

# Age and sex of Snowy Owls (*Bubo scandiacus*) during summer irruption on Belyi Island, Yamal in 2015

## Idade e sexo de coruja-das-neves (*Bubo scandiacus*) durante a irrupção estival na Ilha de Belyi, Yamal em 2015

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## ABSTRACT

In early summer 2015 a super peak of lemmings (*Lemmus sibiricus*) appeared on Belyi Island north of Yamal peninsula, Russia (73°19'N, 70°15'E). Considerable numbers of Snowy Owls (*Bubo scandiacus*) were present, possibly as a result of the abundance of lemmings. On 7, 9, 13, and 15 July a total of 69.7 km was covered on foot. Snowy owls were approached and 344 images of perching and flying birds were captured. At most 89 individual Snowy Owls were seen from one vantage point.

Images were sorted by number, time and date recorded on the image files. Images suitable to sex and age the owls were treated in Photoshop to enhance details of molt and bar patterns in wings. The birds were aged analyzing molt patterns, and individuals were recognized by bar and molt patterns in their wings.

Eleven males and 14 females were aged, of which 14 (56%) were second calendar year (2CY) birds hatched in 2014. Six owls were in their second or third wing feather molt, thus classified

as 3CY-4CY birds, while only five were birds with no juvenile flight feathers left (5CY+). Several individuals only photographed perching on the ground appeared to be juvenile 2CY birds, but these were not included in the sample due to lower certainty of identifying individuals and aging perched birds from images. Although two nesting pairs were recorded, the majority of the Snowy Owls on Beliy Island in July 2015 were young, presumably non-breeding birds.

This study shows that photographing as many Snowy Owls as possible during an irruption may reveal the age and sex distribution of the birds present.

**Keywords:** *Bubo scandiacus*, irruption, photo identification, sex and age distribution, Snowy Owl

## RESUMO

No início do verão de 2015, ocorreu um superpico de lemingues (*Lemmus sibiricus*) na Ilha de Beliy, no norte da península de Yamal, Rússia (73°11'N, 71°17'E). Neste período houve também um aumento considerável no número de indivíduos de coruja-das-neves (*Bubo scandiacus*), possivelmente como resultado da abundância de lemingues. Nos dias 7, 9, 13 e 15 de julho foram percorridos a pé 69,7 km, tendo sido registadas 344 imagens de aves pousadas e em voo. No máximo, 89 indivíduos de coruja-das-neves foram registados a partir de um ponto de observação.

As fotografias foram ordenadas por número, hora e data. As imagens adequadas para a determinação do sexo e da idade das aves foram tratadas no Photoshop para melhorar os detalhes dos padrões de muda e das barras nas asas. A idade foi estimada através da análise dos padrões de muda e os indivíduos foram identificados pelos padrões de barras das asas e pelas mudas.

Foi determinada a idade de 11 machos e 14 fêmeas, dos quais 14 (56%) correspondiam a aves no segundo ano (2CY), nascidas em 2014. Seis aves estavam na segunda ou terceira muda, tendo sido classificadas como aves 3CY-4CY, e cinco eram aves já sem penas de voo de juvenil (5CY+). Os indivíduos que foram apenas fotografados pousados no chão, aparentando ser juvenis 2CY, foram excluídos da amostragem devido à incerteza na identificação e estimativa da idade a partir de imagens de aves pousadas. Embora tenham sido registados dois pares nidificantes, a maioria das corujas-das-neves na Ilha Beliy, em julho de 2015, eram aves juvenis, presumivelmente não reprodutoras.

Este estudo mostra que fotografar o maior número possível de corujas-das-neves durante uma irrupção pode revelar a distribuição de idades e sexo das aves presentes.

**Palavras-chave:** *Bubo scandiacus*, coruja-das-neves, distribuição de idades e sexo, identificação fotográfica, irrupção

Figure 1 - Location of Belyi Island (red circle), Russia, where Snowy Owls were seen in great numbers in July 2015.

Figura 1 - Localização da Ilha de Belyi (círculo vermelho), Rússia, onde um número muito elevado de corujas-das-neves foi registado em julho de 2015.

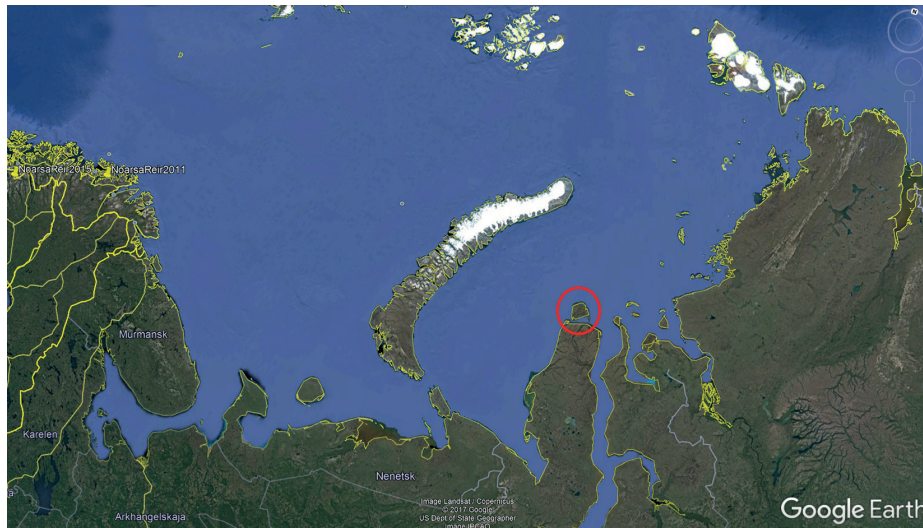
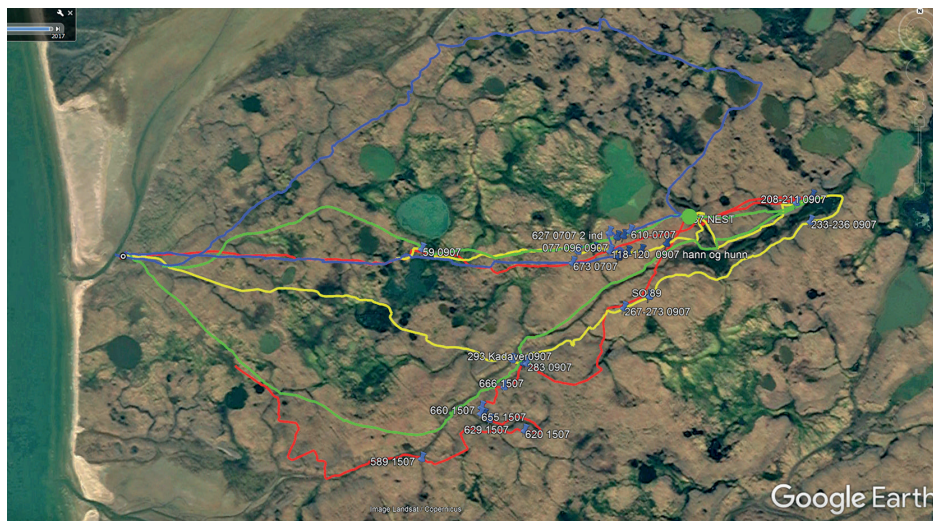


Figure 2 - Walking routes (July 2015) from where Snowy Owls were encountered and photographed on Belyi Island, Russia. Blue = 7 July, Yellow = 9 July, Red = 15 July, and Green = 17 July. Key and locations of sexed and aged birds (see text) appear below the Google map.

Figura 2 - Transetos percorridos a pé na Ilha de Belyi, Rússia (julho de 2015) para registo fotográfico de corujas-das-neves. Azul = 7 de julho; amarelo = 9 de julho; vermelho = 15 de julho; e verde = 17 de julho. A chave e as localizações das aves com sexo e idade determinados (ver texto) aparece abaixo do mapa.



	male	female
2CY	▲	▲
3-4CY	■	■
5CY+	●	●
nest	●	●



**Figure 3** - Original, unedited image (left) of flying female Snowy Owl on Belyi Island, Russia, with Photoshop-edited image (right). On the left wing this female has molted P7, while on right wing both P7 and P8 have been molted. The bird is a second calendar year (2CY) individual in its first molt.

**Figura 3** - Imagem original (à esquerda) de uma fêmea de coruja-das-neves em voo na Ilha de Belyi, Rússia, e a mesma imagem editada (à direita). Na asa esquerda esta fêmea mudou a P7, enquanto que na asa direita foram mudadas a P7 e a P8. A ave está no segundo ano de calendário (2CY) e está a fazer a primeira muda.



## Introduction

Snowy Owls (*Bubo scandiacus*) have a circumpolar distribution, and can be found in the Arctic of Eurasia and North America as far north as 82°N and south to around 60°N (Portenko 1972). They are known to appear in great numbers at irregular intervals both on breeding grounds in summer, and on winter staging grounds (Portenko 1972). The international Snowy Owl Working Group (ISOWG) recognizes that the total world population of Snowy Owls may be far smaller than formerly believed, as indicated by DNA studies (Marthinsen et al. 2008), satellite tracking results (Therrien et al. 2008, Solheim et al. 2008, Jacobsen et al. 2009, Solheim et al. 2014) and also as proposed by Potapov & Sale (2012).

In North America Snowy Owls regularly migrate south during winter to prairie landscapes in Canada and the US, but with great fluctuations in the number of birds (Kerlinger et al. 1985, Smith 1997). When large numbers of birds appear, they are often mostly juveniles from last summer's breeding in the Arctic (Holt et al. 2015). However, also adult, older birds may appear invasionlike south of

their breeding range. The methods described herein will help future studies document the percentage of different age groups of Snowy Owls during such invasions and shed light on the influence of variation in prey abundance and reproductive success on the migration of this apex predator of the Arctic.

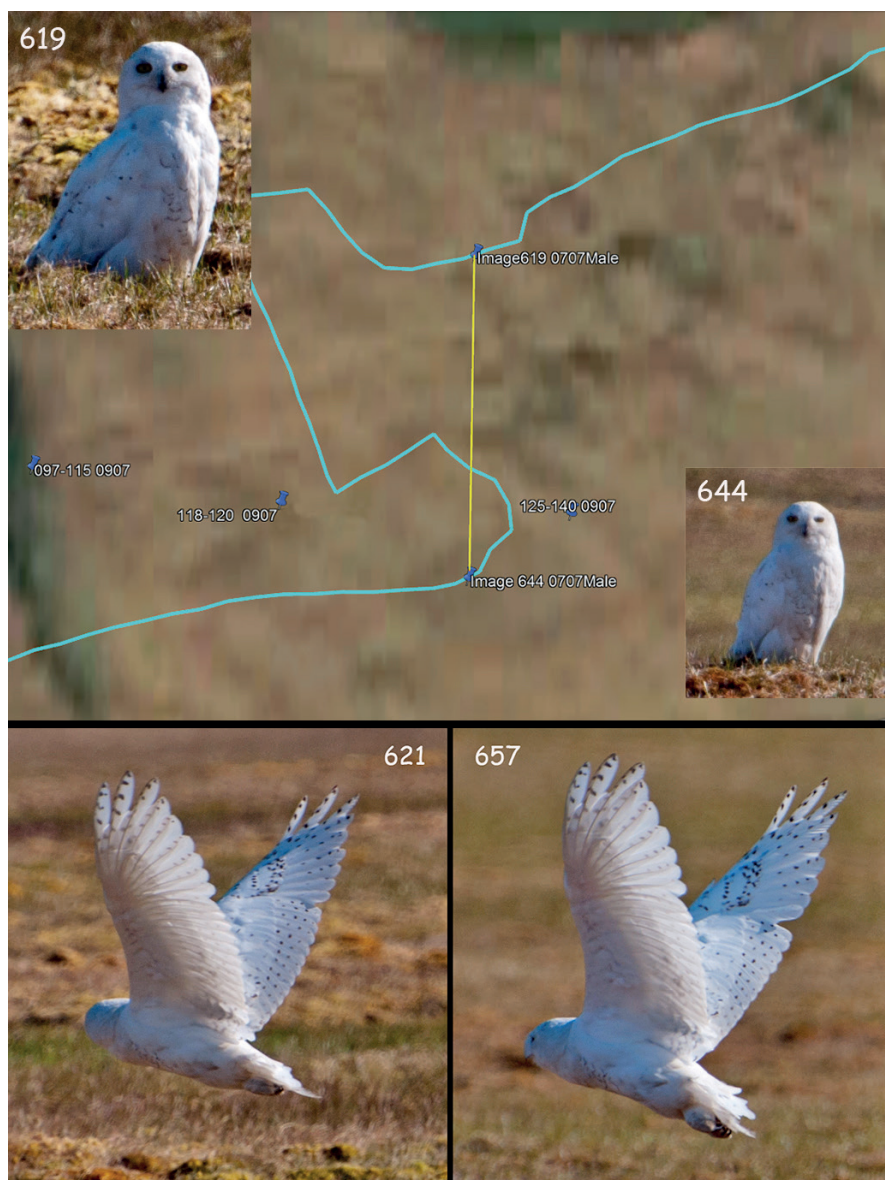
## Methods

In early summer 2015 a super peak of lemmings (*Lemmus sibiricus*) was registered on Belyi Island north of Yamal peninsula (73°19'N, 70°1'E; Figure 1). The abundance of lemmings was estimated by snap-trapping. Considerable numbers of Snowy Owls settled here as a result of the abundance of lemmings. On 7, 9, 13, and 15 July a total of 69.7 km was covered on foot (Figure 2, Table 1). Snowy owls were approached and photographed with a Nikon D90 with a 70-300 mm Nikon lens.

Images were sorted by number, time and date recorded on the image files. Images suitable to sex and age the owls were treated in Adobe Photoshop to enhance details of molt and bar patterns in wings (Figure 3). The birds

**Figure 4** - Snowy Owl images 619 and 644 taken 7 July at 13:13:52 and 13:38:18 on Belyi Island, Russia. The points where the images were captured are plotted along the track route, both points linked with the yellow line. The images were captured 240 m apart, and with almost 25 minutes between them. The enhanced images of the males seem to be uncannily similar, judged by spots and marks on the bodies. On both instances the birds took flight shortly thereafter and were photographed flying (images 621 and 657). When comparing the dark bars on the primaries, it is obvious that these images depict the same individual. The bird must have landed further away along the track route, to be encountered again 25 minutes after first observation. This male has molted P7 on both wings, and is a second calendar year (2CY) bird in its first molt.

**Figura 4** - Fotografias 619 e 644 de coruja-das-neves obtidas no dia 7 de julho às 13:13:52 h e às 13:38:18 h na Ilha de Belyi, Rússia. Os pontos onde as fotografias foram tiradas estão marcados ao longo do transecto e unidos por uma linha amarela. As imagens distam 240 m e estão desfasadas cerca de 25 min. As imagens melhoradas destes machos parecem muito semelhantes, tendo em conta as pintas e marcas corporais. Em ambos os casos a ave levantou voo pouco após a fotografia ser tirada, tendo sido fotografada também em voo (imagens 621 e 657). Quando comparadas as barra escuras nas primárias, é muito claro que as imagens representam mesmo indivíduo. A ave provavelmente pousou mais à frente no transecto, tendo sido encontrada novamente 25 minutos após a primeira observação. Este macho tinha mudado a P7 em ambas as asas, sendo um indivíduo no segundo ano de calendário (2CY) e a efetuar a primeira muda.



**Table 1** - Distance in km travelled on foot during four days on tundra on Beliy Island, July 2015, number of photos of owls taken, and number of images enhanced and checked for molt and individuality.

Tabela 1 - Distância em km percorrida a pé durante quatro dias na tundra da Ilha de Beliy em julho de 2015, número de fotografias tiradas, e número de imagens melhoradas e usadas para determinação das mudas e identificação individual.

DATE	KM	IMAGES	USED
7 July	20.4	64	28
9 July	18.3	167	48
13 July	8.6	32	7
15 July	22.4	81	31
Total	69.7	344	114

**Figure 5** - Snowy Owl images 666 and 673 captured 7 July at 13:41:59 and 13:51:30 on Beliy Island, Russia. Dark bar number four on inner vane from the tip of P10 and P9 is differently aligned with bars on outer vane on these two images, demonstrating that these are two different individuals. Both are second calendar year (2CY) birds in their first molt.

**Figura 5** - Imagens 666 e 673 de coruja-das-neves, obtidas no dia 7 de julho às 13:51:30 h na Ilha de Beliy, Rússia. Na extremidade da P10 e da P9, a quarta barra escura interior está desalinhada relativamente às barras exteriores, demonstrando que se trata de indivíduos diferentes. Ambos são aves no segundo ano de calendário (2CY) a efetuar a primeira muda.



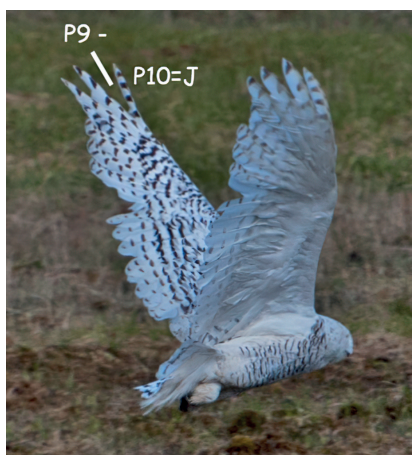
**Figure 6** - Snowy Owl images 092 and 094 captured 9 July on Belyi Island, Russia. It is a second calendar year (2CY) male taking off, showing the upper side of right and left wing. The bird has molted P7 in both wings, all other primaries are juvenile.

**Figura 6** - Imagens 092 e 094 de coruja-das-neves obtidas no dia 9 de julho na Ilha de Belyi, Rússia. Macho no segundo ano de calendário (2CY) a levantar voo, revelando a parte externa de ambas as asas. A ave mudou a P7 em ambas as asas e todas as outras primárias são de juvenil.



**Figure 7** - Snowy Owl image 616 captured 15 July on Belyi Island, Russia. This female has formerly molted P7 and P8, while P9 has been molted in 2015. P10 is still juvenile, as are three of the innermost primaries. P6 is growing, while P5 may have been molted, or may be the outermost of the three juvenile feathers in line inwards. The bird has at least molted once before 2015, and most possibly twice. To judge if it is a third or fourth calendar year bird, all secondaries would have to be inspected, which is not possible on this image. The owl is thus classified as a third-fourth calendar year (3-4CY) bird.

**Figura 7** - Imagem 616 de coruja-das-neves obtida no dia 15 de julho na Ilha de Belyi, Rússia. Esta fêmea tinha mudado a P7 e a P8 anteriormente, tendo mudado a P9 em 2015. A P10 ainda é de juvenil, bem como as três primárias mais internas. A P6 está em crescimento, e a P5 pode ter sido mudada ou pode ser a mais externa de três primárias juvenis alinhadas. A ave efetuou pelo menos uma muda antes de 2015, possivelmente duas. Para determinar se esta ave estaria no terceiro ou no quarto ano de calendário, teriam de ser observadas todas as penas secundárias, o que não é possível nesta imagem. A ave foi classificada como estado entre terceiro e o quarto ano de calendário (3-4 CY).



**Table 2** - Age and sex of Snowy Owls on Belyi Island, July 2015, as judged from images.  
\* Bird found dead

Tabela 2 - Idade e sexo da coruja-das-neves na ilha de Belyi em julho de 2015, estimados a partir das imagens.

DATE	MALES			FEMALES			SUM
	2CY	3-4CY	5CY+	2CY	3-4CY	5CY+	
7 July	1			4			5
9 July	3		2	3	1*	1	10
13 July	1			1			2
15 July		2	2	1	3		8
Sum	5	2	4	9	4	1	25

were aged analysing molt patterns described by Solheim (2012) and later collected molt data (Solheim 2017), and individuals were recognized by bar and molt patterns in their wings (cnf. Solheim 2016).

A GPS track file was used to record the location of the owls that were photographed and subsequently aged and sexed (Figure 2). The spacing of the images helped when comparing images of birds of similar age to determine if they were the same (Figure 4) or different individuals (Figure 5).

## Results

The lemming trap-index reached 13.7 animals per 100 trap-nights, which is the highest value ever measured on the Yamal peninsula since 1999 (Unpublished Data). At most 89 individual Snowy Owls were seen from one vantage point. Judged by the number of owls encountered along the track routes, probably at least 150 Snowy Owls were present in the area surveyed. A total of 344 images were captured of both perching and flying birds. Of these 114 images showed flying birds and could be used for closer inspection to check the birds' age and identity. Many of these images were however series of the same bird

as it took off. The best images showing the upper side of one wing and later the other wing (upstroke and downstroke from side view; Figure 6) were used to determine molt stage. It was possible to age 11 males and 14 females (Table 2). Fourteen individuals were juvenile or second calendar year birds (2CY) in their first molt (five males, nine females). Six birds (two males, four females) were in later molt stages with still recognisable juvenile flight feathers in their wings (Figure 7), while only five individuals (four males, one female) were classified as adult 5CY+ birds in their fourth molt stage or later, recognised by the total lack of juvenile flight feathers in their wings.

## Discussion

When encountering Snowy Owls it is recommended to take as many flight images as possible before the bird advances too far off. With modern digital photography there are no serious limitations to how many images one can secure, as in former days when photography was expensive. The camera should be set to multiple image shooting at the highest speed for the camera at hand, and usually at ISO values of 1000-3200 to freeze the wing motion of a flying owl.



It is usually possible to use images to recognise molt stage 2 and 3 in Snowy Owls based on number of juvenile feathers left in the wings and differences in contrast and wear of molted, adult feathers (Solheim 2012, 2017), provided that the image clearly shows all secondaries and primaries (see Solheim 2016). On images of flying birds, the innermost secondaries may be hard to judge, and non-adult birds after their first molt have thus been categorized as 3-4CY, although several of the aged birds in this category seemed to be in their third molt (4CY).

Only five individuals (20%) of the aged birds were fully grown, thus hatched in 2011 or earlier, while the 14 juvenile birds made up more than half of the aged birds (56%). These birds were hatched in 2014, while the rest of the group (six individuals; 24%) were hatched in 2012 or 2013.

Since 80% of the aged Snowy Owls on Belyi in summer 2015 were hatched in the period 2012-14, the question arises where did they originate from. Snowy Owls were found nesting in Fennoscandia in 2007, 2011 and 2015. The Norwegian Snowy Owl Project equipped three male and nine female Snowy Owls with satellite transmitters in Norway in 2011 (Jacobsen et al. 2012). During summer 2012 and 2013 these owls moved along the Russian Arctic from Kola peninsula to Novaya Zemlya and Vaygach Islands, with Novaya Zemlya as the most probable area for breeding (Jacobsen et al. 2013). Adult Snowy Owls equipped with satellite transmitters in Norway documented that Snowy Owls breeding in Scandinavia in peak lemming and vole years move to Russia as far east as the Taimyr peninsula (75° N 100° E) (Solheim et al. 2008, Jacobsen et al. 2009, 2013), and even to the October Revolution Island (80° N 99° E) (Jacobsen et al. 2014) during years with no or few lemmings in Scandinavia.

According to information provided through the arctic birds conditions survey ([www.arcticbirds.net](http://www.arcticbirds.net)), 2014 was a good breeding year for Snowy Owls in western

Taimyr (Kharitonov, 2014). It is thus highly probable that the young 2-4CY Snowy Owls which made up most of the Snowy Owls on Belyi in July 2015, may have been hatched in the same part of the Russian Arctic, between Novaya Zemlya and Taimyr. Snowy Owls thus seem to make up one sub-population from Fennoscandia to Taimyr.

## Acknowledgments

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