2002). Following the enforcement of legislation, grey seal populations rapidly increased between the 1960s and 1990s (Duck and Thompson, 2007). Recent population counts show a slight reduction in grey seal pup production, suggesting carrying capacity has been reached (Thomas *et al*., 2019). The conservation status of the grey seal is currently listed as Least Concern on the IUCN Red List (Bowen, 2016).

Annual Lifecycle

The breeding season for grey seals in the UK occurs between September and November and varies depending on location. The dates of breeding follow an anti-clockwise cline around the coast; with populations in the south-west breeding in early September and those on the North Sea coast breeding in late November. Variation in breeding dates has been shown to correlate with sea-surface temperatures (Coulson, 1981). During the breeding period females will aggregate at breeding sites where they give birth to a single pup (Bonner, 1981). Birth is followed by an intensive lactation period where pups will nurse for 16-18 days. In the meantime, males aggressively compete in order to establish territory within the breeding site. Once the nursing period ends, females will mate with the male established in the area.

After mating, both males and females return to sea for approximately two months (Bonner, 1981). During this time seals are required to hunt in preparation of the moult. The moult occurs between January and March, in which time seals undergo a complete hair regrowth.

Grey Seals in the Isle of Man

The Isle of Man provides an important haul-out location for seals within the Irish Sea. Although both seals are regularly observed, grey seals are more abundant in Manx waters (Bruce *et al*., 1963). The Sound, Langness and Maughold (Figure 1) are common haul-out sites on the mainland. Although not shown on the figure (Figure 1), the Point of Ayre has recently been recognised as a common haul-out site (Howe, 2018).

Figure 1. Grey seal numbers (on land and in the sea), across the Isle of Man. The Sound, Langness and Maughold are shown to be popular haulout sites (Stone et al, 2013)

The Calf of Man, a small islet half a mile off the southwest of the main island, has long been seen as significant for Manx seals (Duck, 1996) (Figure 2). The island, which is owned by Manx National Heritage (MNH), is inhabited only by wardens and volunteers of Manx Wildlife Trust (MWT). Although public access is granted year-round, the island can only be accessed by boat and, therefore, is not possible in poor weather conditions. Due to the nature of the island, most visitors are not permitted to stay overnight, exploring the island for only a few hours in the day. As a result, the island is considered to have low levels of human disturbance; providing an ideal environment for grey seal pupping. As the main breeding site for the Isle of Man, the Calf of Man provides an excellent opportunity to study this species. Since 2009, MWT have been sending volunteers to stay on the island for the duration of the breeding season, in order to monitor the females and pups present.

Figure 2. Map of the Calf of Man (maintained by Manx National Trust and Manx Wildlife Trust). Map shows the island in relation to the Isle of Man, with the Sound shown in the top right corner).

Study Aims and Objectives

The primary aim for the study is to census the number of pups born on the island. Each individual pup is monitored throughout the field season, in order to gain information on pup total count and survival rates. Furthermore, the study aimed to identify levels of site fidelity in returning females. Throughout the survey period, all observed individual seals (both male and female) were photographed with the aim of matching them to existing catalogue entries. This continuous updating of the catalogue allows for an estimation of the number of individuals using the site, and can be shared with other organisations to get information of individual movement throughout Europe.

Methods

Study Area

The Calf of Man is a small island half a mile off the southwest of the Isle of Man, in the Irish Sea. The Calf of Man has long been seen as an important site for grey seals due to its rocky coastline proving to be an important habitat for seal birth site selection (Duck, 1996). Previous seal breeding surveys had identified the 14 sites along the north and south coastlines utilised for pupping, which were the sites primarily used for this survey (Figure 3). These sites are between 2,111m²-21,821m², consisting of one to three gullies or bays of rocky out crops and pebble beaches, with most providing shelter. The eastern and western coasts are composed of sheer cliffs lacking many suitable haul-out sites, due to the absence of historical pupping sites for these parts of the island these were not regularly surveyed.

Code	Location
CL	The Cletts
GH	Grant's Harbour
CH	Cow Harbour
WC	West of Cow
GI	Gibdale
BF	Bay Fine
AM	Amulty
GL	Ghaw Lang
SC	Smugglers Cave
CP	Caigher Point
LE	Leodan
MG	Mill Giau
PU	The Puddle
SH	South Harbour

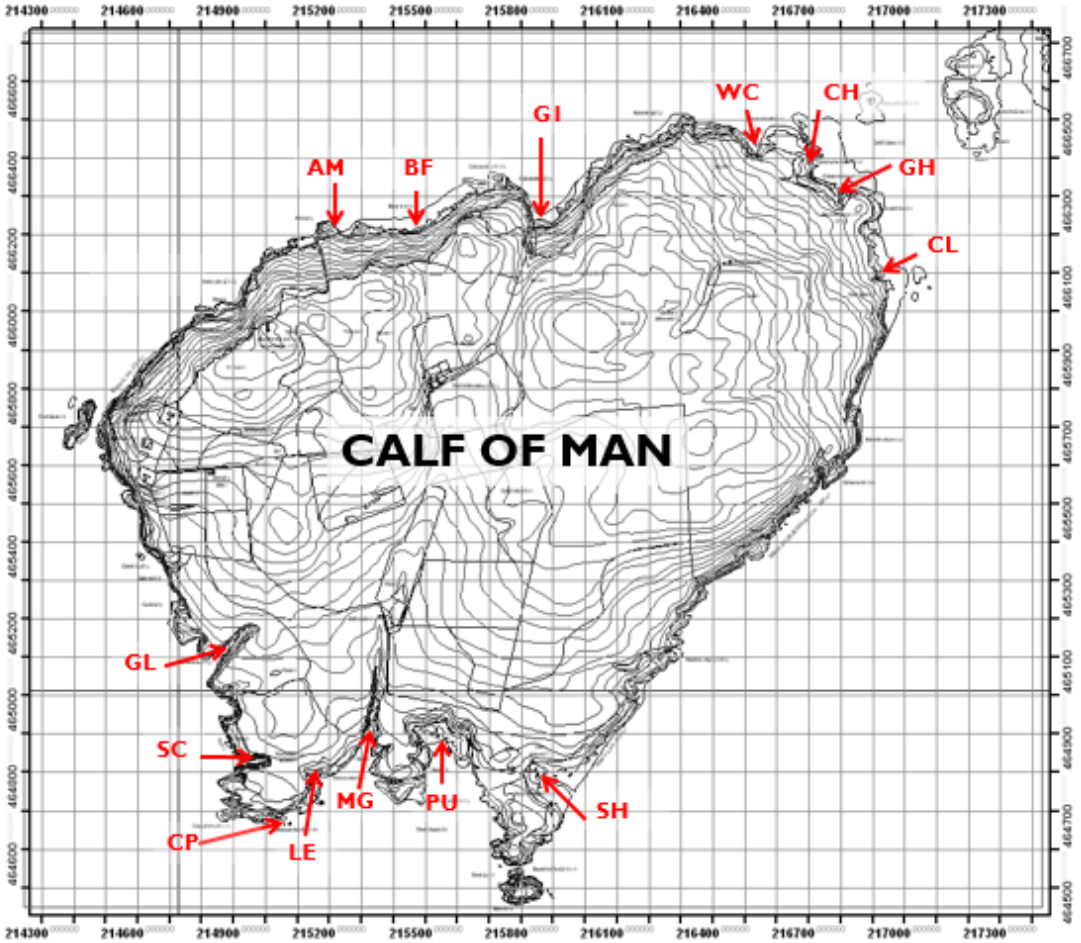

Figure 3. Map of Calf of Man showing the 14 different grey seal pupping locations used for surveys. Table provides full names of sites and corresponding codes

Data Collection

The breeding season on the Calf of Man occurs between September and November, therefore data collection was carried out from 6th September to 2nd November by volunteers Lauren Stokes and Mairi Young, with guidance from Manx Wildlife Trust Marine Officer Dr Lara Howe during the first week of the survey. The 14 sites were split into north (AM-CL) and south (GL-SH) routes with a total of seven sites on each route (Figure 3). Routes were monitored on alternative days by foot, allowing for adequate tracking of the seal pups whilst minimising the level of disturbance from human presence at sites. All seals and pups present at a site, both hauled-out or in the water, were counted at each visit. On one occasion (23/10/2021), a whole-island count of the adult seals was carried out by the seal volunteers and Dr Lara Howe.

The study consisted of two parts, to carry out photo identification of adults and a pup census of the island. At each site adults were counted, activity recorded (hauled-out or in water) and photographed using a Canon EOS 70D DSLR camera fitted with a 70-300mm 1:4-5.6 lens. In order to carry out photo identification, images were taken of seals that were showing a clear natural pelage markings, where possible of both left and right sides of the seal, preferably of both the head and flank of each side. By using high-quality photographs of individual not only increases the chance of being able to re-identify and individual, but also reduces the chance of false rejections, whereby one individual is duplicated (Hiby *et al.* 2013). Priority of photographs were given to mothers and pregnant females. The number of pups were also recorded at each site and photographs were taken. One site in particular called 'Smugglers Cave' had very poor visibility, and previous survey years had found it difficult to determine pup presence within the cave. To overcome this, this year the Pulsar Helion 2 XP50 Thermal Imaging Spotter Scope Camera was used. Thermal imaging works by detecting subtle differences in temperature between a target; in this case seals and their pups, and the surroundings. With a core average body temperature of 38.9°c (Worthy, 1991), thermal imaging cameras are an ideal tool for confirming seal pup presence when visibility is low, as seen in Figure 4. During pup observations behaviours that confirmed filial relationships, such as suckling, were photographed and recorded. On occasions when insufficient data was collected during the initial site visit, a return visit was carried out later that day, sometimes requiring the surveyor to sit out-of-sight until the necessary photographs could be taken to match pups to mothers by witnessing suckling.

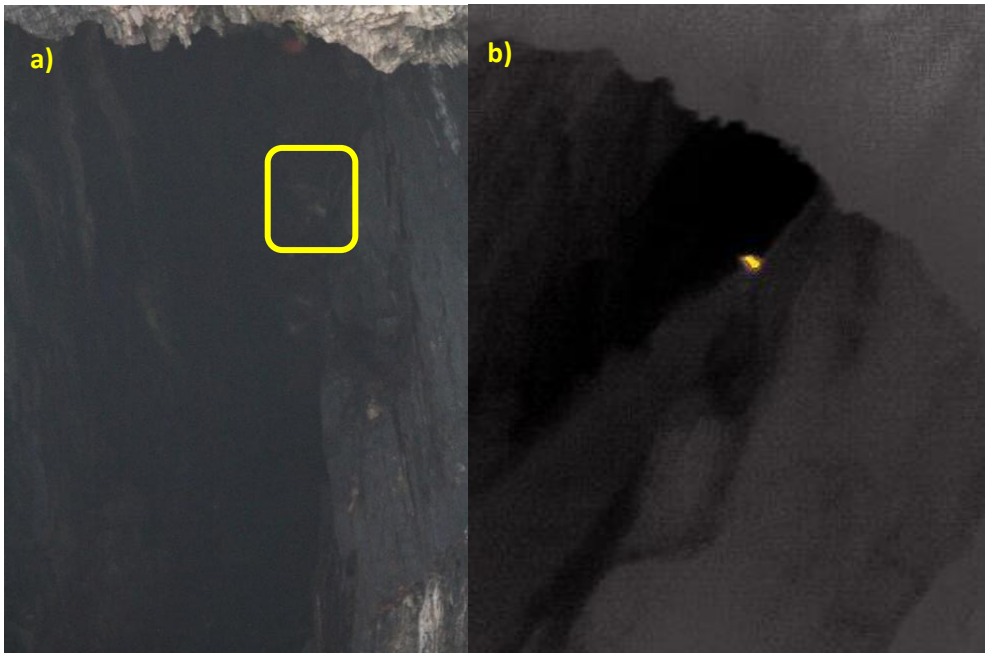

Figure 4. Photographs of 'Smuggler Cave' on the same day, a) A photo using DSLR camera, showing poor visibility to see pup (highlighted in the yellow box) compared to b) using the thermal imager confirms presence of pup in the cave

Pup Development Stages

The photographs of the pups were assessed using a system of classification into five stages (see Appendix B), whereby their physical appearance and behaviour can be related to pup age (Kovacs and Lavigne, 1986; Radford *et al.,* 1978; Russell *et al*., 2019). The stages are separated by percentage of lanugo coat vs moulted as well as body shape. The appearance of fresh afterbirth, umbilical cord and lanugo coat stained yellow as well as blood around the mother also was used to indicate a pup was recently born. Tracking the developmental stages allowed to monitor the growth of seal pups, and the success rate of pups born, all of whom were named beginning with a single letter of the alphabet (the letter 'W') as per the ongoing system on the Calf of Man.

Photo Identification

Photographs of adult seals taken at the pupping sites were compared with a catalogue of individuals recorded previously on the Calf of Man, consisting of 395 females and 45 males before the 2021 season. There was a particular focus on identifying this season's breeding females who were photographed with pups, allowing for continued analysis of the levels of site fidelity shown by returning females. Seals that were photographed and did not match any images in the catalogue were added as 'new seals' and assigned a number and a catalogue folder, establishing a record of

their individualised pelage patterns and any marks such as scarring, and noting the dates and locations in which they were observed.

Camera Trapping

The use of camera traps has increased over the years (Burton *et al.,* 2015) as they are relatively inexpensive as well as non-invasive (Brassine & Parker, 2015), and allow for behaviour observations without human influence (Biancardi & Cerbo, 2012). They have been commonly used across terrestrial habitats but more recently have started being used to study hauled-out pinnipeds (Gucu 2009; Koivuniemi *et al*., 2016). A preliminary trail for the use of camera traps was carried out last year (2020) and the recommendations from this study were used to continue the camera trapping element for this survey season to record and confirm filial relationship as well as missing or abandoned pups. A total of six camera traps were deployed at five location; two at The Puddle and one at South Harbour, Grants Harbour, Mill Gaui and Cow Harbour. Cameras stayed at the same site, however their locations at the sites changed during the survey period. One camera at The Puddle was damaged due to weather conditions so after week three only one camera was at The Puddle. Cameras were placed five to ten metres from the pupping sites before breeding season begun (Figure 5) and set on time lapse, for one photo to be taken every 30 minutes, with photos taken between daylight hours of 6:00 – 19:00 for the full survey season. Using these settings allowed reduced memory storage and battery drainage, which reduced the amounts of times cameras had to be checked, thus minimising potential human disturbance to seals.

Figure 5. Photographs showing the location of the camera trap at Grants' Harbour (a) and Cow Harbour (b). The cameras are highlighted with a yellow square.

Data Analysis

To visually represent the data, GPS points corresponding to births were displayed in QGIS. GPS points were also used to show the number of pup and females at each site in QGIS, with the size of the point corresponding to the number. The program Microsoft Excel 2013 was used to analyse results for pup and female analyses. This program was also used to produce graphs comparing this year's data compared to previous years as well as calculating levels of site fidelity and success rates of pups.

Results

Pup Census

A total of 62 pups were recorded on the Calf of Man over the duration of the survey for the second year running. Figure 6 compares this to the total number of pups recorded over previous survey years, ranging from a minimum of 26 pups in 2009 to a maximum of 84 pups in 2016. A trendline has been placed which shows the trend of the data over the past 12 years, with an R^2 value of 0.9093 the line is a good fit to the data.

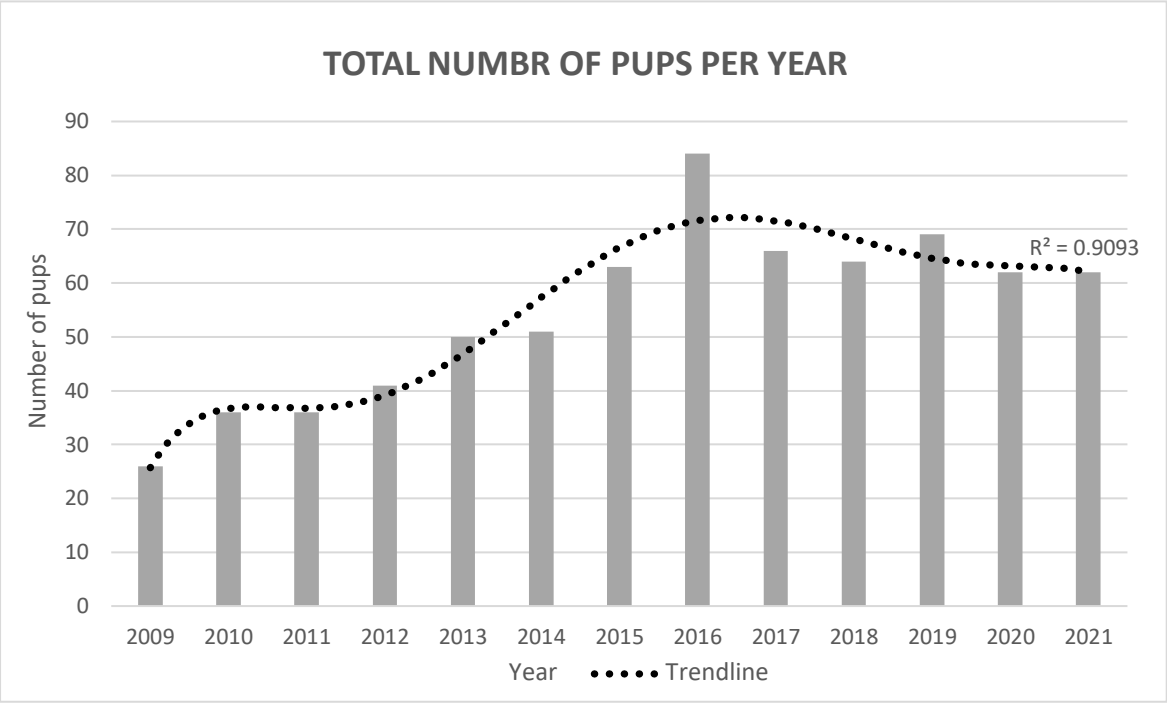

Figure 6. Graph showing the trends in seal pup production from 2009 – 2021, data collected by volunteers during the annual Manx Wildlife Trust seal pupping surveys on the Calf of Man.

The number of new pups observed for the first time in each week of the survey is displayed in Figure 7, giving an indication of the spread of pupping dates over the duration of the season and allowing comparison of this year's data with the mean trends since 2009. The survey period this year started earlier than before (07/09/2021), which is why there is no previous data for this period and the week beginning 8th September can only be compared to the data in 2020, as again no previous years had started this early. Although the week beginning the 8th saw 5 less pups than last year's record, their count would also include pups born the previous week. The peaking pupping period for the previous year average is 11 pups per week for two weeks between 22/09/2021-05/10/2021. The peak period for the 2021 was over the same weeks as the average, but expanded to the 06/10/2021-12/10/2021.

For the final two weeks of the survey the 2021 numbers dropped below the previous year's average. The mean birthdate for pups was also earlier than the previous day's average by six days.

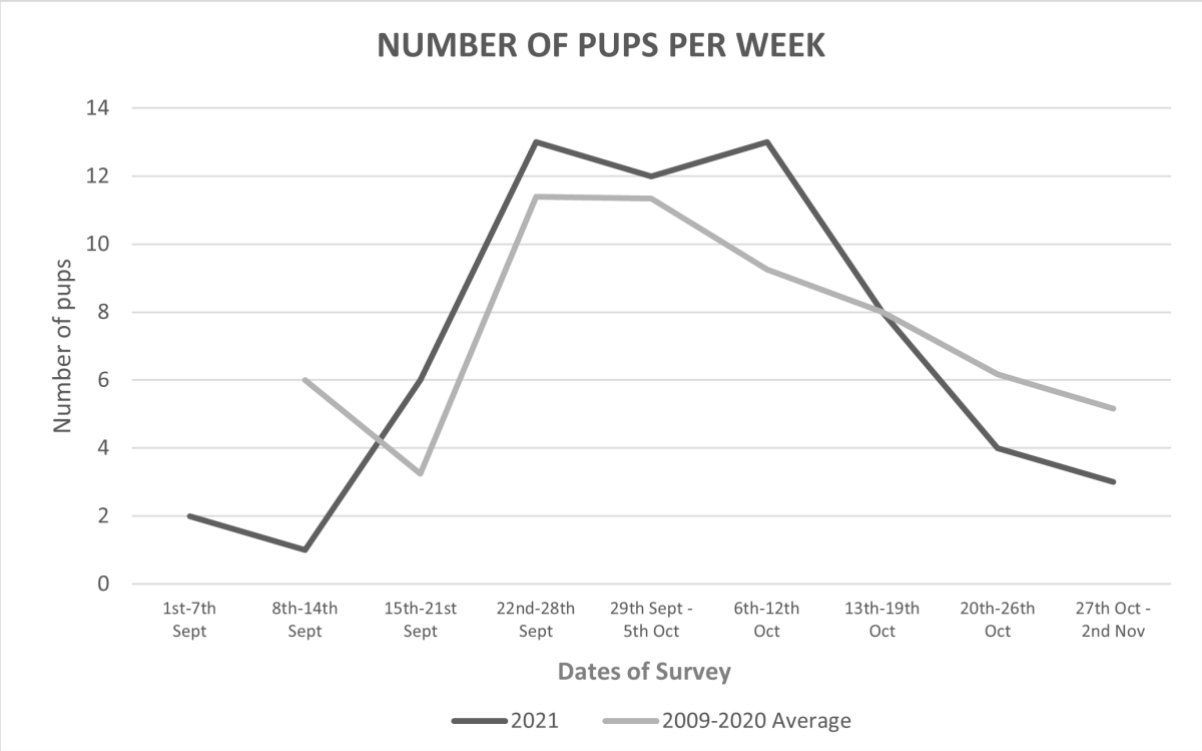

Figure 7. Graph showing the spread of pupping dates over the 9 weeks of the survey. This is compared to the mean spread of pupping dates from the past 11 years.

Of the 62 pups, 4 were confirmed as dead during the survey, making up for 6.45% which although is slightly higher than the average for previous years (5.53%), was less than 2020 (n=7) (Figure 8). A total of 29 pups were tracked all the way through to Stage 5 of development, marked by weaning and full moulting of their lanugo coat. This corresponded to 46.77% of pups, higher to a mean of 34.94% for the past twelve years of data collection. Of the pups that made it to stage 5, the average number of breeding seasons for the mother ranged from 1-11 with an average of four and an average number of sites used previously being two. Of the stage 5 mums which had been seen for two or more seasons, 61.9% had used the 2021 breeding site previously

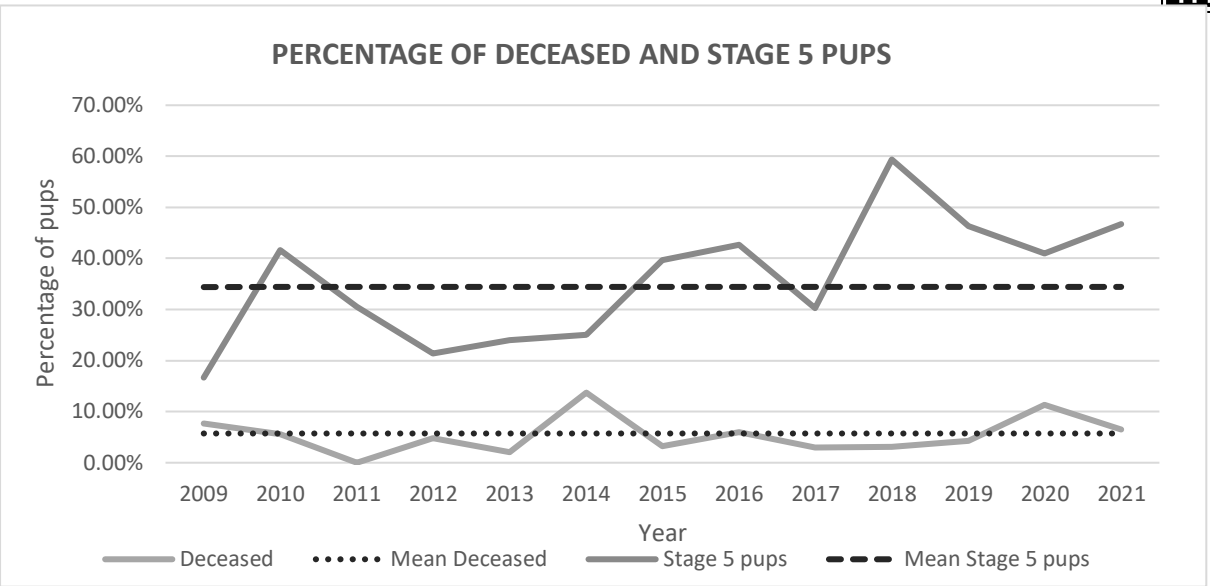

Figure 8. Percentage of pups confirmed as deceased each year, compared to the mean between 2009 and 2020, as well as the percentage of pups successfully tracked through to Stage 5 of development each year and the mean of previous years

Table 1. Table showing number of pups deceased and stage 5 pups each year as well as the corresponding percentage per year. Information is used in graph for Figure 8

YEAR	TOTAL PUPS	DECEASED PUPS	*PERCENTAGE OF DECEASED PUPS*	STAGE 5 PUPS	*PERCENTAGE OF STAGE 5 PUPS*
2009	24	2	8.33%	4	16.67%
2010	36	2	5.56%	15	41.67%
2011	36	0	0.00%	11	30.56%
2012	42	2	4.76%	9	21.43%
2013	50	1	2.00%	12	24.00%
2014	51	7	13.73%	13	25.00%
2015	63	2	3.17%	25	39.68%
2016	75	5	6.67%	32	42.67%
2017	66	2	3.03%	20	30.30%
2018	64	2	3.13%	38	59.38%
2019	69	3	4.35%	32	46.38%
2020	62	7	11.48%	25	40.98%
Average pre-2021	***54.08***	***2.92***	***5.39%***	***19.67***	***34.39%***
2021	**62**	**4**	**6.45%**	**29**	**46.77%**

*Table 2. Summary of mothers of stage 5 pups. *Not including females where 2021 was their first recorded breeding season. **Using females that had pupped for 2 seasons or more (n=13)*

		MIN	MAX
AVERAGE NUMBER OF BREEDING SEASONS	4	1	11
AVERAGE NUMBER OF SITES USED*	2	1	4
USED 2021 SITE PREVIOUSLY	61.90%**	-	-

Pup Distribution

Pups were seen in 10 of the 14 main pupping sites, with Amulty (AM), West of Cow (WC) and The Cletts (CL) being the exception. No pups were also seen at Caiger Point (CP) but despite being flagged as a potential pupping site, no pups have been seen here since 2009. Of these The Puddle (PU) was the single most populous site, contributing to 20.97% (n = 13) of the total pup productivity for this year. The number of pups born in the south route was higher compared to the north; with 61.29% (n = 38) born in the southern sites (Ghaw Lang - South Harbour) and 38.71% (n = 24) born in the northern sites (Bay Fine - Cletts).

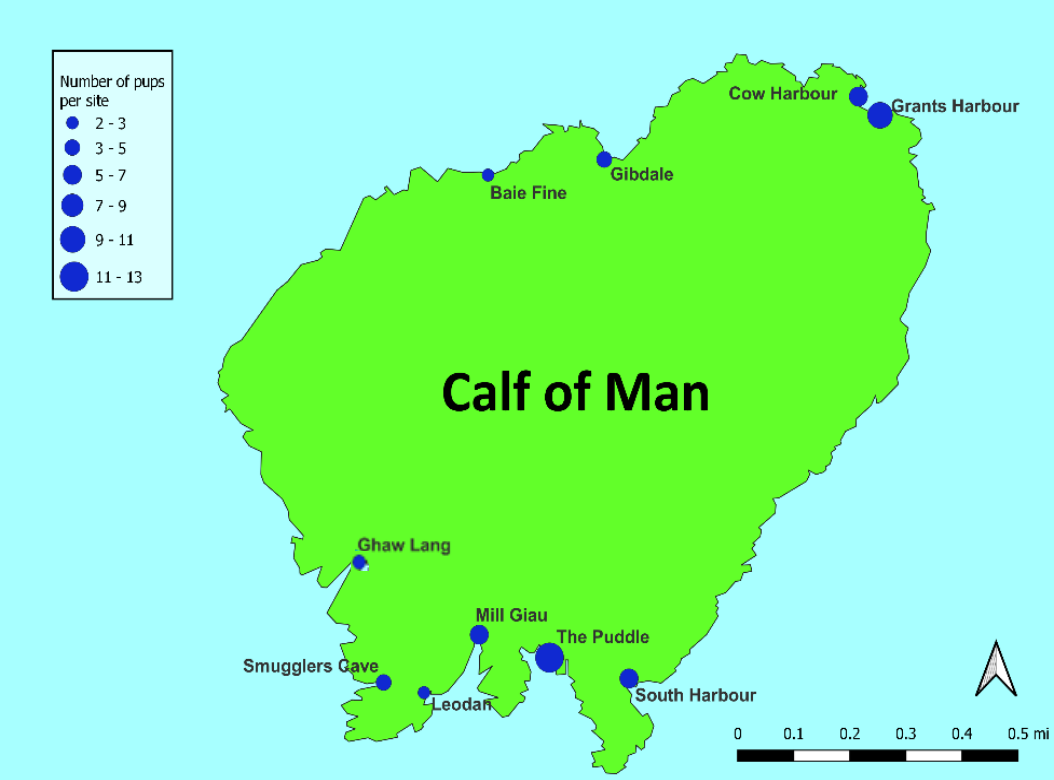

Figure 9. Map showing the distribution of pups around the Calf of Man in the 2021 pupping season, produced using QGIS software. The relative size of the blue dot corresponds to the number of pups

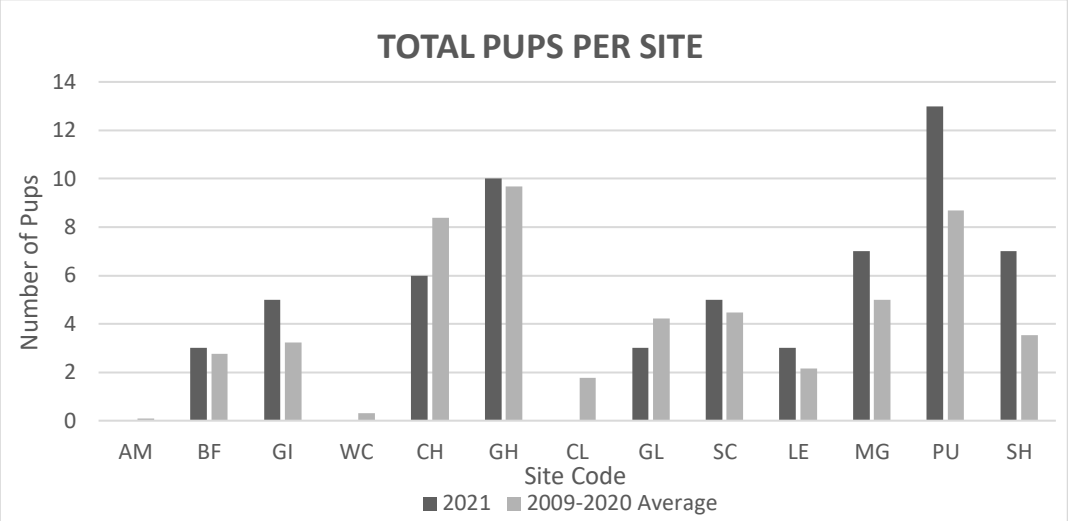

Figure 10. Graph shows number of pups born at each site, compared to mean of previous years

The below map (Figure 11) looks at the first day a stage one pup was born at each pupping site. The first pup to see a pup born was Gibdale (GI) on the first day of the survey season, with the last pup being born on the 26th day at Cow Harbour (CH). The rest of the sites had their first pup close together with three sites having pups on the 9th and 10th day, and the remaining sites having pups between days 16-19. North nor the south side of the island had pups significantly early or later than the other, with the average day for North being day 14, and day 15 for the South.

Table 3. Date and survey day first pup born at each site (start date 07/09/2021).

SITE	SURVEY DAY FIRST PUP SEEN	DATE PUP SEEN
GI	1	07/09/2021
BF	9	15/09/2021
SC	10	16/09/2021
MG	10	16/09/2021
SH	16	22/09/2021
GL	17	23/09/2021
PU	17	23/09/2021
GH	18	24/09/2021
LE	19	25/09/2021
CH	26	02/10/2021

Figure 11. Map shows order of pups born at each site, with colour dot corresponding to a number, as per guide. Information for map seen in Table 3. Map made using QGIS

From the 62 pups born this year a total of 4 pups (6.45%) were deceased, 39 pups (62.9%) were seen until stage five, or until the last survey day but had not yet reached stage five and 18 (29.03%) were classed as missing (Figure 12). Missing pups were lanugo pups seen, recorded and tracked during a survey until their last sighting, which varied from one sighting to eight, and were not seen again after this. It is unknown if these pups survived or not. There was no site that had a higher number of deceased pups, although there were more deceased pups in the south than the north. The Puddle and Grant's Harbour had the highest number of stage five pups with Smugglers cave and Gibdale had the highest of pups that went missing, although difficulties with visibility of these sites could have contributed to this.

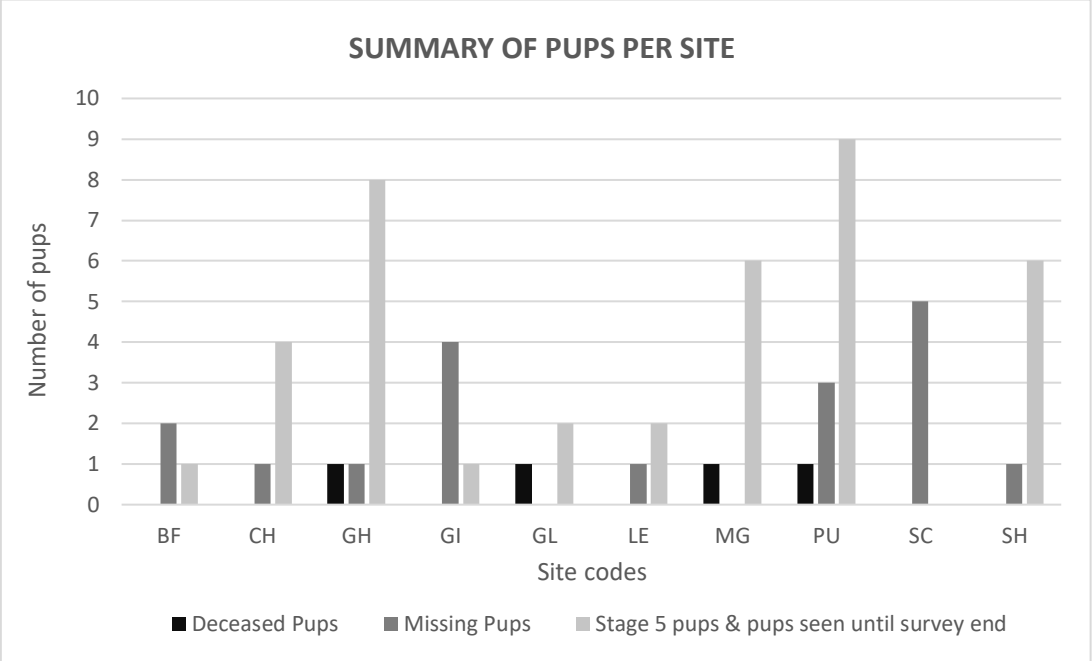

Figure 12. Graph shows number of pups that were deceased, missing or reached stage 5 at each site. Pups seen on last day of survey were also included as they did not reach stage 5 by the end of survey.

Table 4. Number and relative proportions of deceased pups, missing pups and stage 5 pups/ pups seen until last day of survey

	DECEASED PUPS	MISSING PUP	STAGE 5 PUPS & PUPS SEEN UNTIL LAST DAY
Total	**4**	**18**	**39**
Percentage	**6.45%**	**29.03%**	**62.90%**

Of pups seen at stage 2 or earlier, the changes of them being successful and fully weaned reaching stage 5 was looked into (Figure 13). 100% of pups at south harbour were seen to be fully weaned and reach stage five, making this the most successful site. This was followed by MG and GH with 83-85% of pups reaching stage 5. On the contrary, sites BF and SC had a 0% successes rate for pups, followed by GI only seeing 20% of pups reaching stage 5, which equates to only one pup. The south had a higher success rate for fully weaned pups than the north with the average for the south (n=65.74%) being 26.81% higher than the north site (n=38.26%)

Table 5. Summary of pups seen from stage 2 through to stage 5 per site. Percentage does not include pups that did not have reach stage 5 by end of the survey season

SITES	% OF STAGE 2-STAGE 5 PUPS SITE
BF	0.00%
CH	50.00%
GH	85.71%
GI	20.00%
GL	66.67%
LE	66.67%
MG	83.33%
PU	77.78%
SC	0.00%
SH	100.00%

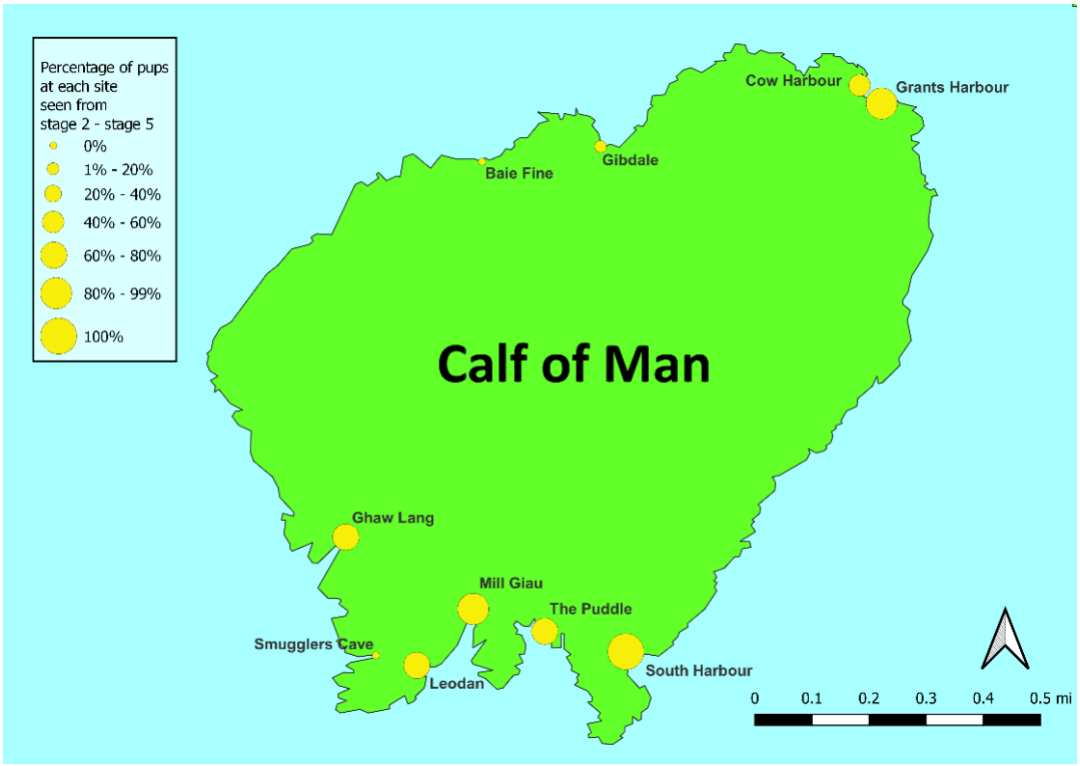

Figure 13. Map shows percentage of pups at each site that were seen from stage 2 until fully weaned. The relative size of the yellow dot corresponds with the percentage range at each site, with exact numbers seen in Table 5. Map made in QGIS.

Adult Distribution

The number of seals was seen to vary across the survey sites (Figure 14). The highest number of adults were recorded at The Cletts (average of 22 seals per survey) and The Puddle (average of 20 seals per survey). Caigher Point and Amulty had the fewest numbers of seals seen (each having an average below zero). Overall, greater numbers of seals were recorded in the North (Figure 14)

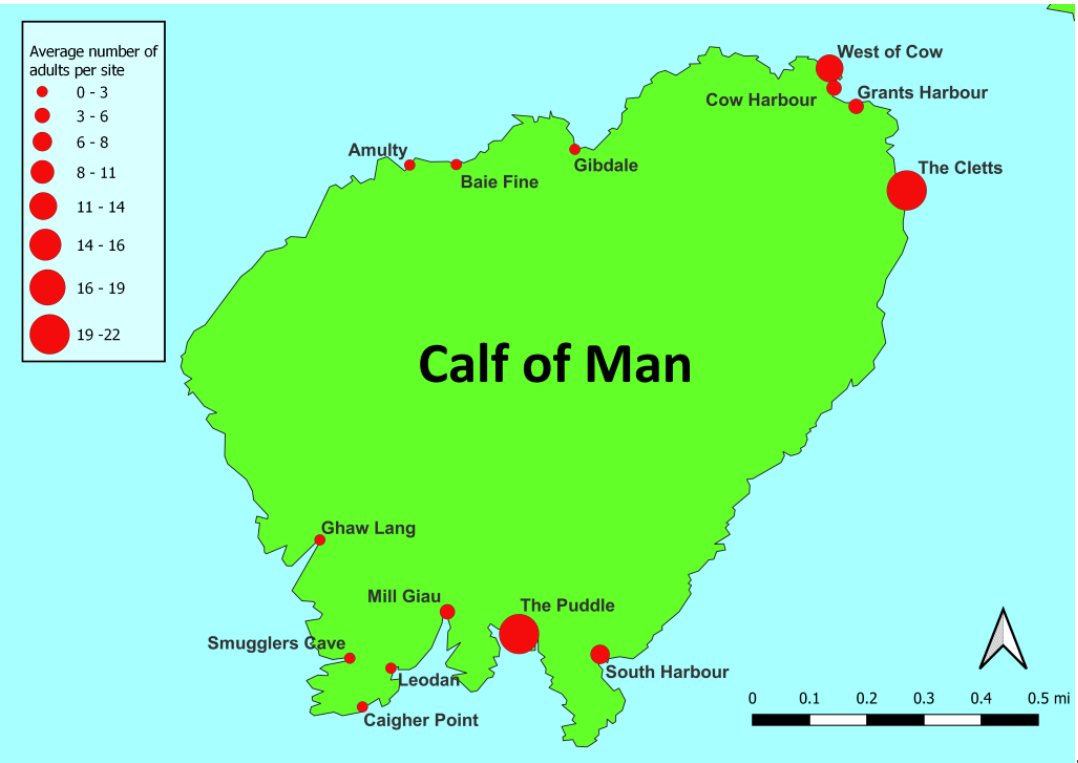

Figure 14. Map showing the average number of adults observed at each site (per survey). High numbers of adults were recorded at The Puddle, West of Cow/Cow Harbour and Grants Harbour; which were popular pupping sites. High numbers were also observed at The Cletts; where no pups were recorded.

There was also found to be a great sex-bias in the number of seals recorded. There was an overall adult average count of 83.5 (per survey), 12% of these were recorded as male.

Photo Identification

Mothers

Of the 61 known mothers of 2021, 35 were matched to existing entries in the catalogue. 15 were identified as being new and were subsequently added to the catalogue. The remaining 11 mothers were either not observed, or were not photographed in a way that would allow for a match and, thus, are recorded as unknown.

Furthermore, of the 35 matched mothers, 29 had been observed pupping previously, whilst the other six had been previously observed without a pup (Table 1).

Table 6. The number and percentage of the 61 known mothers of 2021 that were identified from the existing catalogue, never been seen before, and unidentified mothers.

	Identified Mothers	**New Mothers**	**Unidentified (Unknown) Mothers**
Number (*n*)	35	15	11
Percentage (%)	57.38	24.59	18.03

Furthermore, a number of females, who have been known to pup previously, were sighted without a pup this year. One such female (catalogue 005) who has had a total of 10 pups, was regularly sighted during 2021 observations – but never recorded with a pup, or as being visibly pregnant.

Non-pupping females

Throughout surveying, all individuals were photographed in order to generate a match within the current catalogue. As a result, a number of non-pupping females were also identified. 294 non-pupping females were observed and photographed in the North comparative to 116 observed and photographed in the South. Of these; 139 females were matched with existing seals in the catalogue. A further 89 were added to the catalogue (26 as full, and 63 as LRN). For the remaining females, the photographs were not of a high enough quality to either match, or confirm a new individual. These have been stored in the database in case of future matching.

Furthermore, 10 duplicate females were identified in the catalogue, and recorded as such in order to improve accuracy. There are currently 484 unique and living females in the catalogue.

Males

Males were also photographed and identified using the existing catalogue. As males generally have less obvious markings, matching is harder and, thus, fewer individuals are identified. Of the 13 males found in the north; only three were able to be matched, and the remaining were added as new individuals. Within the Southern sites, 25 males were photographed, of which five could be matched to existing catalogue entries and ten new males added. There are currently 61 known males in the catalogue.

Site Fidelity

Overall site fidelity of the identified 2021 mothers was calculated at 80.7%. This included 14 mothers who had 100% fidelity; having only ever pupped in the one site (Table 2).

Table 7. The number, and percentage, of seals that have been observed pupping at a certain number of sites. 14 of those represent total site fidelity (having only ever pupped in the same location). Only mothers that had be observed pupping previously were included in the analysis.

Number of Sites	Number of Seals (*n*)	Percentage (%)
1	14	41.18
2	13	38.24
3	4	11.76
4	3	8.82

Although a number of seals were seen to pup in multiple site locations, only nine of the 2021 mothers have been observed to have a pup on the other half of the island (north and south), whilst 25 were only ever seen on the one half of the island. Furthermore, it is important to note that, particularly in the north, the distinction of each site is arbitrary and created to ease surveying. Although treated separately, there are a few sites without physical separation and, thus, could be considered to be the same site. The same analysis was performed with such sites treated as one, and increased the percentage of seals having 1 site to 53%.

The level of fidelity was also tested for each half of the island (north and south). Females who have only ever pupped in the same location was shown to be higher in the south (Table 3).

Table 8. The number, and percentage, of seals with total site fidelity (only having pupped in the same location) for the north and south ends of the island.

	Number of Seals (*n*)	Percentage (%)
North	9	69.23
South	16	76.19

Pregnant females

During observations, it was important to successfully identify females who had a pup. As a result, a focus was placed on identifying females who were visibly pregnant – and thus assumed to become a mother at the site. Interestingly, it was noticed that not all these pregnant females went on to give birth on the Calf. 19 females, who we recorded as being pregnant, were not observed having a pup at the site, and, thus assumed to have left the site for birthing.

Birthdate Analysis

The dates at which mothers had their pups was recorded across all survey years (Table 9). From this data, it is possible to examine changes in times at which mothers pupped. Of all the mothers than pupped in 2021, 71% had their pup earlier than the previous years (Figure 15).

Table 9. Birth date analysis of returning 2021 mothers. Table shows the day at which their pup was recorded (Day one = 1st September), and the same for the previous year of pupping. The table also shows the difference in those days; with positive numbers showing an earlier birth in 2021.

Individual Number	2021 Date	2020/Previous Pup Date	Difference to 2021	Last Year Pupped
004	22	25	3	2020
014	33	36	3	2020
019	6	8	2	2020
034	22	23	1	2020
040	30	32	2	2019
062	24	31	7	2017
098	21	19	-2	2020
107	29	29	0	2019
120	14	8	-6	2020
127	14	33	19	2016
136	31	34	3	2018
194	28	27	-1	2020
196	29	34	5	2020
199	21	29	8	2019
203	25	21	-4	2020
206	38	46	8	2019
221	36	42	6	2019
223	29	33	4	2019
248	15	19	4	2019
251	22	61	39	2020
265	22	23	1	2020

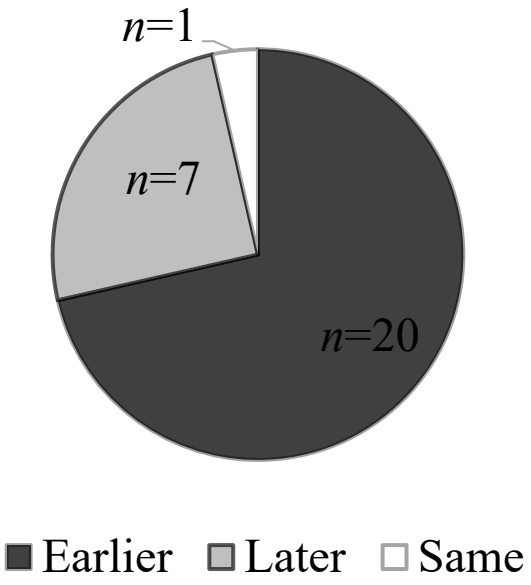

Figure 16. The number of returning mothers who pupped earlier, later or on the same day as the previous pupping year.

Duration of Stay

The length of time in which mothers were seen at the site (from the first date seen to the last date seen) was also recorded during the 2021 survey. Mothers were observed at the site for an average of 15 days; with a minimum of 10 and a maximum of 22. Data was only taken from mothers of pups who were recorded to reach weaning age and not considered abandoned.

There was not found to be any relationship between the number of years a mother had pupped previously, or the location of pupping, and the amount of time spent with the pup. It is also important to note that the data may not be representative of all mothers who remained until pup weaning. A number of sites, such as Smugglers Cave (south) and Gibdale (north), had limited viewer visibility and, therefore, it is possible that mothers remained longer but weren't seen during the survey.

Discussion

Pup numbers

The overall number of pups recorded on the Calf of Man this season was the same number recorded in 2020 (n=62), with the past four years pup numbers being within the sixties, suggesting the grey seal breeding population at the Calf of Man has begun to level out and potential reached, or close to reaching carrying capacity. This corresponds with previous research that has shown the growth of the seal population in areas besides the central and southern North Sea has dropped to less than 1% compared to the growth in the 1980s of 6% (Russell *et al.,* 2019; Thomas *et al*., 2019). Explanations for this levelling-off include at-sea density-dependent processes such as foraging conditions, as well as local colony-level processes that influence recruitment to the breeding colony, including habitat quality and the conspecific-attraction hypothesis (Russell *et al.,* 2019; Stamps, 1988). Looking at the pup population growth over the past 13 years demonstrated in the trend line in Figure 6, the pattern of the calf population is similar to that seen in other breeding seal populations in The Outer Hebrides, the Inner Hebrides, and Orkney (Thomas *et al.,* 2019). Between 2009 and 2015 the seal pupping numbers increased each year, although this could also be down to longer survey periods as well as increased and improved survey effort. In 2016 the highest documented number of pups was recorded (n=85) before decreasing and levelling out in the following years. As with the pupping populations studied by Thomas *et al.,* (2019), it seems that in 2016 the Calf of Man overshot their carrying capacity, before decreasing and levelling out between 2017-2021. Pupping sites that had reached carrying capacity of their pup population had previously seen a peak in the adult population five year previously (Thomas *et al*., 2019), and although this cannot be seen in the adult population on the Calf, as numbers have increased each year since the start of the survey, again improved survey effort and methods could have results in more adults being identified, rather than more adults being present.

It should be noted that the number of pups recorded for the Calf this year, as with previous years, may be underestimated due to two limitation of this study. The first being that due to the land based surveys, it is feasible that some potential pupping being used are not visible via land**.** In fact, a study in Wales found more than half of pups were born in cryptic breeding habitats such as sea caves (Stringell *et al,.* 2014) and during a scuba diving trip around the Calf of Man, the group saw a sea cave and heard a seal pup inside, although there was no visual sighting. This signifies it is more than likely that pups are being born in such sites that are not able to be observed from land. The second

limitation of the study is due to adverse weather condition in the winter months, the survey has to end in early November, despite the breeding season for the West being between September and November. After the end of the survey season in 2020, two new pups were seen in the following weeks, and during the 2021 season, one pup was born on the last survey day, meaning it is likely more pups were born after the survey season ended.

Pup trends

Weekly Trends

The survey season started earlier than all previous seasons, with the aim of being present for the first birth and catching the beginning of the survey season. It seemed as though this had been achieved, after a full island survey, a birth was seen on the first survey day and a stage one deceased pup. It should be noted that there are occasionally pups that are born outside of the breeding season (Westcott and Stringell, 2003) which could have been the case when a stage 3 pup (around seven days old) was seen on the 08/09/2021. No further pups were recorded until the 15th September, indicating that we did begin the survey season early enough to gain an accurate understanding of the pup production for this year. Future survey seasons should therefore aim to start the survey by the second week of September in order to catch the beginning of the pupping season.

The peak of the pupping season this year was between 22/09/2021-12/10/2021 with a total of 38 pups being born within this period. Colonies in the North of Wales and Northern Ireland with similar breading season also saw the peak period within the same months (Strong *et al.,* 2006; OCadhla *et al.,* 2008). An interesting observation from the Calf 2021 data was that this year's peak period continued for three weeks, compared to previous year's average showing a peak for just two weeks. The 2021 peak lasted a week after the previous year's average, but saw the downwards trend to the end of the season drop faster compared to before. A possible explanation for this trend could be that pups are being born earlier, which corresponds with the result that overall 2021 mothers were birthing earlier than before (Figure 15). A long-term study of pup births on Sable Island mean birthdate becoming earlier over time (Bowen *et al.,* 2020) as well as report on Skomer Island seeing the birthdate in 2020 being earlier than previous years (Wilkie & Zbijewska 2021). Bull *et al.,* (2021) found that in warmer years the pupping season peak was earlier than the coolest years. This year on the Calf was particularly mild, which could explain the shift forwards of births at the end of the season. Future studies into the Calf of Man seal pup production may be able to confirm if this is an ongoing trend.

Mortality

Confirmed pup mortality was recorded when the remains of a deceased pup were visible to surveyors. Four pups were confirmed deceased this season, representing 6.45% of the pups born on the Calf of Man in 2021, although slightly higher than the average of 5.39% from 2009 – 2020 (Figure 8), the mortality rate has dropped from last year's figure of 11.48%. Unlike previous years, there were no storms that could have affected the seal pups survival this year, with previous research finding good weather conditions also deceased morality rate (Baker and Baker, 1988). It is feasible however that some pups died during the survey but were not recorded as no remains were seen. Of the 62 pups, 18 (29.03%) were classed as 'missing' during the survey, so it is possible that some missing pups were, in fact, deceased. This being said, as our overall population fits in with the trend for the last four years, this mortality number may not be much higher.

Baily (2014) found that the main causes of mortality in seal pups in Scotland was starvation, infection, septicaemia, stillbirth and trauma. Of the four pups confirmed as deceased, one Pup, 'Wings', was confirmed as stillborn as afterbirth was still attached to mother and pup. Of the remaining pups; 'Woolly Socks', 'Wayne' and 'Wallacea' we are unable to confirm cause of death. The death of seal pup 'Wayne' was of particular interest due to the pup's age of 14 days (compared to the other two pups of < one day old). Stage 3 pups weighing more than 35kg (examination of the body by surveyors estimated the pup was over this weight) are thought to stand a high probability of survival (Bowen *et al.,* 2015). Camera trap footage and observations of mother (Number 265) and pup confirmed there was a filial bond, with lack of such being a possible cause of pup mortality and no trauma was seen to have happened to the pup. Examination of pup 'Wayne' confirmed he was male, with males having a lower probability of survival than females (Hall *et al.,* 2002). Hall *et al.,* (2002) also found that seal pups infected with a pathogen were in poorer condition and may lose mass faster. 'Wayne' had a slower growth rate than other seal pups, as well as being inactive, but without the ability to carry out post-mortems we cannot confirm the cause of death.

<u>Pup Distribution</u>

Pup abundance was the highest at PU (n = 13) and GH (n=10), which historically have been the most popular sites, however another historical popular pupping site, CH saw a decrease in pupping numbers (n=6) (Figure 10). In fact, not only were there a higher percentage of pups in the southern sites but overall pup numbers for the northern sites saw an average decrease compared to previous years data of 0.4, in contrast to an increase of two for the southern sites. Surveys in 2019 and 2020 also saw a higher pup production in the South, although less so than this year as well as an increased

number of pups in the southern sites. The decrease in the pupping seal population in Outer Hebrides was thought to have been caused by superior habitat quality becoming available (Russell *et al.,* 2019) with optimal pupping habitats features including low gradient shores, the presence of tidal pools or access to the sea, with no tidal or storm-surge influences. (Anderson *et al*., 1979; Twiss *et al.,* 2001; Weitzman *et al.,* 2017). The difference in the habitats on the northern and southern sites may also explain the variation in pup numbers on the Calf. Although all sites have access to the sea with low gradient shores, the sites with an increased pup numbers which were predominantly in the south had differences in their topography making them more sheltered and therefore giving protection from adverse weather. The northern sites all seem more wave-affected than the southern sites and besides Grants Harbour are all relatively exposed thus reducing the number of protected platforms for supporting pups safely. With females thought to choose pupping sites based on habitat (Twiss *et al.,* 2000), and sites with the best habitat mainly being in the South, this could explain the higher pup numbers in these south sites.

The sites which had the highest success rate of fully weaned pups are seen in Figure 13. Most of the sites with a higher success rate than 50% have been identified above as also having high quality habitats that protect pups. Pups in habitats likely to be flooded by high tides or sites negatively affected by storms are more likely to be separated from their mothers (Allen *et al.*, 2022). Premature separation from mothers vastly reduces pup survival (Anderson *et al.,* 1979). An example of this may be seen in one of the Calf sites, Cow harbour. This is an exposed site making it susceptible to the effects of storm and although 50% of pups reach stage 5 at this site, there were also two pups that were abandoned at stage 1. Grants harbour is next to this site and had 85.71% of pups seen to reach stage 5, which possibly could have been due to the fact the gullies in this site offer protection for pups. As well as separation, studies have found that pups raised in floodable habitat were lighter at weaning by about 1 kg – 1.5kg than those raised in non-floodable sites (Weitzman *et al.,* 2017; Allen *et al.,* 2021). Pup survival increases with weight at weaning (Bowen, den Heyer, Mcmillan, & Iverson, 2015; Hall, McConnell, & Barker, 2002) and therefore floodable sites could see a lower success rate of pups. Gibdale was one of the northern sites where high tide vastly reduced available shore available, that begam particularly flooded in high tides, with multiple pups seen swimming in high tide. This site also saw the second lowest success rate of just 20% which equates to just one pup out of five. Overall the southern sites had a higher percentage of successful pups (n=67.74%) compared to the north (n=50%).

Female Site Fidelity

Site fidelity refers to the tendency of individuals to return to the same breeding site over multiple years. Female grey seals have been shown to display high levels of site fidelity (Pomeroy *et al.,* 1994, Langley *et al.,* 2020). Furthermore, there is evidence to suggest that grey seals are philopatric (returning to natal site to breed). The location that breeding females choose to return to, is influenced by previous reproductive failure. The familiarity of the local conditions, and the predictability of the habitat are believed to be instrumental in determining site fidelity (Wietzman *et al.,* 2017). Like many other sites documented, females are continuing to show high levels of site fidelity on the Calf. Not only do females return to the island, but typically pup in the same area. As the number of females choosing to pup at the Calf increases, the more important the area becomes for grey seals in the Irish Sea and, thus, must be adequately protected to ensure their conservation.

Birthdates

In addition to site fidelity, there is evidence to suggest potential patterns in grey seal birthdates. Historic research suggests that females tend to give birth at the same date each year (Summers *et al*., 1975). Sea temperature has been named as the main factor in influencing birthdates; resulting in variation (up to six months) in birthdates around the UK (Coulson, 1981). However, in recent years, a level of plasticity in birthdates has been observed. A well-studied grey seal colony on Sable Island (Canada) reported an advancement in mean birthdate of 15 days within 27 years of monitoring (Weitzman *et al.,* 2017). The study examined how maternal characteristics, demography and environmental conditions influenced birthdates. Colony size (Coulson, 1981), male aggression (Boness *et al.,* 1995), and female body condition and size (Anderson & Fedak, 1987; Weitzman *et al.,* 2017) have all been shown to result in birthdate advancement. Furthermore, changes in environmental conditions are associated with a variation in female pupping. Research conducted on Skomer Island, Wales, found that a temperature increase of 2°C was associated with a pupping season advance of approximately seven days at the population level (Bull *et al.,* 2021), which supported results from Sable Island (Weitzman *et al.,* 2017). Continued advancement in birthdates, as a result of anthropogenic climate change and increased sea temperatures may distort the critical synchrony between pups and their food supply. Although it is not possible to conclude that females on the Calf are influenced by changing climate, further research could ensure that sufficient conservation is implemented in time.

Additional Observations

'Wandering' Pups

A challenging part of understanding pup production on the calf during this year's survey was the appearance of Stage 5 pups, at a site that was not their natal location, termed 'wandering pups' (Wilkie and Zbijewska, 2019). The Skomer report in 2019 attributed the appearance of these 'wandering pups' to storm or spring tide events (Wilkie and Zbijewska, 2019). These pups were predominantly seen around West of Cow and Cow Harbour and were not accompanied by an adult female nor had pelage marking that could be matched to known moulting pups. Satellite tagging of five recently weaned pups in Iceland showed two broad strategies once taking to the ocean; with some pups remaining near their birthing location, and others dispersing to locations up to 300 km away (Baylis *et al.,* 2019). Last year's survey identified a stage 5 pup that had moved from Cow Harbour to South Harbour, which shows the possibility that some pups travel to different sites once fully weaned. For this reason, these 'wandering' pups were not included in the pup totals for this year as it could not be determined whether they represented a new birth or a relocated existing birth, possibly to a pup that was classed as "missing" or a pup not born on the Calf of Man. For such occurrences on the Calf of Man it would be interesting to determine any potential links with pups born on the Isle of Man, and whether moulting pups can disperse to this extent, possibly driven by the greater level of human disturbance on the main island.

Allosuckling

During this year's surveys on the Calf, two instances of allosuckling were observed; whereby a mother feeds a non-filial pup as well as providing protection and care (Maniscalco *et al.,* 2007). Whilst allosuckling has been frequently recorded, little is understood about the behaviour, although there are hypotheses for its occurrence (Roulin 2002). Allosuckling has been observed in many pinnipeds such as South American fur seals (Franco-Trecu *et al.*, 2010) and Stellar sea lions (Maniscalco *et al.,* 2007) as well as grey seals (McCulloch *et al.,* 1999) including during the previous

two years surveys on the Calf of Man. The first observation of allosuckling this year was at the site Leodan, with female 288, whom had a pup on the 27/09/2021 named 'Withe', with filial relationship confirmed through suckling. This pup was observed at the site until 03/10/2021 and after this the pup was classed as 'missing'. On the 05/10/2021 a stage 5 pup was observed at the same site; although this pup was unknown to surveyors it was not possible that this was 'Withe', who would have only been eight days old (stage 3) at this point. Female 288 came up to the bay, seemingly looking for her pup when the stage 5 pup approached her. Both seemed cautious at first, smelling each other, until eventually the female rolled over allowing the stage 5 pup to suckle (Figure 16). The pair were seen together on three more occasions after the initial observed interaction, where suckling was observed again as well as other parental behaviours. From the possible hypothesis presented by Roulin (2002) two could fit this scenario. Misguided parental behaviour which occurs especially when a reproductive individual is already hormonally or behaviourally primed to provide parental care but have lost their young (Riedman 1982), such as with the case of female 288. Another possible explanation would be that the females nursed the unrelated offspring to evacuate surplus milk, as her biological pup went missing at six days old there could have been a need to remove this milk supply. According to Roulin (2002), getting rid of surplus milk before commencing a foraging trip could serve to prevent teat infection, or to reduce body weight and buoyancy to the benefit swimming and diving ability. The milk theft and the misdirected parental care hypothesis often seem to be connected (Roulin, 2002), therefore it could be possible both scenarios occurred here which led to allosuckling.

Figure 17. Female (catalogue number 288) photographed non filial suckling stage 5 pup. Photograph taken at Leodan on 5th October 2021 (Manx Wildlife Trust, 2021).

The second instance where allosuckling was observed was at Grants Harbour, where pup 'Willy Wonka' was seen suckling from two females, 196 and 388. The biological mother of pup 'Willy Wonka' was Seal 196, whilst female 388 had a pup known as 'Winnie', born four days after 'Willy Wonka'. 'Winnie' went missing on the 06/10/2021 confirmed through the analysis of the camera trap footage. Despite her pup being missing female 388 was still seen around the site, and then was observed offering pup 'Willy Wonka' her milk. After this, this pup was observed suckling from both female 388 and 196, which led to the pup being noticeably larger in comparison to pups the same age, potentially advantageous for the pup's long-term survival. Sea Lion pups who suckled from two females were also larger and grew faster which was seen to have benefitted their survival (Acevedo *et al.,* 2016). The two females were frequently seen guarding the pup from one another, with aggressive behaviour and fighting observed between the two females. This could have possibly been due to the fact after losing her pup, female 388 was attempting to 'kidnap' the pup. Abduction attempts of pups have more frequently been seen to involve females that recently lost their own offspring (Marlow 1972; Boyle, 2010) as was the case of female 388. Another hypothesis for allosuckling is that inexperienced females that have lost their own offspring nurse unrelated offspring to improve their maternal skills. This was the first year female 388 was recorded as having a pup on the Calf. Hypotheses for this behaviour are not mutually exclusive (Roulin, 2002) so misguided parental behaviour and surplus milk this could have influenced female 388s behaviour.

Roulin (2002) did acknowledge that explanations for allosuckling are often more intricate than first assumed, but with the two cases seen this year both had lost their own pup. This could have been the primary factor to why these females exhibited this behaviour. Allosuckling is still a poorly understood and requires further research but there has been suggestion that the drivers behind this behaviour can differ between different colonies (Civil *et al.,* 2021). This highlights the importance for this study to continue to identify finial relationships, and therefore being able to confirm when allosuckling occurs on the Calf.

Figure 18. Photograph of pup 'Willy Wonka' with biological mother catalogue number 196 and female catalogue number 388 who had been seen offering paternal care to non-filial pup. Taken at Grants Harbour on the 2021 (Manx Wildlife Trust, 2021).

Human Disturbance and Pup Abandonment

The direct impact of disturbance on the breeding success of seals is not fully understood. Human disturbances have, in many cases, led to the abandonment of favourable sites and altered haulout patterns that may impact breeding opportunities and success (Dendrinos *et al*., 2007; Kenyon, 1972; Stevens and Boness, 2003; Toorenburg *et al*., 1993). Furthermore, human disturbance can decrease survival rates of pups. Due to the intensive nature of nursing, disturbance within the first few hours of birth may result in the abandonment of the pup (Burton *et al*., 1975; Robinson *et al*., 2015). During the nursing period, repeated disturbances may result in reduced suckling of pups (or a reduced investment from mothers), which may impact pup weaning weight and reduce chances of survival (Engelhard *et al*., 2001; Kovacs and Innes, 1990; Reijnders, 1980). Pup mortality may also occur as a direct impact of human disturbance as pups can be vulnerable to crushing or separation from mothers in the event of a mass stampede (Holst *et al*., 2005; Mattlin, 1978; Moss, 1992).

During the 2021 survey, a total of 3 pups were considered to have been prematurely abandoned. A pup was classified as having been abandoned if the mother was not seen with, and/or nursing a pup who hadn't reached weaning age. Typically abandonment occurs in the early stages, whilst the pup maintained it's white-coat, and is reliant upon milk. It was possible to examine whether abandonment had occurred if the pup did not continue to put on weight. Although the individuals began to moult like any other Stage 4, they were visibly smaller, thinner and weaker (Figure 18). Furthermore, the use of camera trap technology was vital for identifying whether a pup had been abandoned. Once an individual was identified as potentially without it's mother, camera traps were set up to constantly monitor the area (1 photo every minute) for 48 hours. Although the exact causes of abandonment could not be identified, human disturbance is unlikely to have played a role.

Figure 21. Visual differences in pups that were considered abandoned. The two photographs show two different pups, born at the same location, and the same number of days old (11 days). The abandoned pup (left) is visibly smaller and weaker than the pup on the right.

Further Recommendations

Photo Identification

The method of photo identification is essential to the grey seal study on the Calf of Man, which not only allows for surveyors to gain a census of seals at the Calf, but also permits for the identification of mothers. This method is used in many studies of grey seals, but for the most accurate results high-quality photos, showing enough pelage should be used. This year it was identified that some photos within the catalogue are either blurry or pixelated and/or show a small proportion of the seal's pattern. Images such as these reduce the chance that the individual will be matched again too these photos as there is too little to make a positive re-identification. This leads to the duplication of individuals and thus an overestimation for the number of seals. For future surveys, it should be recommended that adding individuals to the catalogue should only be done if the photos are of a high quality and show clear wet pelage of either the head and neck, or preferably also including the flank. There are some limitations to this, as different sites have different visibility and well as distance from the seals which could result in some seals not being logged if the photo quality is not high enough for re-identification. This being said, it would also reduce risk of duplications and thus increase the accuracy in the results for the seal population on the Calf of Man.

Figure 22. a) Shows photos in the catalogue showing a small about of pelage as well as being blurry compared to b) Showing flank and head of seal

Furthermore, at present, only adult seals are added to the main catalogue. During the 2020 and 2021 season, an emphasis was placed on ensuring we got high quality photos of known stage 5 pups. As these pups already have their pelagic markings, it may be possible to observe these seals in future. This long-term study, which will hopefully continue for many more years, presents an excellent opportunity to study the movements of such pups. Maturing at around 5 years old, it may be possible to examine these pups returning to breed in the future; giving further evidence of breeding and natal site fidelity. In addition, it might be found that these pups do not return – choosing instead to breed elsewhere. By sharing these records with other organisations, it may be possible to track their movements across their lifetime. Whilst improvements still must be made to the global sharing of photo-id catalogues, we would recommend that future years continue to add their stage 5 pup individuals to the catalogue.

Boat Surveys

A limitation to this study which has been identified in previous seasons is that there is a high possibility that seals are pupping in locations that aren't visible during land surveys. A possible solution to this would be the use of boat surveys around the Calf of Man that could identify possible additional pupping sites and record any pups seen in other locations. Without doing the boat surveys the same way that the land surveys are carried out it would probably not be possible to track the pups or use the data to calculate survival rates, but it would give a better idea of pups born on the island, even if it is to confirm that it is unlikely pups are born outside of the previous identified pupping sites. As it would not be possible to do boat trips on a regular basis, we suggest carrying out boat surveys around three times during the season. Using the pups born per week graph (Figure 7) these surveys should be spaced out, beginning at the start of peak (22nd September) until the end of the survey season.

Marking Individuals

One of the main aims of the study was to census the number of pups born during the 2021 breeding season. Individual pups were monitored throughout the field season in order to gain information on pup counts and survival rates; as well as female site fidelity. As such, it was important that each individual seal could be recognised. In many cases, this could be confidently be done on the basis of location, age, size and distinguishable features/ traits. However, as the breeding season peaked, it was common to have multiple pups born on the same day and in the same location, making distinguishing individuals tricky. This became problematic in a few instances; such as allosuckling, where it wasn't possible to conclude who was the mother and who was not. Later in the season, a

number of non-new-born whitecoat pups (stage 1-3) began to appear in locations we did not expect. In times like this, we couldn't conclude whether the pup had moved locations, become separated from mum, or arrived on the island post-birth. As a result, it is likely that pup counts are not completely accurate. We suggest the possibility of marking individuals. A number of different organisations have used coloured aerosol sheep-fleece marker sprays in order to differentiate pups. Although shown to have little or no impact on pup development and pup-mother bonds, taking this action would require extensive research before being implemented. Furthermore, it must be acknowledged that many of the Calf sites have limited access and, thus, would not be possible. However, we believe that trialling this method may, not only improve accuracy in counts, but produce interesting results on pup movement.

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Appendix

Appendix A - Pup 'Willet'

During observations, it became apparent that one of the pups (named Willet) in Cow Harbour had been abandoned by its mother. Although 5 days old, no females or possible mothers had been seen in the area. Furthermore, it's behaviour was indicative of this; crying loudly, approaching other mothers, and suckling from other pups. Over the next few days, careful monitoring was done (see Human Disturbance and Pup Abandonment) in order to conclude that Willet was not being nursed. On the 16th October it was decided that it would be suitable to take Willet to a seal-care facility (rehab) on the Isle of Man. The decision was not taken lightly, and many parties were involved in the process. This rescue was only possible as there were trained seal handlers, and weather made the boat crossing possible – it was not feasible to rescue any of the other pups. Previously, only one other pup has ever been taken from the Calf of Man, and sent to ManxSPCA for rehabilitation.

Figure 23. Pup 'Willet' suckling on another pup in the area. This behaviour, which can be indicative of abandonment, was observed during the careful monitoring. This, along with other factors, led to the decision to take Willet to a rehabilitation centre on the Isle of Man.

Figure 24. Pup 'Willet' being transported from The Calf of Man to a rehabilitation centre on the Isle of Man. Handling was done under appropriate licensing.

Appendix B – Developmental stages of grey seal pups

Table 10. Details of the timings and recognition features of the five stages of a grey seal pup development. Developed by Kovacs and Lavigne (1986); Radford et al., (1978).

Stage	Age	Characteristics	
Stage 1	0-2 days	Thin baggy-skinned body Yellow stained or white natal fur Conspicuous umbilical cord Docile & poorly coordinated	
Stage 2	3-7 days	Smoother bodyline, few loose folds Neck still distinguishable Umbilical cord atrophied Aware & coordinated	
Stage 3	7-15 days	Rounded or barrel shaped body Neck thickened/indistinguishable Partial moulting from head or flippers May be aggressive on approach	
Stage 4	16-20 days	Rounded body Partial moulting from torso Head & flippers moulted May be aggressive on approach	
Stage 5	18-25+ days	Fully moulted to short fur coat (< 100cm^2 natal coat remaining) May be aggressive on approach	

Appendix C – Glossary of Terms

Term	Definition
Allosuckling	When a female feeds a pup that is not her own offspring.
Anthropogenic	An environmental change cause or influenced by people.
Carrying Capacity	The maximum population size of a species in an environment.
Filial relationship	A link between the parent and their direct offspring.
Hauled-out	When seals come out of the water and spend time on dry platforms.
Lanugo	The white hair that covers seal pups before their first moulting.
Moulting	When seals shed their hair and replace it with a new growth of hair.
Pelage	The hair covering a seal's body.
Philopatric	The tendency to return to or return near a breeding site.
Pinnipeds	A suborder of carnivores referring to the group of fin or flipper footed marine mammals
Sex-bias	A result skewed towards a certain sex.
Site fidelity	The tendency to stay within or habitually return to a specific location.
Subspecies	Different populations of the same species showing some variation.
Topography	The arrangement of the natural and artificial physical features of an area.
Weaning	The process or causing young to stop feeding on their mother's milk.

Appendix D – Calf of Man Births 2021

Table 11. Overview of the pups recorded on the Calf of Man in the 2021 breeding season. The data shows when the pups were first seen, last seen and when they were recorded as being Stage 5 pups. Where 'Date last seen' is bold, the pup was still present in the area on the last day of observations. The complete spreadsheet including information on developmental stage timings can be found on the MWT hard drive.

Pup Number	Pup name	Date first seen	Location	Mother ID	Stage 5	Date last seen
1	Wallacea	07/09/2021	GL			07/09/2021
2	Wellington	07/09/2021	GI	19	30/09/2021	04/10/2021
3	William	08/09/2021	BF	Unknown		08/09/2021
4	Widget	15/09/2021	GI	398LM		04/10/2021
5	Wispa	15/09/2021	BF	120		02/10/2021
6	Wren	16/09/2021	SC	127		03/10/2021 or 05/10/2021
7	Wink	16/09/2021	MG	396	11/10/2021	15/10/2021
8	Wish	18/09/2021	SC	248		03/10/2021 or 05/10/2021
9	Wally	21/09/2021	SC	Unknown		29/09/2021
10	Willow	22/09/2021	GI	300		06/10/2021
11	Waldo	22/09/2021	SH	98	15/10/2021	02/11/2021
12	Woollard	23/09/2021	GL	199	15/10/2021	23/10/2021
13	Winter	23/09/2021	GL	34	15/10/2021	15/10/2021
14	Wayne	23/09/2021	MG	265	Y	1/14/1900
15	Wave	23/09/2021	PU	251	09/10/2021	25/10/2021
16	Waffle	24/09/2021	GH	4	16/10/2021	26/10/2021
17	Wright	25/09/2021	LE	15	15/10/2021	01/11/2021
18	Whilhelmina	25/09/2021	MG	62	13/10/2021	01/11/2021
19	Wyatt	25/09/2021	PU	303	13/10/2021	25/10/2021
20	Wanderer	26/09/2021	GI	Unknown		26/09/2021
21	Worm	27/09/2021	MG	203	15/10/2021	25/09/2020
22	Withe	27/09/2021	LE	288		03/10/2021
23	Wednesday	29/09/2021	LE	151	19/10/2021	21/10/2021
24	Wind	29/09/2021	PU	194	17/10/2021	25/10/2021
25	Waterbaby	30/09/2021	GH	290	20/10/2021	24/10/101`
26	Whiskers	30/09/2021	GH	306	16/10/2021	28/10/2021
27	Willy Wonka	30/09/2021	GH	196	28/10/2021	01/11/2021
28	Walaby	30/09/2021	SH	397LM	27/10/2021	29/10/2021
29	Womble	30/09/2021	SH	223	25/10/2021	02/11/2021
30	Wailer	01/10/2021	MG	107	27/10/2021	01/11/2021
31	Wings	02/10/2021	GH	40		N/A
32	Whirlpool	02/10/2021	PU	136	23/10/2021	31/10/2021
33	Winnie	04/10/2021	GH	388		06/10/2021
34	Wonder	02/10/2021	CH	14	20/10/2021	28/10/2021
35	LE1	05/10/2021	LE	Unknown	05/10/2021	13/10/2021

Deceased

Date at which pup was recorded as being Stage 5

New pup not seen at S1 and no apparent mother

36	Whu	07/10/2021	PU	Unknown	17/10/2021	25/10/2021
37	Worthy	07/10/2021	MG	400LM	31/10/2021	01/11/2021
38	Woody	08/10/2021	GH	221		01/11/2021
39	MG1	09/10/2021	MG	Unknown	09/10/2021	15/10/2021
40	Wilberforce (William)	09/10/2021	PU	302	27/10/2021	01/11/2021
41	Waverley	09/10/2021	PU	Unknown		01/11/2021
42	Weevil	10/10/2021	MG	206		01/11/2021
43	Wairi	11/10/2021	SC	409LM		21/10/2021
44	Wauren	10/10/2021	SC	308		15/10/2021
45	Wolly Socks	11/10/2021	PU	Unknown	N	
46	Willet	11/10/2021	CH	Unknown	N	Taken to Rehab in Isle of Man
47	Wotsit	12/10/2021	CH	Unknown		20/10/2021
48	Walter	12/10/2021	SH	401LM	31/10/2021	02/11/2021
49	Wilma	12/10/2021	SH	402LM	31/10/2021	02/11/2021
50	GL1	13/10/2021	GL	Unknown	13/10/2021	13/10/2021
51	Why	13/10/2021	PU	Unknown		17/10/2021
52	Wasabi	14/10/2021	GI	404LM		20/10/2021
53	Walnut	14/10/2021	PU	408LM		01/11/2021
54	Wes	15/10/2021	PU	230		01/11/2021
55	SH1	15/10/2021	SH		15/10/2021	15/10/2021
56	Wendy	16/10/2021	GH	373	31/10/2021	31/10/2021
57	Wallace	16/10/2021	GH	399LM		30/10/2021
58	Warbler	17/10/2021	SH	410LM		02/11/2021
59	WHAM!	17/10/2021	PU	411LM		23/10/2021
60	Weasley	20/10/2021	CH	405LM		01/11/2021
61	Wilson	22/10/2021	CH	298		01/11/2021
62	Wiggle	23/10/2021	BF	407LM		29/10/2021
63	Watson	26/10/2021	CH	278		01/11/2021
64	CL1	26/10/2021	CL		26/10/2021	26/10/2021
65	WC1	26/10/2021	WC		26/10/2021	01/11/2021
66	WC2	26/10/2021	WC		26/10/2021	26/10/2021
67	WC3	26/10/2021	WC		26/10/2021	26/10/2021
68	CH1	26/10/2021	CH		26/10/2021	26/10/2021
69	Wakiki	27/10/2021	PU	Unknown		29/10/2021
70	When	27/10/2021	SH			27/10/2021
71	CH2	28/10/2021	CH		28/10/2021	
72	CH3	30/10/2021	CH		30/10/2021	30/10/2021
73	CL2	30/10/2021	CL		30/10/2021	30/10/2021
74	WC5	30/10/2021	WC		30/10/2021	30/10/2021
75	CH4	31/10/2021	CH		31/10/2021	31/10/ 2021
76	CH5	30/10/2021	CH		30/10/2021	30/10/2021
77	CH6	30/10/2021	CH		30/10/2021	30/10/2021
78	Warden	01/11/2021	GH	406LM		01/11/2021