

Alderney's Blonde Hedgehogs



**Report By
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We would first like to send a big thank you to all the Citizen Science Volunteers for carrying out the surveys in 2021 and 2022. Without your efforts our study would not have been possible.

The aim of this 2022 Report is to update you regarding the results of our surveys, studying the proportions of blonde (leucistic) and brown hedgehogs, and to see whether there are any significant variations in the numbers shown, as well as presenting our other research activities. This follows on from the 2021 Report and is by way of a yearly summary of our continuing research.

2022 Survey Results

Table 1: Survey Results 2022

| Date | 23 rd May 2022 | 25 th July 2022 | 19 th Sept 2022 | 17 th Oct 2022 |
|----------|---------------------------|----------------------------|----------------------------|---------------------------|
| Blonde | 36 | 39 | 30 | 24 |
| Brown | 25 | 21 | 19 | 20 |
| Total | 61 | 60 | 49 | 44 |
| % Blonde | 59% | 65% | 61% | 55% |

To summarise Table 1: The percentage of blonde animals in May was 59%, in July 65%, in September 61%, and in October 55%.

Table 2 highlights the percentage of blonde and the total animals counted in the seven years that data is available.

Table 2

| Year | 2011 | 2012 | 2013 | 2014 | 2015 | 2021 | 2022 | Seven Year Average |
|-----------------------|------|------|------|------|------|------|------|--------------------|
| % Blonde | 56% | 64% | 68% | 59% | 57% | 56% | 60% | 59% |
| Total Animals Counted | 55 | 89 | 34 | 98 | 70 | 56 | 54 | 65 |

The data above shows a remarkable consistency in the proportions of blonde to brown hedgehogs from 2011 onwards, with the 2022 result confirming all the other survey results.

The overall conclusion therefore is that over this time there hasn't been any significant change in the proportions of blonde and brown animals.

The seven year average being 59% blonde, 41% brown.

Our Commentary

This suggests that the proportion of blondes to browns on Alderney seem to be fixed in the population.

Indeed, it can be assumed that these proportions were already embedded into the population by 2011 as the data throughout is so consistent.

This is a highly unusual result in any mammalian population, but nevertheless confirms that the blondes are here to stay on Alderney.

Looking at the result from a genetic perspective, as “being blonde” is a recessive trait*, the question that must now be asked is how did a recessive mutation become fixed in the population?

**** Recessive denotes heritable characteristics, controlled by genes, that will be expressed in the offspring only when inherited from both parents.***

It is understood that no additional hedgehogs have arrived on the island since the 1960s, and, therefore, there have been no additions to the genetic pool (see 2021 Report for the description of the hedgehog introduction to Alderney). It follows that this population will be inbred and over time it is possible that any mutation could become more numerous, as long as it isn't so deleterious that the animals aren't fit enough to survive to sexual maturity.

Although leucism (blonde) is caused by a recessive mutation and can have some harmful effects on the individual hedgehog, it is clear the Alderney animals are viable. Of course, under normal circumstances a blonde animal, (that should be brown and therefore camouflaged), will stand out and be easy prey, however, Alderney hedgehogs don't have any predators, so this mutation has thrived.

Nevertheless, the high numbers of the Alderney blonde hedgehog remain a mystery.

To produce a blonde hoglet both brown male and female parents must have the recessive (silent) blonde gene, and if the two “silent” genes combine, a blonde hoglet will be produced.

Although the explanation above is a reasonable genetic answer to blondes appearing in the first place, once the mutation appeared, how did it “take hold” the way it has?

Inbreeding can account for the survival of the trait, however not in the numbers that are found on the island, i.e. the browns should still outnumber the blondes.

Further, as described in the 2021 report, the anecdotal evidence suggests that the founder hedgehogs brought onto the island were all brown.

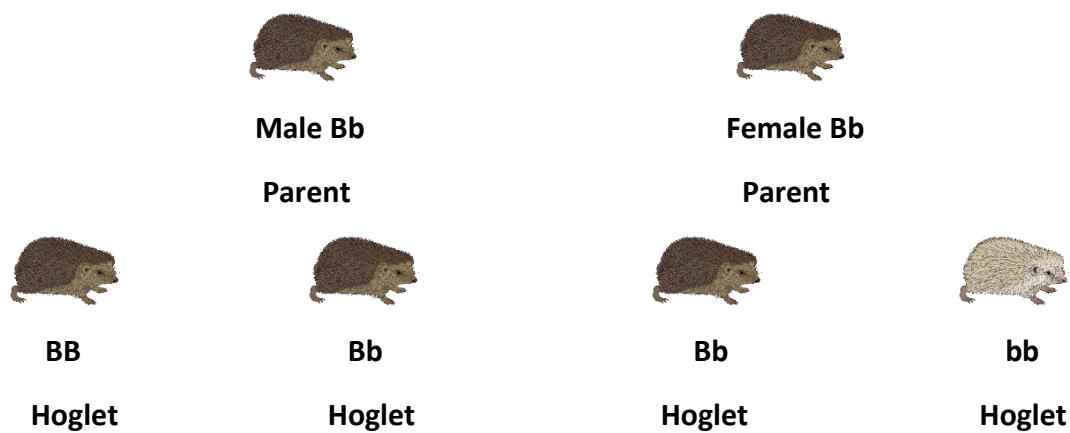
So, there is a conundrum.

For blondes to appear at all then the mutation either came onto the island with two or more of these hedgehogs, or the mutation occurred sometime after they arrived. Unfortunately, it would be difficult to prove how the blonde trait arrived, but we can attempt to study the reasons for its persistence in such large numbers.

The Genetics

As discussed in our 2021 report and reiterated here, if it is assumed that the anecdotal evidence is correct and the founder hedgehogs were all brown, and it is further assumed that the first blonde hoglet was produced because both parents carried the recessive gene, the outcome would be 1 blonde out of four hoglet. (See figure 1 below)

Figure 1



The genetic convention uses a capital letter for the dominant gene, B, and lower case letter for the recessive gene, b.

That means that if the hoglets have at least one dominant gene then the hoglet will be brown, and only when two recessive genes combine will the hoglet be blonde.

The resulting ratio would be a 3 to 1 in favour of brown hoglets so the population would be 75% brown. That is clearly not the case on Alderney.

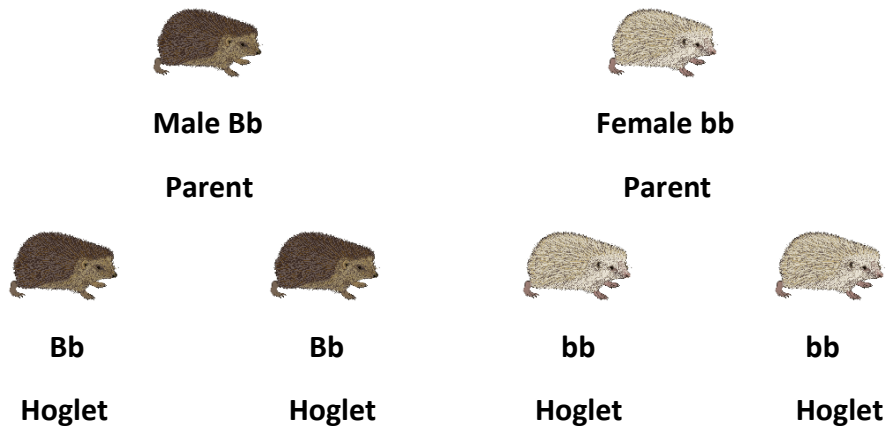
So, one of the ways to achieve a fixed population ratio of around 50/50 of brown to blonde individuals would be for the majority of brown animals on the island to carry the recessive gene and for them to mate with blonde animals (see Figure 2 p.6).



Picture showing blonde and brown hedgehogs mating

Courtesy of AWT

Figure 2



As explained for Figure 1, Capital B is the dominant gene, and lower case b is the recessive. In this scenario, Figure 2, two hoglets will be brown and two will be blonde, giving a 50/50 ratio.

Of course, they can also pair up brown with brown, producing all brown hoglets, and blonde with blonde will produce all blonde hoglets, but to sustain a recessive population in the proportions seen the majority of the brown hedgehogs would need to be Bb (the genetic description for an animal having one dominant and one recessive gene is described as **heterozygous**).



Picture of two blondes mating

Taken by a visitor to the island in 2022

Population Size

The working assumption regarding the number of founder hedgehogs (based on the anecdotal evidence already described in our 2021 report), is that three brown pairs were introduced in the 1960s. That is approximately 60 years ago.

It has been reported when hedgehogs have been introduced on other islands, that their numbers increase significantly, and in some cases they become a significant pest species.

However, on Alderney the population size doesn't seem to be large, indeed, we wonder why there aren't many more hedgehogs on predator free Alderney?

What are the possible restricting factors?

To attempt to answer this ecologically complex problem, we decided to initially investigate two possible limiting factors, or at least collect some evidence that would eliminate them. One study (**Study 1**) emerged from the anecdotal suggestion that starvation maybe a factor. The other (**Study 2**) is an investigation to check the presence of endoparasites, and if so, to ascertain whether the infection is clinically significant, and, therefore, causing mortality.

Study 1: Marking, Tagging and Weighing

To investigate whether the hedgehogs can find enough food to reach and maintain a healthy weight we marked (by colour spray), tagged and weighed hedgehogs found on two sights, the golf course run by Suzy Weir, and the airport run by James Vizard.

To identify the hedgehogs from each site we used orange spray and tags for the golf course, and blue spray and tags for the airport. (The coloured sprays used were nontoxic and are regularly used for marking farm livestock.)

Photograph 1



Photograph by Suzy Weir



Photograph by James Vizard

The method employed was to attach a uniquely numbered tag on each hedgehog and weigh it. That gave its weight at a certain date, allowing us to check if it was a healthy weight, and then, if found again or multiple times, the animal was reweighed. This would indicate whether it was losing weight over the season enabling us to check whether the animals were finding enough food.

The summary of the weight data for the golf course and the airport are presented in Table 3 below.

Table 3

Golf Course and Airport Hedgehog Weights

| | Total Animals | Average Weight | Heaviest | Lightest | Average Initial Weight Found and Weighed at least twice | Average Final Weight Found and Weighed at least twice | Average Blonde Weight | Average Brown Weight |
|--------------------|---------------|----------------|----------|----------|---|---|-----------------------|----------------------|
| Golf Course | 36 | 683g | 1050g | 250g | 633g | 696g | 722g | 675g |
| Airport | 38 | 695g | 1025g | 250g | 633g | 686g | 720g | 638g |

Summary of Results

The total individual animals weighed were: 36 at the golf course; 38 at the airport.

These results show that the average weight from the two sites is very similar: 683g on the golf course; 695g at the airport.

Furthermore, comparing the first and last measurements, clearly shows that in both sites the animals sustained a healthy weight.

Finally, we checked whether there were differences in the weights of the blonde animals as compared to the browns at both sites. Although the average weight of the blonde animals was heavier than the brown in both sites, these data were statistically insignificant.

Conclusion

From these results we can conclude that the hedgehogs are finding adequate food to maintain a healthy weight, and that 600g to 700g is satisfactory for a successful hibernation.

This study is planned to continue into 2023 to see if there are any differences between years.

Study 2: Parasite Study

Parasite infection can put pressure on population size, so we decided to start a study of endoparasite (internal) presence.

We would like to note here that a very experienced animal naturalist on the island, Jens Gardner, who has taken care of injured animals, including hedgehogs, for many years, explained that he has never seen any hedgehogs or other animals suffering from endoparasitic diseases. Further, he has had discussions with others and was advised that, "... there haven't been any cases, to date, even among domestic animals".

(It should also be noted that external parasites, such as fleas and lice, haven't been recorded, however, the odd animal has been seen with a tick, although none with a heavy infestation).

This year's study of hedgehog endoparasites is preliminary and we plan to continue next year in order to amass more information. However, we wanted to include these initial results in this report.

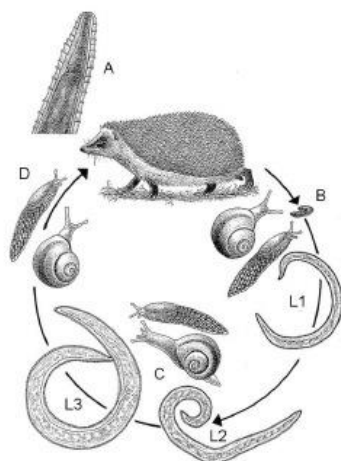
The main researcher on this project is Alex Purdie M.Sc., currently the Ramsar Officer for the AWT. (We would like to sincerely thank Alex for his important input in this study).

We would also like to thank Mr Ian Carter for his generosity in supplying the microscope.

Summary of Endoparasites in Mammals and Birds including Hedgehogs

There are four common endoparasites found in these animals, two species of worm which effects the lung, and therefore are called lungworm. Their scientific names are *Crenosoma striatum* (see life cycle diagram below), and a *Capillaria aerophile*. Hedgehogs can also carry a round worm (*Capillaria erinacei*), and a fluke (*Brachylaemus erinaceid*), both of which infect the digestive system. It is generally understood that lungworm and fluke are carried by slugs and snails, and roundworm by earthworms.

These are the endoparasites that we were looking for in the Alderney hedgehogs.



Life cycle of *Crenosoma striatum* (lungworm)

Developmental cycle of *Crenosoma striatum*. (A) Adult female in the lungs of a hedgehog. (B) L1-larvae from the faeces actively penetrate the snail intermediate hosts. (C) Development to the infectious L3-larvae within the intermediate host. (D) Ingestion of infectious snails by a hedgehog (after REEVE 1994)

Evidence from Study of Faeces

Pictures of lungworm and round worm in hedgehogs on Alderney.



Lungworm (Crenosoma striatum) Photo: Alderney Animal Welfare Society



Roundworm (Capillaria) Photo: Alex Purdie

Preliminary Results

As this is an ongoing study, we can only report some initial results here. So far, Alex Purdie has found evidence of lungworm (Crenosoma striatum), picture above, and roundworm (Capillaria), and a fluke (Capillaria) egg (no picture available). Indeed, although we have examined a relatively small number of animals to date, Crenosoma striatum was found in some of the samples.

This proves that lungworm is present on Alderney but doesn't seem to manifest clinically, which suggests that the parasitic load is low and the animals are able to tolerate its presence.

(Recently an isolated case of a hedgehog suffering from lungworm has been reported, but this would appear to be very unusual).

Our Commentary

These very preliminary results suggest that the animals are carrying parasites however, in general, the load is insignificant, and they are able to tolerate a small infection. By collecting more data, we will see whether this conclusion holds. (Although outside of the scope of this study, it would be interesting to see the infection levels in other wild and domesticated animals on Alderney.)

Other 2022 Observations

Hedgehog Wanderings

During the tagging and weighing study, we took advantage of the sprayed animals and asked people to look out for them around the island.

For observations, apart from utilising the golf course (orange spray) and airport (blue spray) hedgehogs, we added two other sites, Platte Saline Common (red spray) and a garden on Braye Road (purple spray).

We would like to thank John Horton and Matt Scragg for running the Platte Saline site and the Arkwright family for their help in their garden.

Hedgehog Movements Results

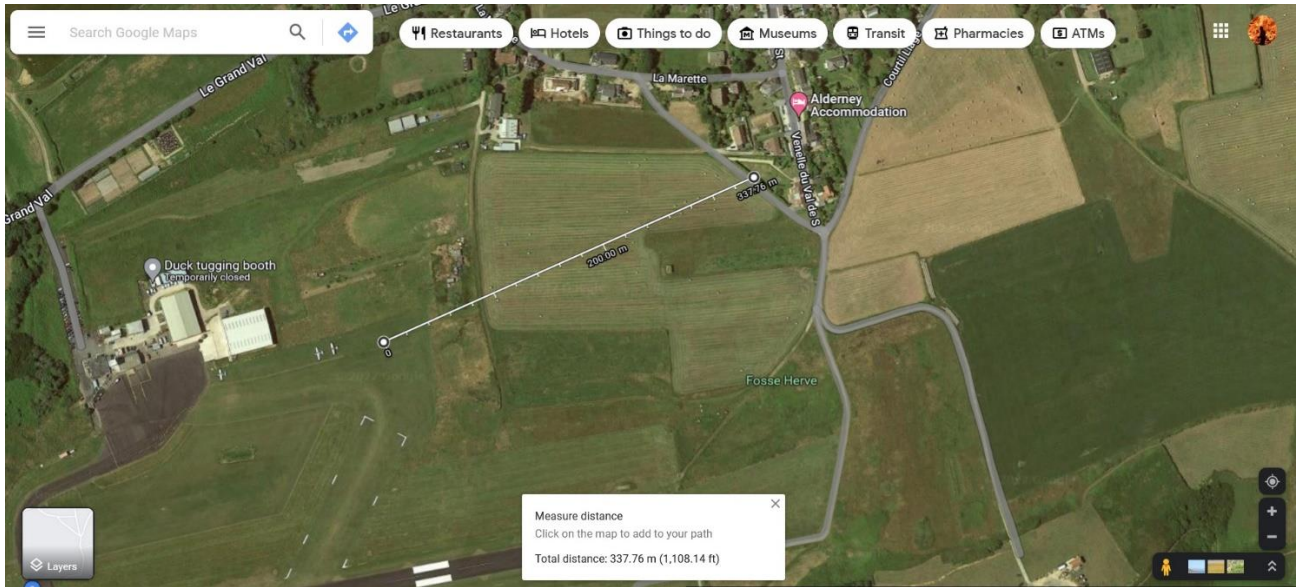


Note the purple spray on the hedgehog on the right hand side. This one was sprayed in the Braye Road garden and was photographed in Suzy Weir's garden 1.3km away.

Below are James Vizard's photographic records of two separate sightings of individual blue sprayed hedgehogs: one near the southern cliffs; the other 337 meters away near Vennelle Du Val Du Sud.



See blue circle.



This hedgehog on Platte Saline beach. was sprayed red (top right) a number of weeks before the sighting and is clearly a local hedgehog that is attracted to the beach.

Our Commentary

Although it is not surprising that hedgehogs are moving around the island, marking them was a good exercise for collecting information. However, we will also be considering other methods for collecting more detailed data in the future.

Beach Hedgehogs and Flies

One of many mysteries surrounding Alderney's hedgehogs is the strange behaviour of those that wander down to Platte Saline beach, although it has yet to be determined whether some frequent other beaches on the island.

It seems a very strange habit as their staple diet is beetles and Platte Saline Common, ideal for finding food, is close by. Nevertheless, all hedgehogs found the beach have probably walked from the common. One of the animals John Horton and Matt Scragg marked on the grass nearby (in the photograph above) was subsequently found on the beach a number of days later.

The question is what attracts them? Indeed, as the beach fauna and flora is extremely salty, if they are eating the sand hoppers and/or seasonal flies, then does this mean that they are able to tolerate salty food?

As we were curious about this, and we had noticed that during the Spring and Summer there are countless numbers of flies that swarm on the beach, we thought it would be useful to identify the species.



Alderney Beach Blonde Hedgehog tolerating swarms of flies (July 2021)

Photographs taken by the authors July 2021

Some of the flies were collected by Suzy Weir in October 2022 and sent to an expert entomologist, Dr Andrew Whittington (Consultant Entomologist, PhD, FRES), who kindly agreed to identify them for us.



Photograph courtesy of Andrew Whittington. He identified the flies as *Fucellia tergina* (Zetterstedt, 1845) of the family Anthomyiidae. *Fucellia tergina*, a seaweed fly.

Dr Whittington remarked: "The larvae of these flies are likely to be small - rice grain in size, so it would be slim pickings for the hedgehogs, but if there are loads of larvae, there would probably be a meal in it. The hedgehogs might also eat the adults of course."

Ongoing Research Projects for 2023

1. Citizen Science brown/blonde proportion count.
2. The continuation of the tagging and weight data collection.
3. The continuation of the endoparasite study in order to ascertain a better overview of parasitic loads in the hedgehogs, and also check whether there is a difference between brown and blonde animals in this regard.
4. Genomic Sequencing Studies will begin in 2023, initially investigating genetic markers that will give some indication of the number of females that started the hedgehog population on Alderney (called "founder mothers"). We have added a short summary of the initial genomic sequencing goals below.
5. We will be considering other projects that have not, as yet, been elucidated.

Genomic Sequencing: Summary of Initial Goals

Founder Mothers

DNA will be extracted from the buccal samples of brown and blonde hedgehogs multiple copies of the same DNA fragment will then be produced using a genetic marker technique (PCR) and then sequenced on an Oxford Nanopore sequencer. These data will be analysed in order to ascertain whether there are any distinct patterns that might identify a founder mother signal.

Leucism Study

As explained above, for a recessive mutation to become fixed in such high numbers in the population the majority of brown hedgehogs on Alderney are likely to carry one recessive gene (Bb).

Although there are a number of genes that are involved with the manifestation of leucism, there is one that effects the development of the cells that produce the normal colour in the embryo, called the KIT gene.

This will be our initial target gene.

We hope to be updating you about this study by the end of 2023.

Another aspiration is to run a controlled breeding programme.

This is easier said than done. It would mean making sure that brown and brown, blonde and blonde, and brown and blonde, mate in separate, confined pens, so that the pregnant females cannot get out, thereby ensuring that the colour of each hoglet can be recorded.

We are considering the practical implications of this programme regarding the methodology, in order to decide whether or not to attempt this experiment in the future.

If you have any queries about our research, please feel free to contact us.

Finally, we thought we would add this amazing photograph, found on the internet, of a starling murmuration in the shape of a hedgehog (check out its eye!).



Title Page Photograph: David Nash