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Using DNA barcoding
to identify
birdstrike remains in
Norway

Arild Johnsen and Christian K. Aas
Natural History Museum

NATURAL HISTORY MUSEUM
UNIVERSITY OF OSLO

DNA can be used as a «barcode» for species identification

- DNA consists of four nucleotides (A denine, C ytosine, T hymine, G uanine)
- All organisms have a unique sequence of nucleotides
- Species specific sequence → DNA barcode (ca. 650 bp)

GGAGCATGAGCCGGAATAGTAGGTACCGCCCTAAGT
GGIGCATGAGCAAGGAATAGTAGGCACCGCCCTAAGC

Chiffchaff



Willow warbler

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DNA-barcode:

Short, standardised DNA sequence that enables **species discrimination** of a large fraction of species on earth



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DNA-barcoding:
Horizontal genomics – one gene, all species



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The barcoding gap

COI variation (%)

Group	Within Species	Between Species	Ratio
Saturniidae	0.25	9.52	38.1
Sphingidae	0.22	7.06	32.1
Noctuidae	0.36	6.30	17.5
Ephemeroptera	0.34	15.36	45.2
Odonata	0.56	10.90	19.5
Hymenoptera	0.29	11.90	41.0
Collembola	0.09	14.97	166.3
Aves (birds)	0.30	7.27	24.2

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The international “Barcode of Life” project (iBOL)

- Global initiative to barcode the fauna and flora of the earth.
- Development of publicly available barcode database.
- Barcodes with voucher specimens in natural history museum collections.

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barcodinglife.com

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Barcoding of Scandinavian birds



Photo: Frode Jacobsen

Barcoding of Scandinavian birds

Johnsen et al. 2010. Journal of Ornithology, 151: 565-578

- 296 species (>98% av breeding species)
- 957 individuals (1-10 individuals per species)
- **94%** of species have unique barcodes
- Some notable exceptions...
 - which are relevant for identifying bird strikes

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Table 1. Scandinavian species with overlapping barcode clusters

Cluster	Order	Common name	Scientific name	N	% similarity
1	Anseriformes	Pink-footed goose	<i>Anser brachyrhynchus</i>	1	99.84
		Lesser white-fronted goose	<i>Anser erythropus</i>	1	
		Bean goose	<i>Anser fabalis</i>	2	
2	Anseriformes	Common eider	<i>Somateria mollissima</i>	4	100
		King eider	<i>Somateria spectabilis</i>	1	
3	Charadriiformes	Herring gull	<i>Larus argentatus</i>	2	99.86
		Lesser black-backed gull	<i>Larus fuscus</i>	4	
		Glaucous gull	<i>Larus hyperboreus</i>	2	
		Greater black-backed gull	<i>Larus marinus</i>	4	
4	Passeriformes	Common redpoll	<i>Carduelis flammea</i>	6	100
		Hoary redpoll	<i>Carduelis hornemanni</i>	5	
5	Passeriformes	Common crossbill	<i>Loxia curvirostra</i>	6	100
		Parrot crossbill	<i>Loxia pytyopsittacus</i>	6	

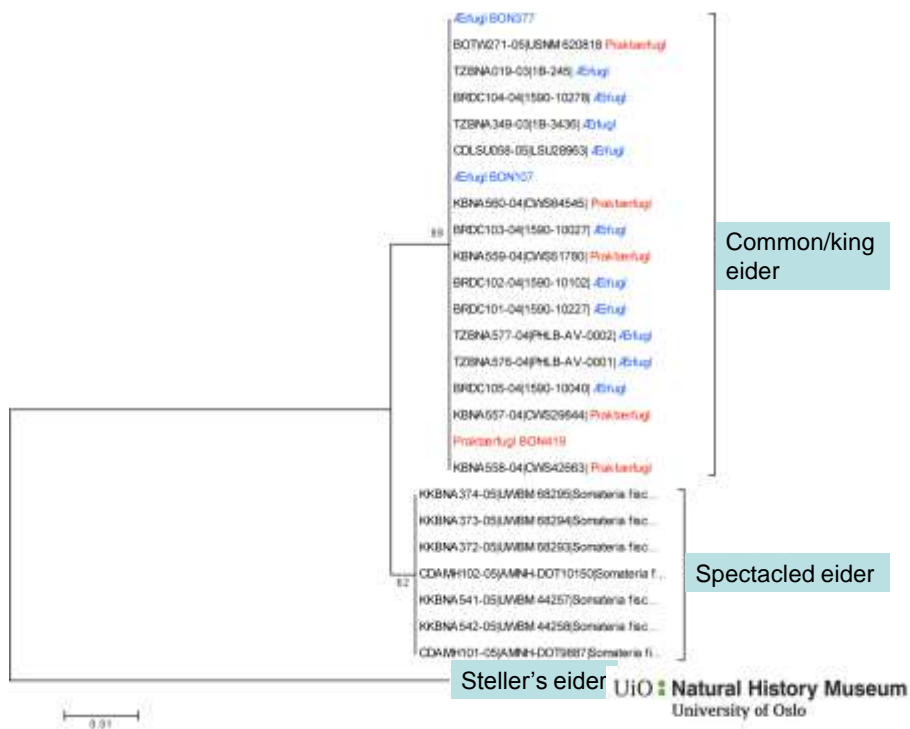
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Somateria



From del Hoyo et al. Handbook of the Birds of the World

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When barcoding does not separate species

- Subspecies within one species – wrong taxonomy?
- Recent splits– not enough time for divergence of mtDNA
- Hybridization

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Identifying bird strikes



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**Impact between C-130 and whooper swan
at Ørland Main Air Station December 2004**



Photo: N.L. Skjærseth



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Foto: Christian. K. Aas

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Bird remains from plane at Ørland Main Air Station 17th January 2006



Illustration photo: Arild Johnsen

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ccggaatggtggaacgcgcctaagcctactaatccgtgcagaactaggccaacc
ggcactctttaggagatgaccaaattacaatgcatcgtcactgctcatgctttgtaa
tgaactctctcatagtaataccaatcataattggtgcttcggaactgactagctccgct
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tatgatcagctctcaccgctgctactcctactcactcccagctctgctgccgg
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aggaggagatccaatttatataacatctctctgattcttgccaccaggaagtcta
catcctatcctcccaggatttgaatta

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Jack snipe



Photo from Wikipedia

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Search Request:

Type: Full Database Search

Search Result:

Identification Summary:

Taxonomic Level	Taxon Assignment	Probability of Placement (%)
Phylum	Chordata	100
Class	Aves	100
Order	Anseriformes	100
Family	Anatidae	100
Genus	Anas	100
Species	Anas crecca	100

A species level match has been made. This identification is solid unless there is a very closely allied congeneric species that has not yet been analyzed. Such cases are rare.



Photo: Bjørn-A. Bjerke, NHM



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Barcoded birdstrikes from Norway

Airport	Date	Morphological species	Confirmed species
20nm V Stokmarknes	20.01.2005	Greater or lesser black-backed gull	Greater black-backed gull (100%)
Ørland	17.01.2006	Unknown	Jack snipe (100%)
Kabul/Inverlic/Ørland	12.05.2006	Unknown	Red knot (100%)
Setermoen	26.07.2006	Unknown	House martin (100%)
Ørland	20.09.2006	Probably golden plover	Golden plover (100%)
Torp	12.04.2007	Passerine	Skylark (100%)
4 nm SE Kjeller	13.04.2007	Unknown	Eurasian teal (100%)
0.5nm W Sørreisa	24.05.2007	Probably pipit	Meadow pipit (100%)
Tromsø	05.11.2007	Probably ptarmigan	Willow ptarmigan (100%)

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Main advantages with DNA barcoding

- Relatively rapid/cost effective.
- Identifies small fragments and all life stages of an organism.
- Good resolution in birds.
- Good barcode libraries exist for avifauna of Scandinavia/Paleartic and North America.

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