

Evaluation of two observational  
methods to assess  
the numbers of nesting puffins  
(*Fratercula arctica*)



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# Background

- Accurate monitoring of population numbers is essential for conservation.
- For some species this can be an easier task than for others.
- Large numbers, camouflage or inaccessible landscapes make counting individuals difficult or near impossible.
- Reliable methods are needed.



# North Atlantic Puffin (*Fratercula arctica*)

- Belongs to the Auks
- Pelagic bird
- Uses wings to move under water
- Feeds mostly on sand eels



# North Atlantic Puffin (*Fratercula arctica*)



- Puffin numbers have declined around the British coastline
- The species is listed on the Red List of Threatened Species by the International Union for Conservation of Nature and Natural Resources
- 580,799 nesting pairs in the UK (RSPB, 2016)

# North Atlantic Puffin (*Fratercula arctica*)

- Breeding failures have occurred at key colonies.
- In recent years, research has found that fewer young birds are surviving
- There was a substantial loss of numbers during winter storms in 2013/14, where many puffin bodies were washed up on UK shores (Centre for Ecology and Hydrology, 2013).
- It is therefore important to provide accurate counts of nesting birds to monitor the distribution and survival of the species.

# Their environment



- Puffins live in large colonies
- They nest in burrows, which makes it very difficult to observe overall numbers.
- They nest on steep slopes or cliffs.
- Even if they were accessible, an approach would affect the animals too much.

# Very steep cliffs...



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Lundy, May 2008. One of our puffins is out collecting nest material - unfortunately it strays too close to the cliff edge...

Video by Grantus4504

# How to count nesting puffins

- Puffins are monomorphic (Doutrelant et al., 2013) and therefore a differentiation between individuals that visit the same burrow is nearly impossible.
- To estimate numbers in a colony, Apparently Occupied Burrows (AOB) are counted by the observation of adult birds returning with fish in their beaks and disappearing into the burrows (Joint Nature Conservation Committee, 2015).





# Problem

- The main source of error is the misclassification or overlooking of burrows.
- The density of burrows can be determined through sample plots, the area of the colony estimated and the measures combined to get an estimated population size. But this needs access.
- The accurate calculation of populations is near impossible and methods vary between key locations (JNCC, 2015).

# Current counting methods

Method	Advantages	Disadvantages
Binoculars	Fast Cheap	Observer fatigue Short range Unsteady
Video	Accurate	Expensive Time-consuming Magnification? Small field of capture Limited memory capacity
Time-lapse photography	Accurate Long-range	Expensive Time-consuming Small field of capture



# Background

- An initial comparison between data obtained by continuous sampling through a telescope and those obtained by a time-lapse camera showed a substantial underestimation of numbers by the continuous live observation (MacDonald, Lundy Warden, personal communication).
- Despite experience in observations of puffin burrows and the use of a high-quality telescope the number of overlooked burrows was considerable.

# Current study

- This study compared two population count methods for seabirds nesting in burrows on steep cliffs.



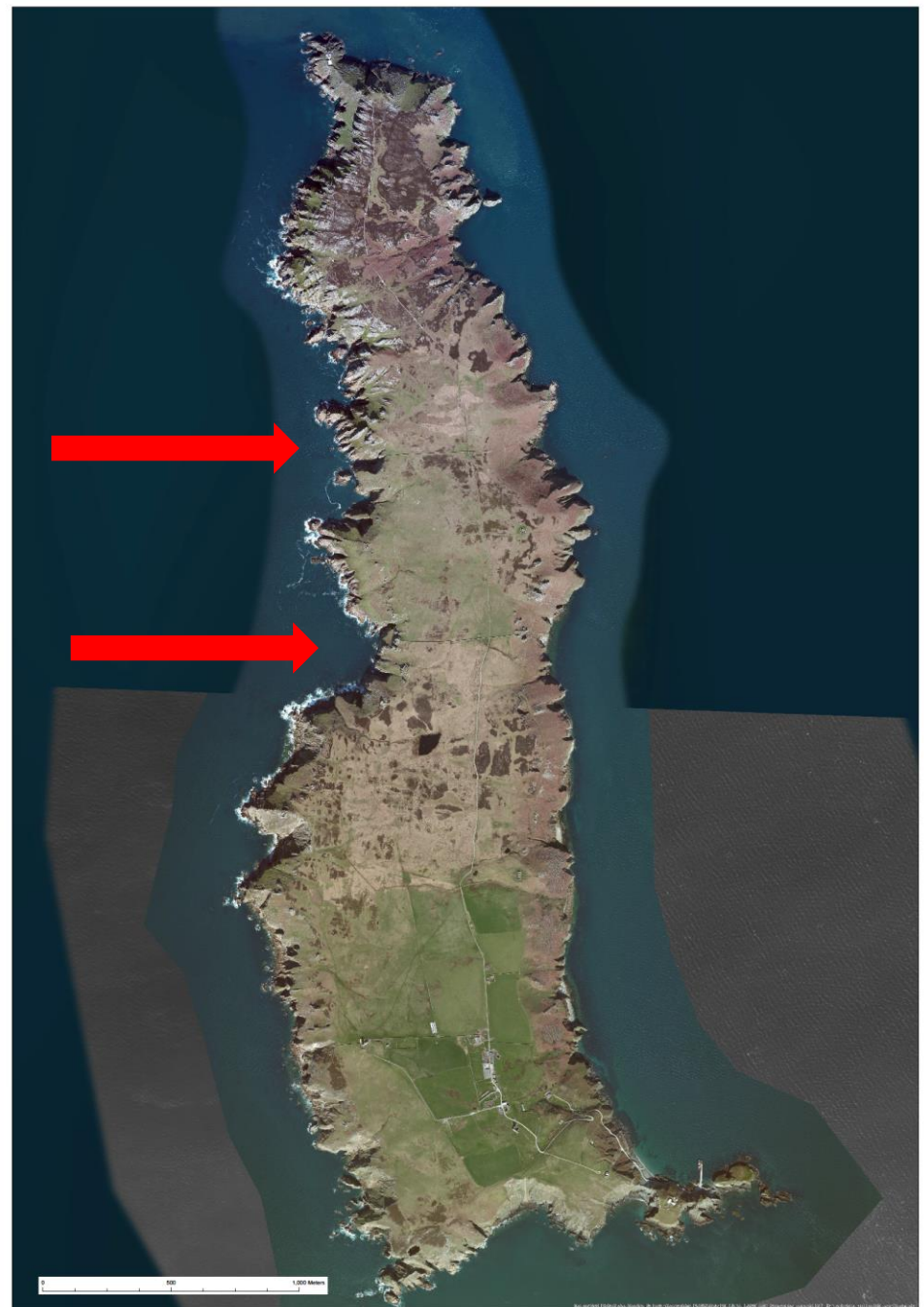
# Location

- The study was carried out on Lundy Island (51 N, 04 W) in the Bristol Channel, UK
- The island is about 3 miles long, and half a mile wide



# Lundy Island

- Puffins nest on grassy slopes above the West-facing cliffs. Data were collected in Jenny's Cove and between St. Phillip's and St Mark's Stone between the 4<sup>th</sup> and the 18<sup>th</sup> of June 2016.



# Method

- The observers were placed at a distance of approximately 200 meters, across one or two gullies, and did not interfere with the animals.



# Observation details

- The two locations were visited in such a way to cover the different times of day, to cover possible differences in attendance (Harding et al., 2005). In total 12 hours of data were recorded.
- Each colony was divided into four sections to allow coverage by the zoom lens.
- Binoculars: 10x40, f/5.8'
- Camera: Canon EOS 40D
- Lens: SP150-600mm f/5-6.3



# Method Total Counts

- Total counts of puffins were done at the beginning of each session, and then again every 30 minutes via binoculars
- Photos were taken at the same time and analysed on a laptop later on.



# AOB counts

- The camera was aimed at one section and an automatic timer set to take photos every 10 seconds for five minutes.
- The two principal observers monitored the numbers of AOBs simultaneously through binoculars.
- At the end of the session both researchers independently recorded the number of AOBs they observed. This was then repeated for the other three quadrants, in a counterbalanced order.

# Computer analysis

- Camera observations were viewed on a laptop.
- Observers used presence, absence, and facing direction of puffins to estimate AOB numbers.
- Several successive photographs were used to account for the general movements and locations of the birds.
- 450 photographs were taken each day.

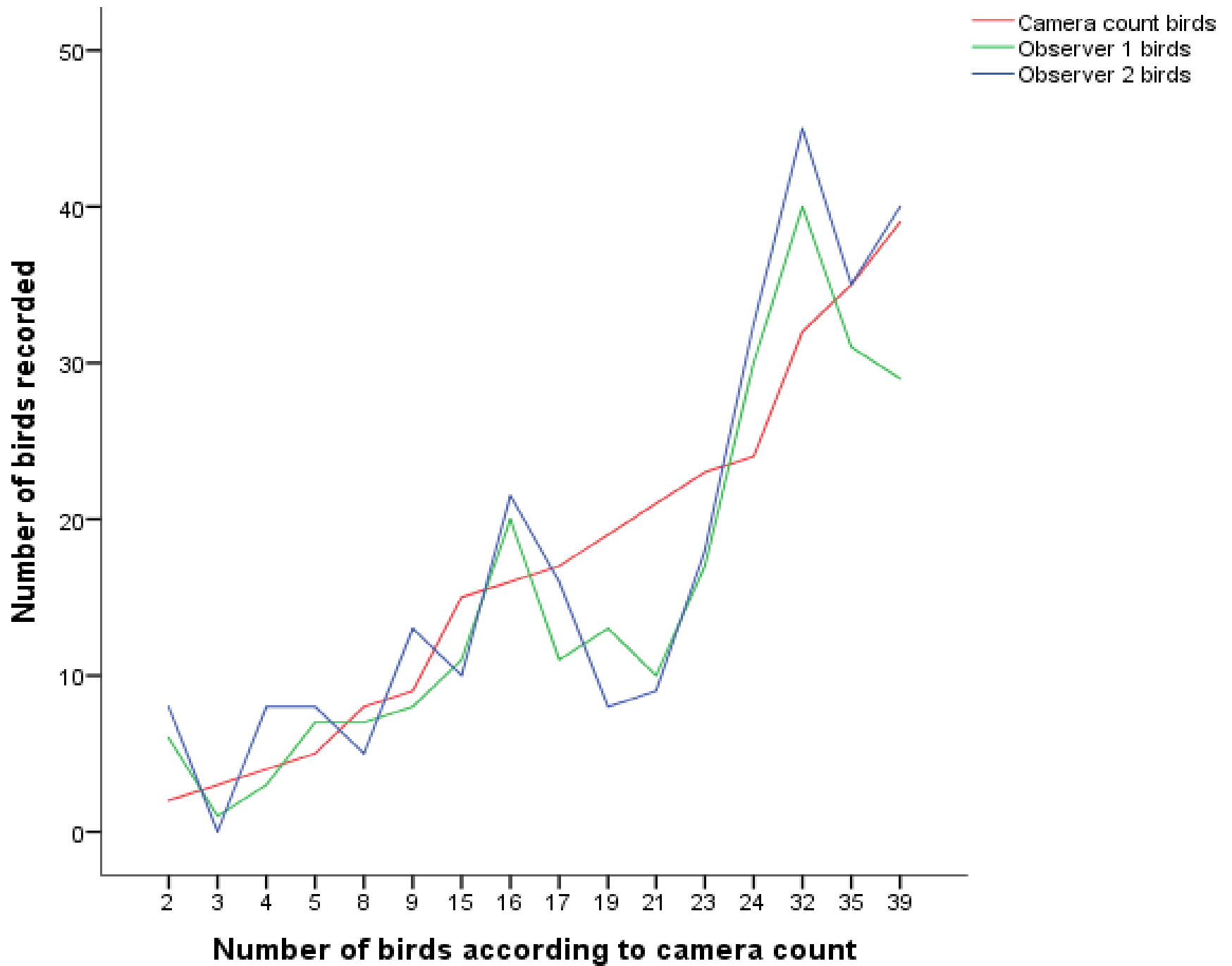
# Bird count descriptive stats

	Counts	Minimum	Maximum	Mean	SD
Camera	18	2	39	17.33	11.035
Obs 1	24	6	40	16.21	10.851
Obs 2	24	0	45	16.58	14.482

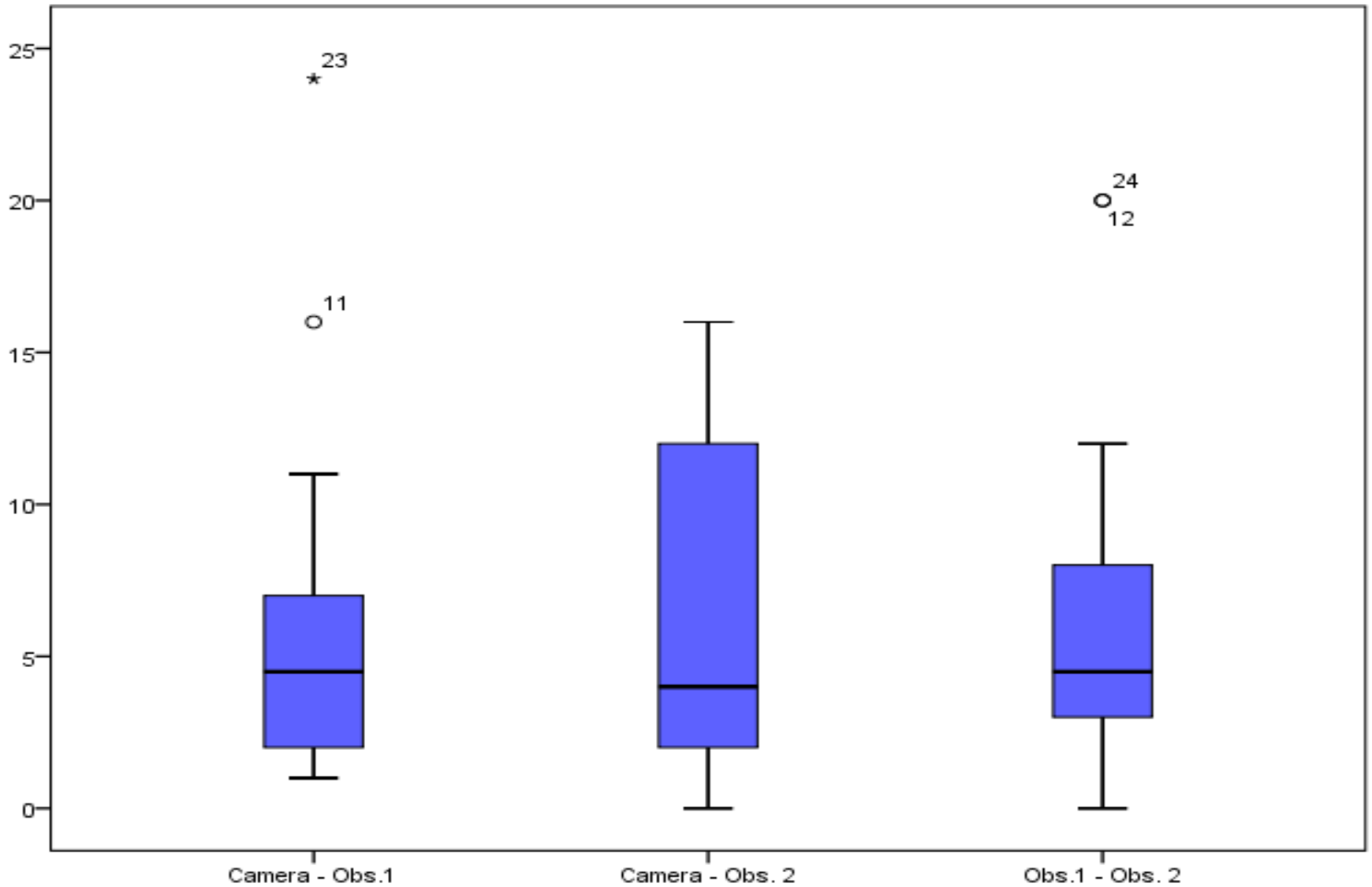
# Bird count results

The data were highly correlated

	N	Pearson's R	<i>p</i>
Camera & Observer 1	18	.717	0.001
Camera & Observer 2	18	.802	<0.001
Observer 1 & Observer 2	24	.699	<0.001



# Mean difference



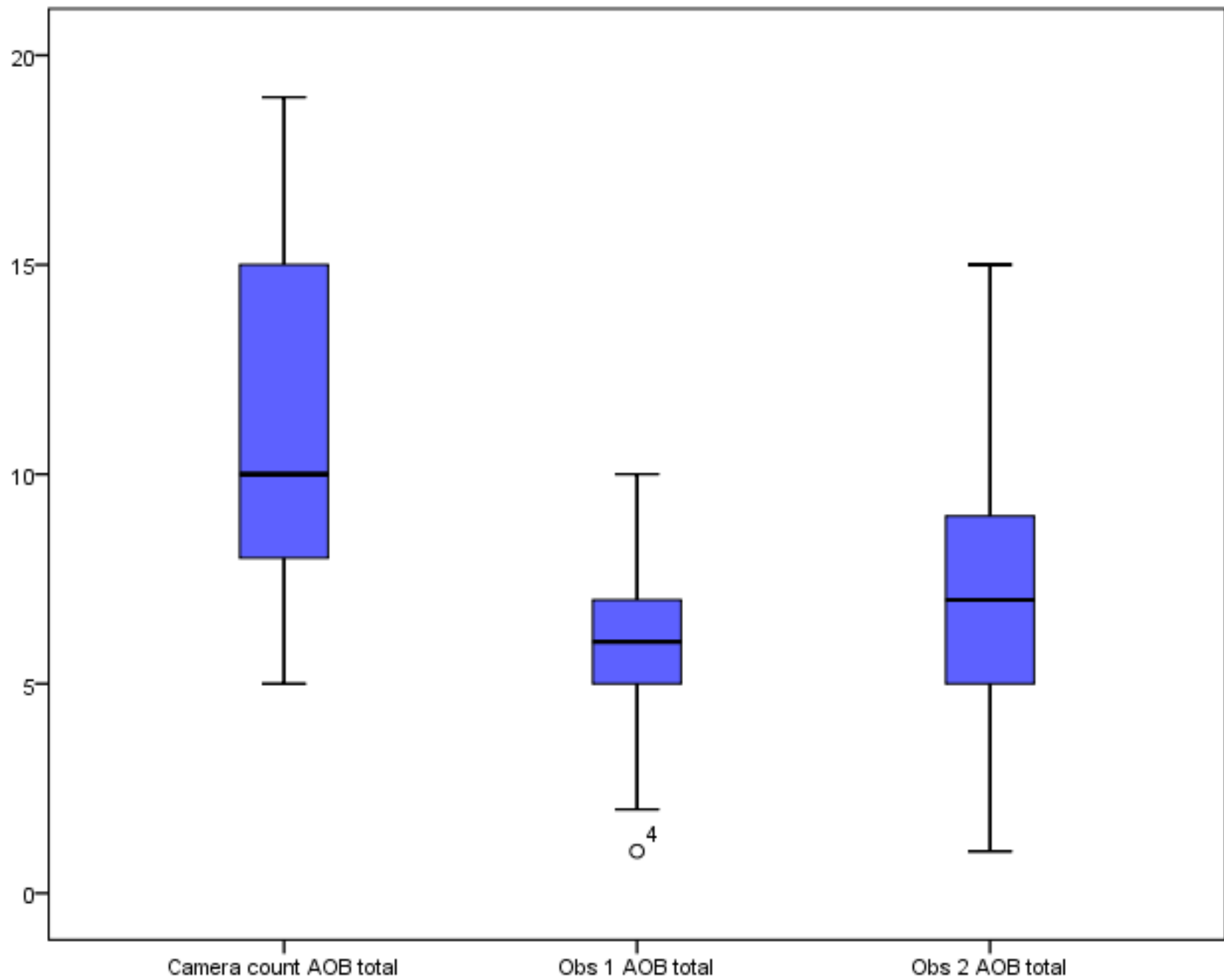
# Bird count results

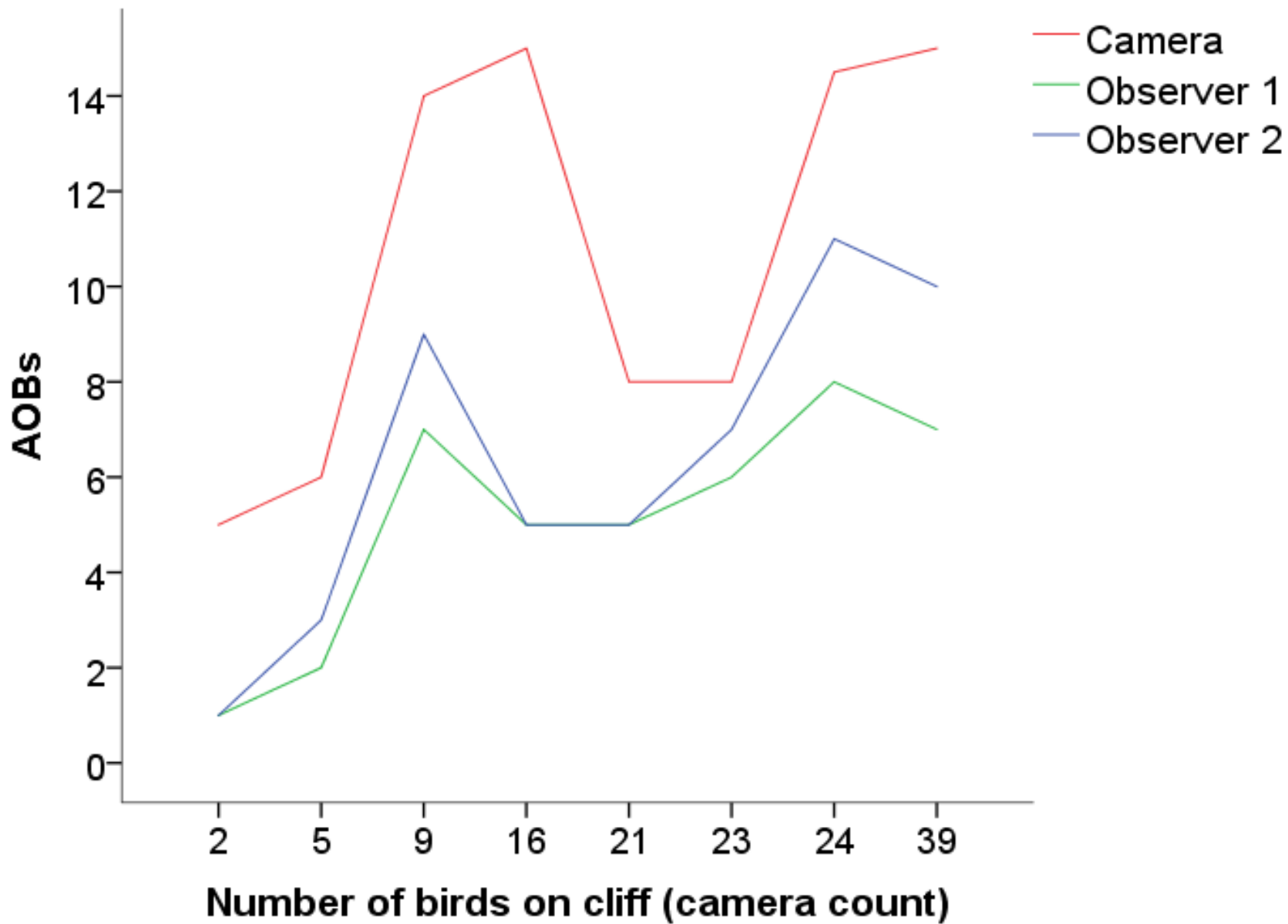
- The observers' bird counts did not show a trend to over- or underestimate total numbers (as given by the camera count).
- There was no significant difference between the three measurements (Obs.1, Obs.2, Camera) ( $t=0.199$ ,  $df=2$ ,  $p=0.821$ )



# AOB descriptive stats

	Sessions	Minimum	Maximum	Mean	SD
Camera	9	5	19	11.11	4.807
Obs 1	12	1	10	5.67	2.535
Obs 2	12	1	15	6.67	3.725





# Results AOB

- All three measures were highly correlated:
  - Camera – Obs. 1:  $R=0.854$ ,  $p=0.003$
  - Camera – Obs. 2:  $R=0.856$ ,  $p=0.003$
  - Obs.1 – Obs.2 :  $R=.931$ ,  $p<0.001$

# AOB Counts

- Overall there was a significant difference between the measurements ( $t=27.187$ ,  $df=2$ ,  $p<0.001$ )
- The difference between the two observers was smaller than the difference between the camera count and the observers.
- Pairwise t-tests:

	<i>t</i>	<i>df</i>	<i>p</i>
Camera – Obs. 1	5.919	8	$p<0.001$
Camera – Obs. 2	5.086	8	$p=0.001$
Obs. 1 – Obs. 2	-2.098	11	$p=0.06$

# Ratio

- The camera count of the AOBs was always higher than the count via binoculars (N=9)
- We calculated the ratio of the camera to the observer count
- The mean ratio was 2.2, SD=1.18, min=1.23, max=5
- A one-sample t-test showed that there was no significant difference of the ratios from the mean (t=0.001, df=8, p=.999)

# Findings



- Overall bird count numbers do not differ between methods.
- AOBs were higher in the camera count by a factor of at least 2.

# Weather



- Both observational techniques were affected by weather conditions and visibility.
- Camera observations were obstructed less in fog and rain, but affected more by wind due to the shakiness of the camera stand.
- Binoculars were more susceptible to visibility issues.
- There are also limitations of observers taking observations by hand, especially in cold and wet conditions.

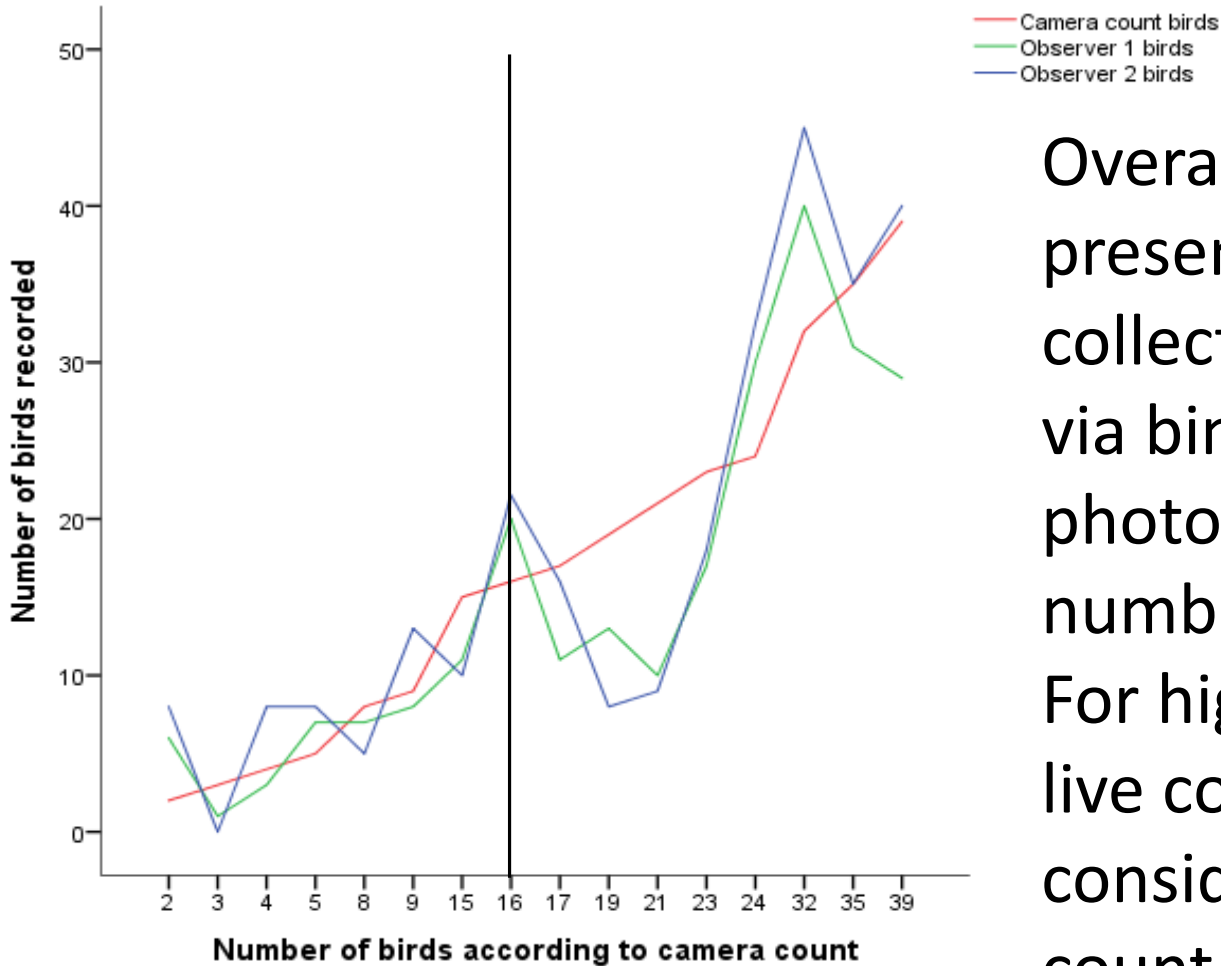


# AOB numbers



- It was easier and more accurate to count the number of AOBs by camera when there were large numbers of birds on the cliff.
- This is due to the fact that it was easier to track various puffins when looking at the camera's pictures as the observer could move forwards and backwards in time, and also focus on different areas selectively.

# Absolute numbers



Overall bird numbers present on a cliff can be collected equally well via binoculars or via photos for lower numbers (up to 16ish). For higher numbers the live counts vary considerably from the count taken from a photo.

# Implications

- Binocular counts of AOBs underestimate the actual number by a factor of at least 2.
- AOBs for cliff-nesting puffins should be counted with the help of a camera.
- Or a binocular count needs to be doubled.
- Absolute bird numbers in large colonies need to be counted via a camera (more data needed for clear cut-off point).

# Thanks

- Amy Farrell
- Paul Fisher
- Pia Heinrichs
- Becky McDonald



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