

# Secret Parentage of an Owlet Parthenogenesis or Hybridization?

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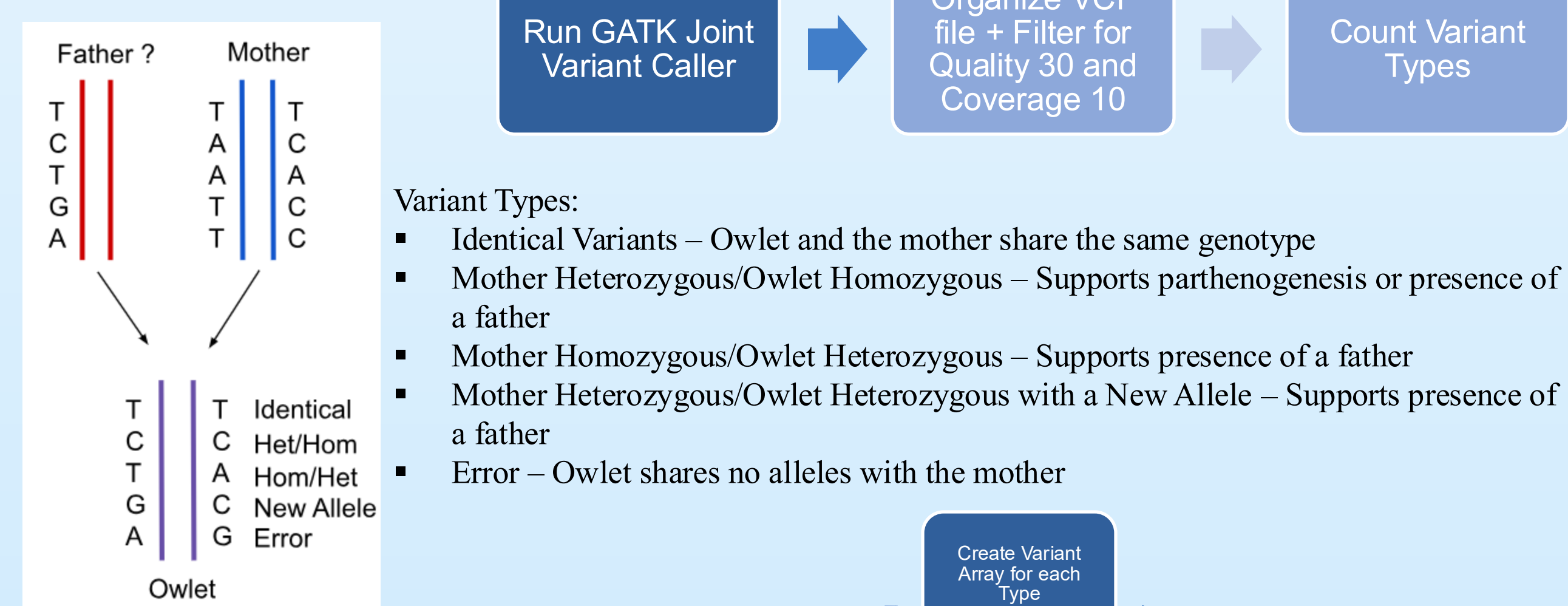
## Introduction

- A non-viable owlet was found in the enclosure of a captive Eurasian Eagle-Owl (EEO), which are native to Europe and Asia<sup>1</sup>
- Since there are no other wild or captive EEOs in New England, the owlet must be a product of either parthenogenesis or hybridization
- Parthenogenesis** is a form of asexual reproduction that can happen in birds. It is the result of an unfertilized egg developing into an embryo. These eggs are mostly abortive<sup>2</sup>
- Hybridization** is when two distinct species reproduce
- A previous hybridization event has been documented between a EEO and a Great Horned Owl<sup>3</sup>
- Goals:
  - Determine whether the owlet is the result of parthenogenesis or hybridization
  - If the owlet has a father, then determine which species the father is

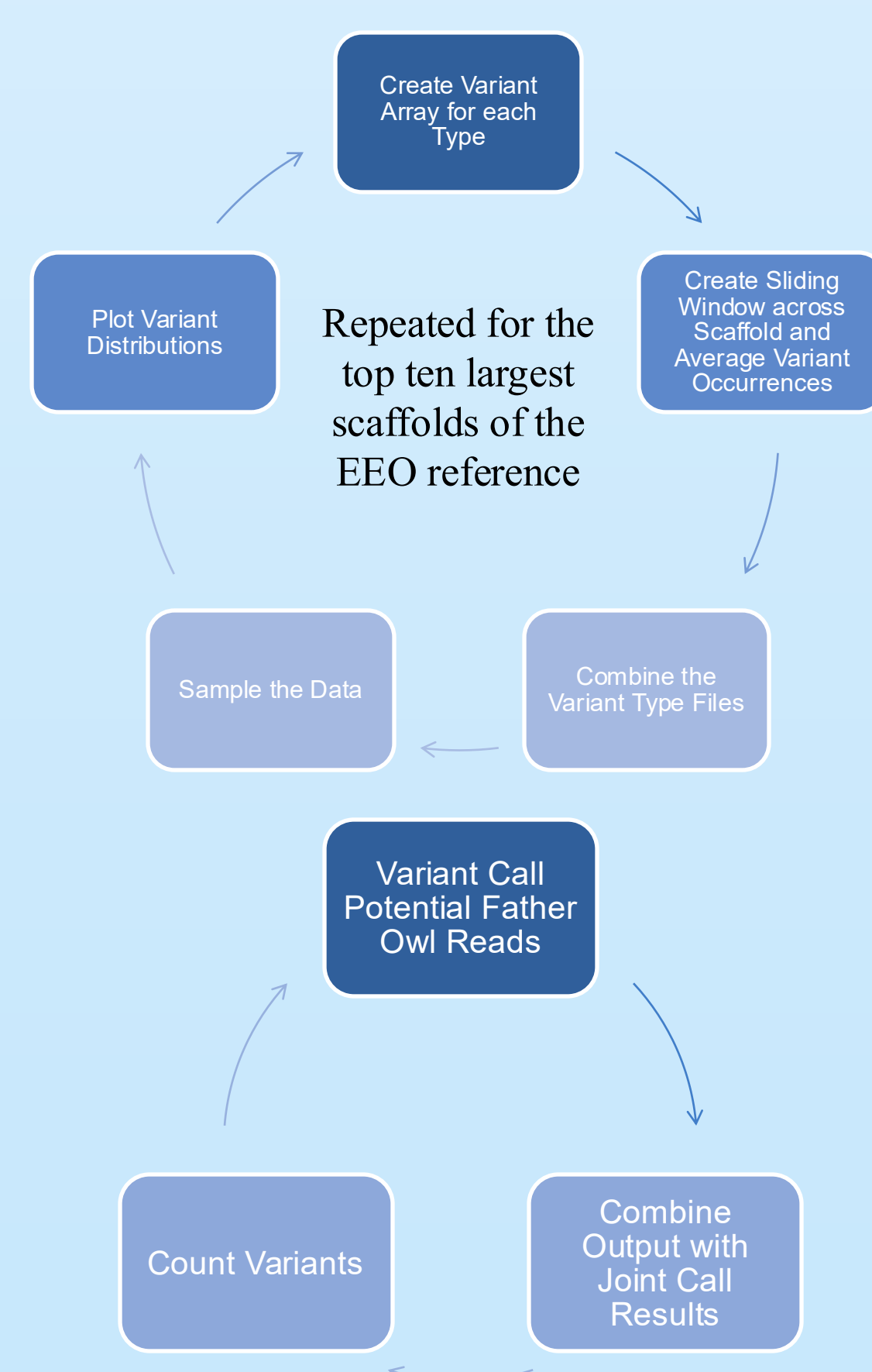
## Methods

### Parthenogenesis or Hybridization:

#### 1. Variant calling



#### 2. Visualize variant distributions



### Determining Father Species:

#### 1. Variant call potential fathers

- Repeated for all potential father species:
- Great Horned Owl (*Bubo virginianus*)
  - Blakiston's Fish Owl (*Bubo blakistonii*)
  - Snowy Owl (*Bubo scandiacus*)
  - Northern Hawk Owl (*Surnia ulula*)
  - Eastern Screech Owl (*Megascops asio*)
  - Boreal Owl (*Aegolius funereus*)
  - Barn Owl (*Tyto alba*)

#### 2. Determine Mapping Percentages

The 'flagstat' command from Samtools was used to determine how well reads from the potential fathers map to the EEO reference as well as how well the owlet reads map to the potential father genomes.

## Results

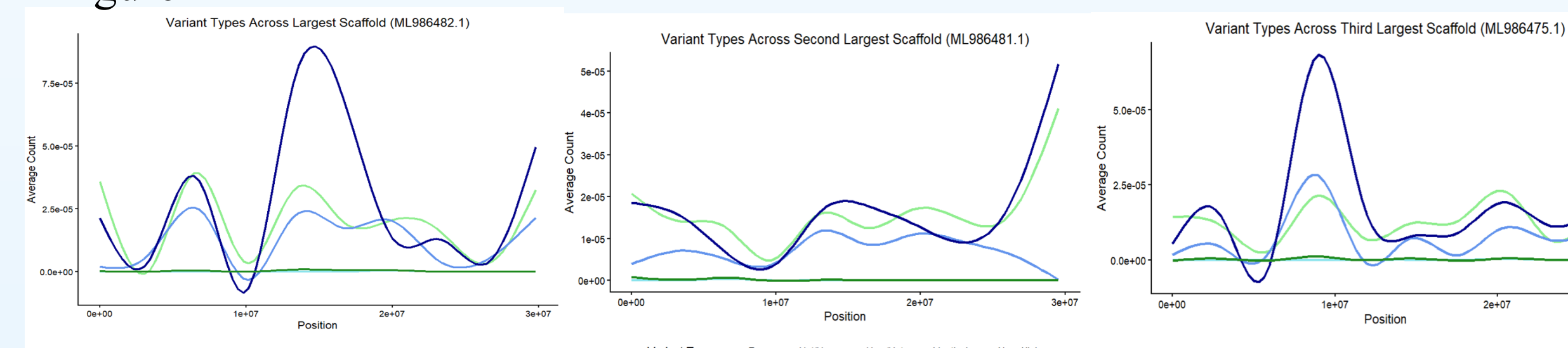
### Parthenogenesis or Hybridization:

Figure 1

Joint Call: Variant Type Counts					
Variant Type	Identical	Het/Hom	Hom/Het	New Allele	Error
Count	132,177	48,880	38,656	1,085	435

Table showing the results of the joint variant call for the mother and owlet reads. Variant types include identical variants, variants where the mother is heterozygous and the owlet is homozygous, variants where the mother is homozygous and the owlet is heterozygous, variants where both the mother and owlet are heterozygous with the owlet having an allele not in the mother, and variants that were considered errors. Errors consisted of variants where the owlet has no matching alleles with the mother.

Figure 2



Variant distributions across the three largest scaffolds.

### Determining Father Species:

Figure 3

	Variant Type Counts with Potential Father Species						
	Great Horned	Blakiston	Snowy	Northern Hawk	Eastern Screech	Boreal	Barn
Identical	21,217	19,284	24,206	4,818	8,659	978	1,652
Het/Hom	9,082	8,714	11,400	2,184	4,389	494	746
Hom/Het	469	746	580	648	714	186	355
Het/Het	7,173	9,062	7,898	4,751	6,412	1,325	1,620
No Father Allele	1,366	2,636	2,143	2,678	2,431	523	1,591
Error	36	47	61	14	26	1	4

Table showing the results of combining the joint variant call results with the variant call for each potential father species. The variant type counts consist of the owlet inheriting an allele from the mother and from the potential father species. The variant type called 'No Father Allele' refers to variants where the owlet does not have a matching allele with the potential father species.

Figure 4

	Mapping Percentage for Father Reads						
	Great Horned	Blakiston	Snowy	Northern Hawk	Eastern Screech	Boreal	Barn
% Mapped	97.03	96.73	96.11	96.06	95.03	93.63	89.09
% Primary Mapped	96.97	96.67	95.77	96.00	94.91	93.54	88.88
% Properly Paired	88.07	87.33	78.03	91.55	92.04	90.03	81.23

Table showing the mapping percentages of reads from the potential father species to the EEO reference. % Properly Paired refers to reads that were mapped onto the right strands.

Figure 5

	Mapping Percentage for Owlet Reads			
	Eurasian-Eagle	Great Horned	Blakiston	Snowy
% Mapped	99.19	99.28	99.54	99.29
% Primary Mapped	99.00	99.05	99.30	99.13
% Properly Paired	90.63	87.32	82.93	85.50

Table showing the mapping percentages of the Owlet reads to the reference genomes of the mother and potential fathers.

## Discussion



Eurasian Eagle-Owl



Great Horned Owl



Snowy Owl

### Parthenogenesis or Hybridization:

The variant types of interest that would support the presence of a father are the 'Hom/Het' and the 'New Allele' variant types (Fig.1, Fig.2). This is because these two variant types involve the owlet inheriting an allele from another source that is not the mother. Figure 1 shows counts of 38,656 and 1,085 for the 'Hom/Het' and 'New Allele' variants respectively, therefore supporting the presence of a father over parthenogenesis. The variant distributions shown in Figure 2 further support the presence of a father because the distributions are spread out over the whole scaffold instead of appearing as a series of flat areas and peaks as would be the case for parthenogenesis, particularly for the 'Het/Hom' variants. While not shown on this poster, this pattern is consistent for all the top ten largest scaffolds. Based on these results, it can be confidently said that **the owlet has a father** and is not the product of parthenogenesis.

### Determining Father Species:

All owl species native to New Hampshire and with available genomes were looked at, in addition to an outgroup species (Blakiston's Fish Owl). Based on the higher identical variant counts in Figure 3 for the Great Horned, Blakiston's Fish, and Snowy owls in comparison to the other species, the list of potential fathers could be **narrowed down to either the Great Horned or the Snowy** since Blakiston's Fish owls aren't native to New Hampshire. Figure 4 serves as a check to make sure that the reads of the father species are mapping well to the reference genome. This is important to know for an accurate comparison of the variant counts between potential fathers because it evaluates whether variant counts are affected by the quality of the reads from the potential father species. Figure 4 shows that all potential father reads map very well to the reference and so the comparison between variant counts in Figure 3 are an accurate representation. To narrow down the father species even further this same idea of using the mapping percentages was used only this time with mapping the owlet reads to the narrowed down father species in hopes of revealing a species that the owlet maps better to. Figure 5 shows the results of this experiment and the results are indistinguishable between species. This makes sense as the species genomes already need to be close enough to hybridize. So, the species couldn't be narrowed down.

**In conclusion**, the owlet is not a product of parthenogenesis, and its father species is most likely either the Great Horned Owl or the Snowy Owl. The father species was able to be narrowed down due to higher similarity and what was physically possible. Currently, another attempt at narrowing down the father species even further is being made by aligning the genomes of the narrowed down fathers, the owlet, and the mother. The hope is that this alignment will reveal portions of one of the father's genomes that align better with portions of the owlet's genome.

## Acknowledgements/References

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