Royal Netherlands Air Force

A species specific Bird Hazard Index

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This presentation:

- **Why a species specific BHI?**
  - –evaluating the bird strike management
  - –provide day-to-day info on bird hazard level
- **Which other hazard rankings of bird species?**
  - –Civil, based on Bird Strike statistics (Dolbeer et.al. 2000)
  - –Civil, includes qualitative expert knowledge (Morgenroth 2003)
  - –Military, based on bird strike statistics (Zakrajsek & Bissonette 2005)
- **What the species specific BHI is based on?**
  - –strike sensitivity
  - –damage sensitivity
  - –An absolute dimensionless figure
- **How the species specific BHI can be used?**
  - –Auditing bird strike management
  - –Bird Control Decision Support System

Evaluating the bird strike management

Simply counting the birds is NOT enough

All birds are hazardous but some birds are more hazardous than other.

adapted from George Orwell, Animal farm








Evaluating the bird strike management

Expert knowledge)
Best professional judgement) → Person dependent
Educated guesses)

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Risk assessment matrix

	Probability				
Severity	**Very high**	**High**	**Moderate**	**Low**	**Very low**
Very High					
High					
Moderate					
Low					
Very low					

→ Based on bird strikes only
5 year running means
Large airports only

Evaluating the bird strike management

Expert knowledge)
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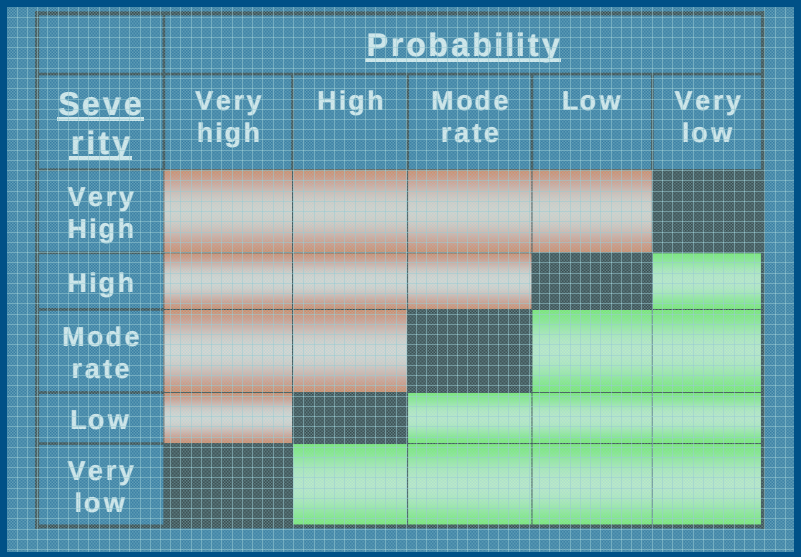
Educated guesses)

Risk assessment matrix



→ Based on bird strikes only
5 year running means
Large airports only

Bird Hazard Index → Only bird counts needed

provide day-to-day info on bird hazard level

The bird hazard index can facilitate instantaneous assessment of bird situation at any given moment

Each RWY inspection results in a hazard index describing the present hazard situation

Other hazard ranking systems

Dolbeer 2000:

- Based on civil BS statistics (< 50% identified)
- Focussed on damage
- Species groups
- Relative ranking

Morgenroth 2003:

- Based on many non quantitative specific behavioural aspects
- Includes site specific factors

Zakrajsek & Bissonette 2005:

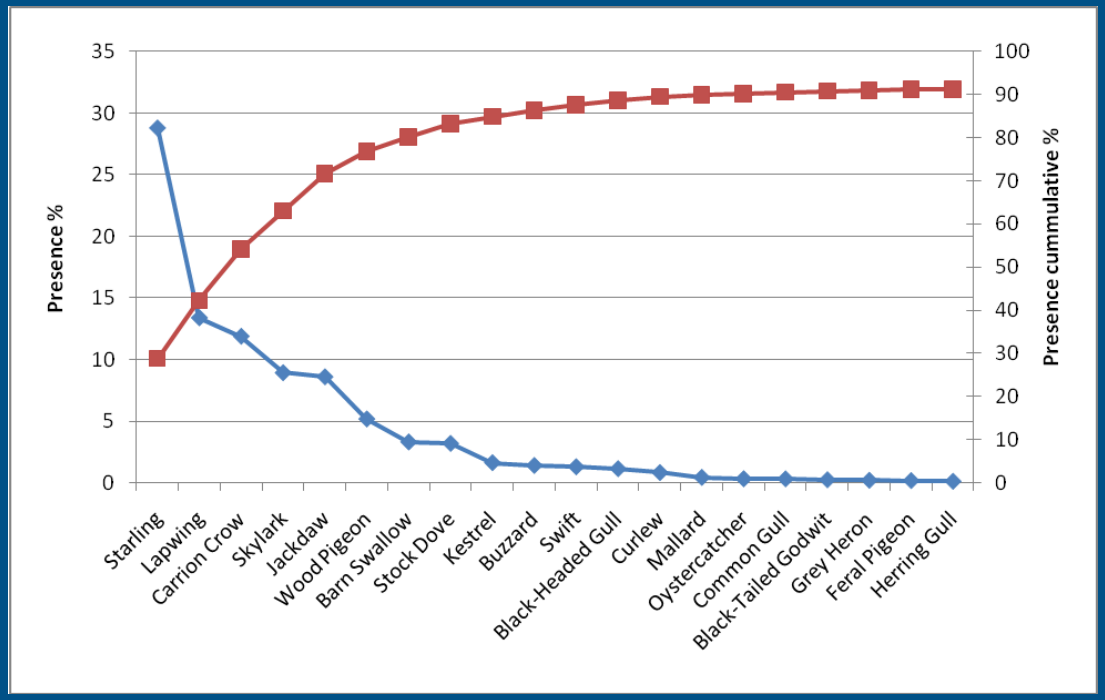
- Based on military BS statistics (20% identified)
- Focussed on damage
- No distinction between local and en-route
- Quantitative index

The BIRD HAZARD INDEX

Based on:

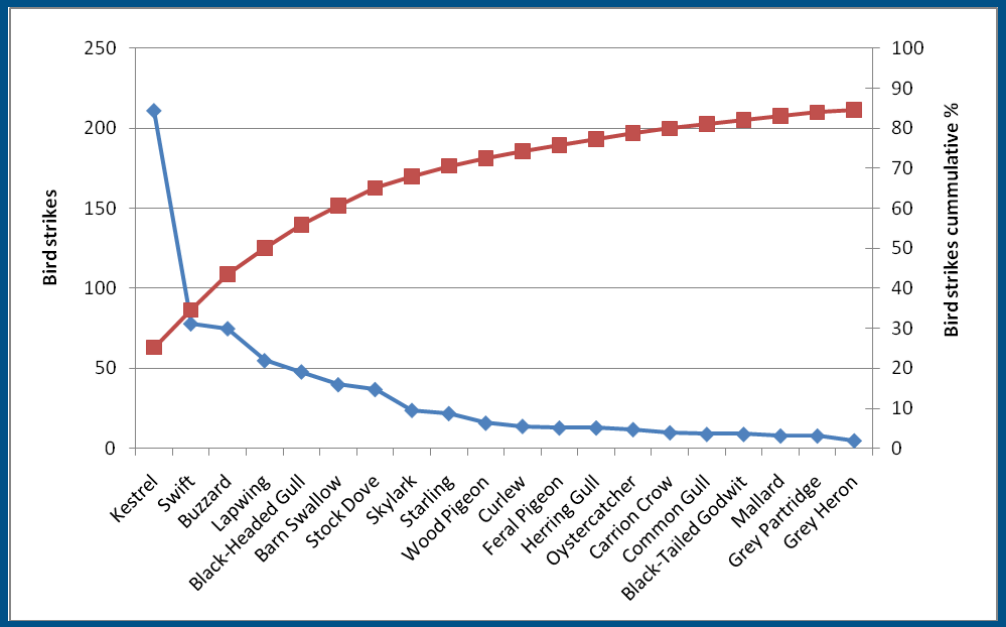
- Data from 15 years, 7 airbases (1995 – 2009)
- Standardised bird counts ±3 times per week (14,192)
- Quick RWY inspections >= 4 times per day (116,414)
- RNLAF Strike data, fix wing, local BS (reported + carcasses found, 836 strikes; 93.7% identified to species level)
- EURBASE data fixed wing, local BS from D, B, GB, DK and NL (7,669 strikes, 52% identified; 35.5% to species level)

The BIRD HAZARD INDEX species selection (1)



Percentual and accumulative percentual presence of the 20 most common bird species on 7 RNLAF airbases during standardised counts in the years 1995-2009.

The BIRD HAZARD INDEX species selection (2)



Real and accumulative percentual involvement of 20 bird species in bird strikes on 7 RNLAF airbases during the years 1995-2009.

The BIRD HAZARD INDEX

Is calculated for 20 species which comprises

- > 95% of birds present on airbases
- ± 85% of strikes

Kestrel
Swift
Black Headed Gull
Buzzard
Stock dove
Oystercatcher
Woodpigeon
Herring Gull
Feral Pigeon
Common Gull
Curlew
Mallard
Black-tailed Godwit
Grey Heron
Starling
Lapwing
Lark
Carrion Crow
Jackdaw
Swallow

The BIRD HAZARD INDEX

Includes two species specific components:

–Strike sensitivity

*****

–Damage probability

The BIRD HAZARD INDEX

Strike sensitivity = relative discrepancy between strike involvement and strike opportunity

Strike involvement = %-age of strikes for a species

Strike opportunity = presence of a species * A/C movements

The BIRD HAZARD INDEX, calculation of strike opportunity:

Calculate yearly presence = year-sum of weekly means for each species, year and airbase, interpolate missing data and correct for day pattern using RWY inspections

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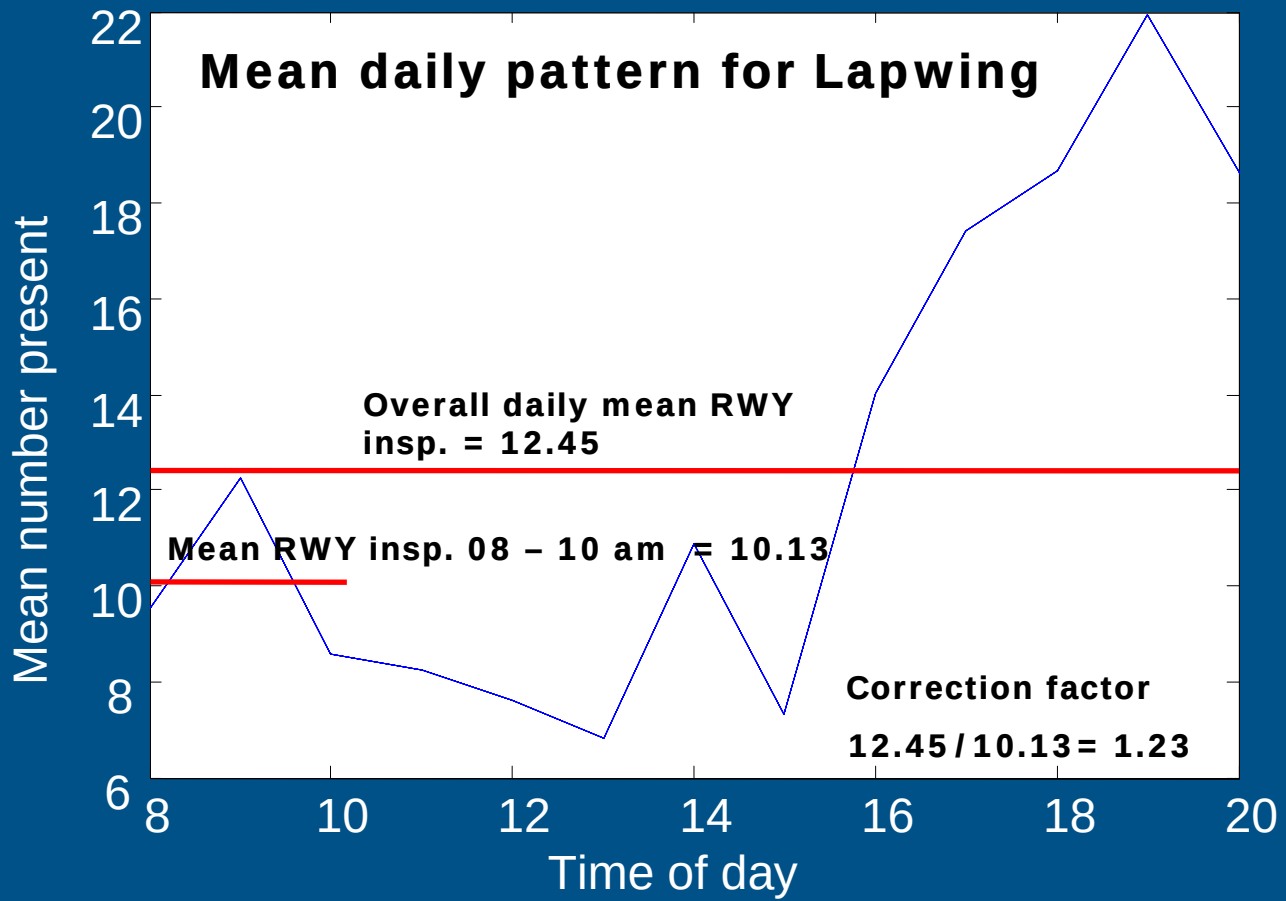
Calculate yearly presence = year-sum of weekly means for each species, year and airbase, interpolate missing data and correct for day pattern using RWY inspections

$$\text{Strike opportunity}_i = \sum_{v=1}^{7}\left(\sum_{j=1}^{15}\left(\text{presence}_{ijv} * \text{N Aircraft movements}_{jv}\right)\right)$$

Correction for day pattern



Our BIRD HAZARD INDEX, calculation of strike opportunity:

Calculate yearly presence = year-sum of weekly means for each species, year and airbase, interpolate missing data and correct for day pattern using RWY inspections

Calculate yearly opportunity = yearly presence * yearly A/C movements for each airbase / species

Calculate opportunity per species/airbase = Sum 15 (yearly presence * yearly A/C movements)

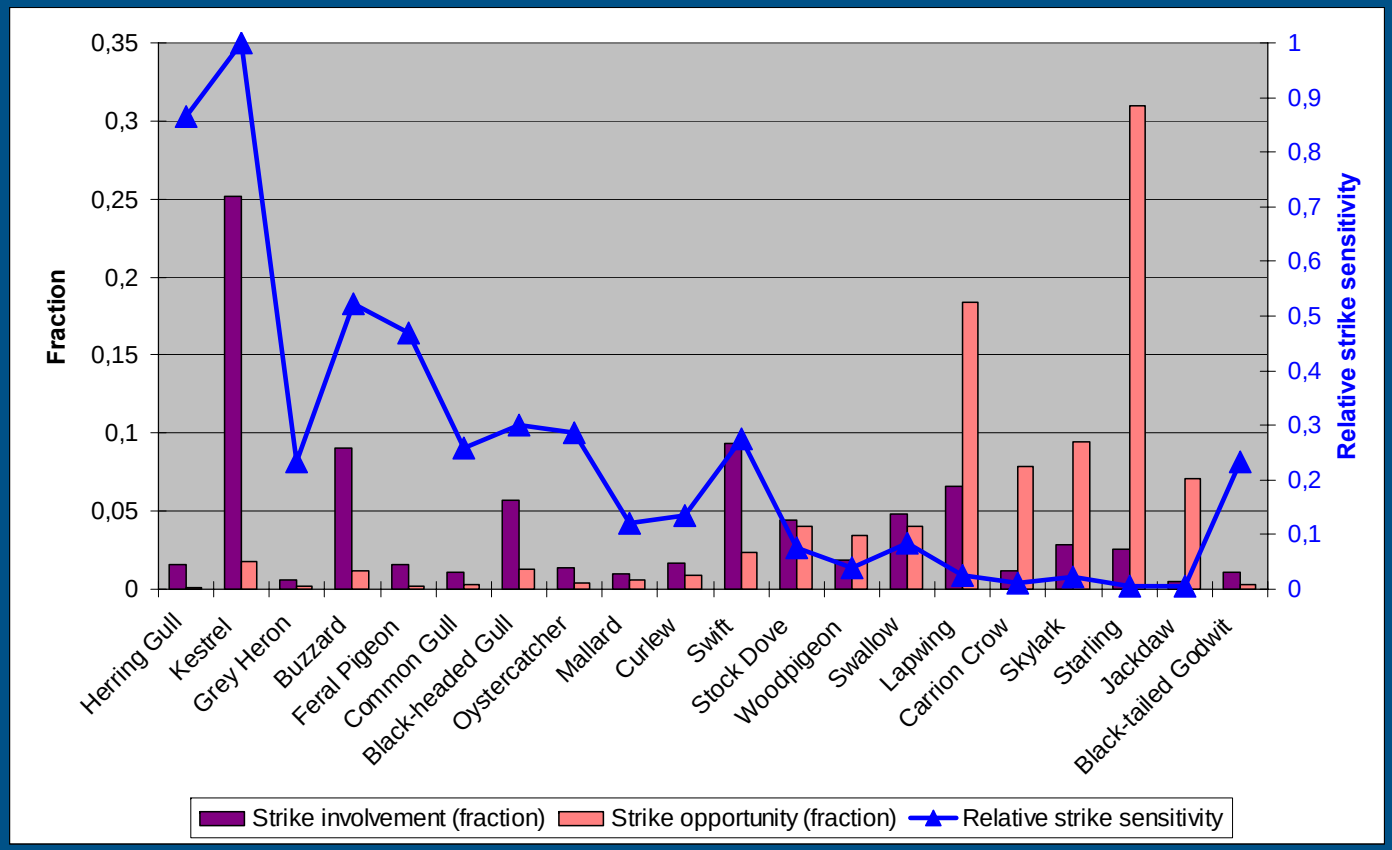
Our BIRD HAZARD INDEX

Strike sensitivity = relative discrepancy between strike involvement and strike opportunity

Strike involvement = %-age of strikes for a species

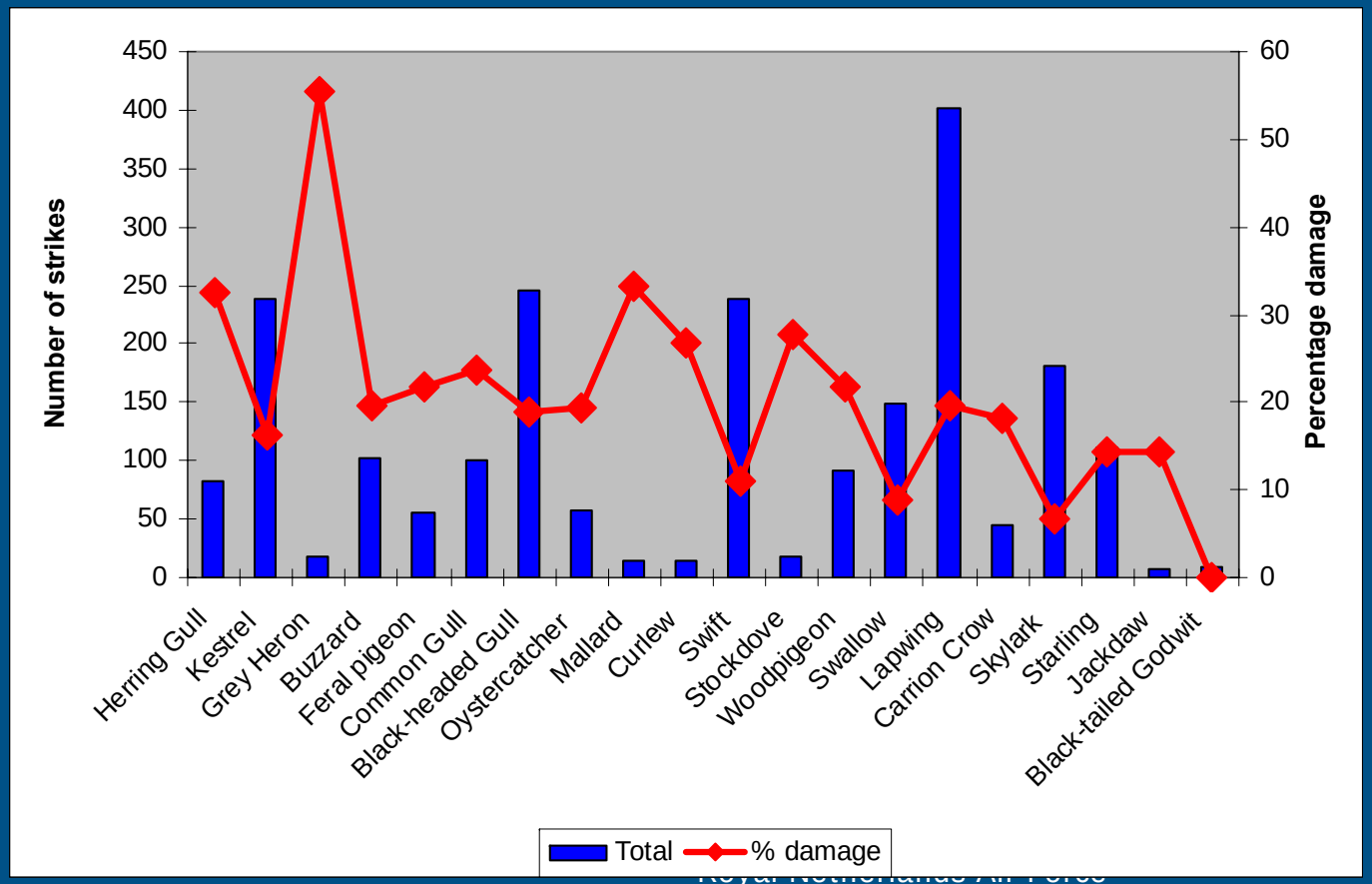
Strike opportunity = presence of a species * A/C movements

Combining strike involvement and strike opportunity into strike sensitivity



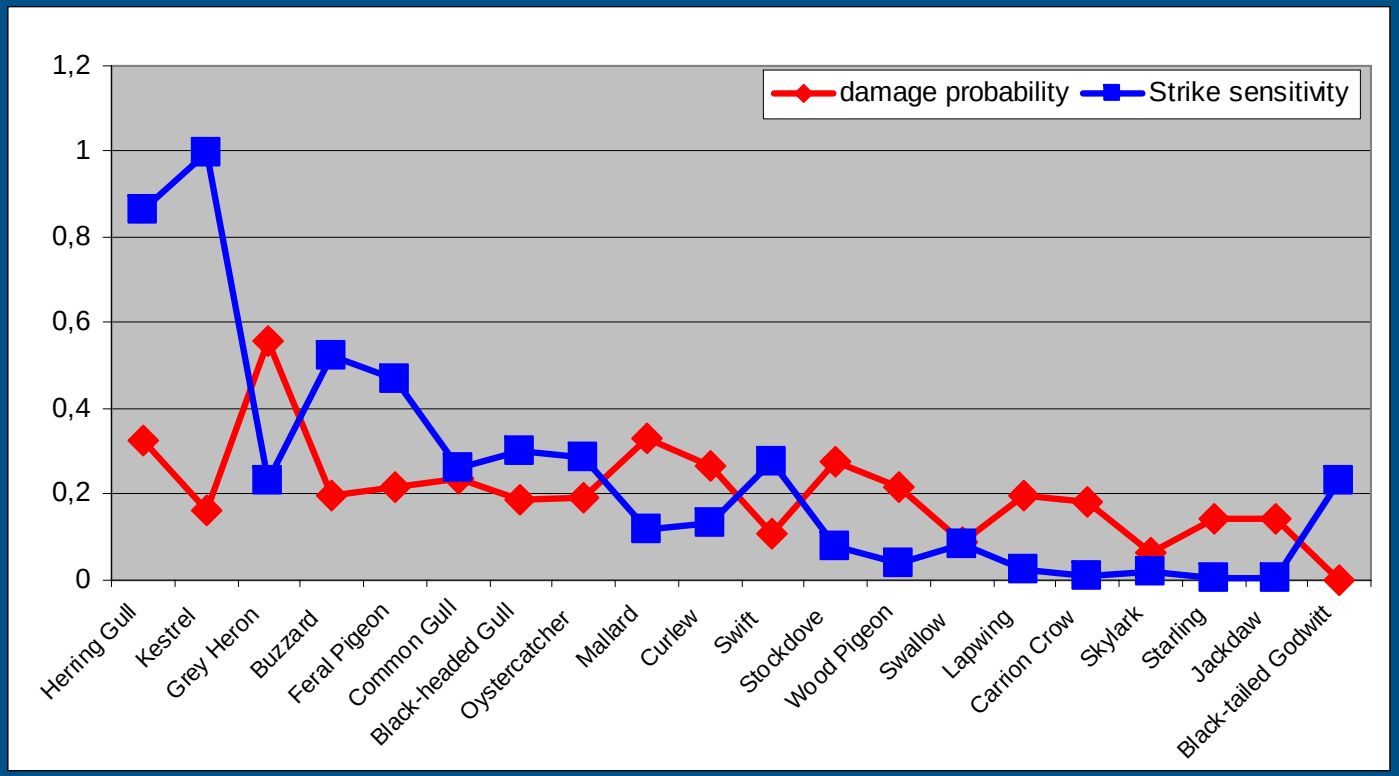
Calculation of damage probability:

%-damage EURBASE D,UK,B,DK&NL, non-heli, local



The BIRD HAZARD INDEX

Combining strike sensitivity and damage probability



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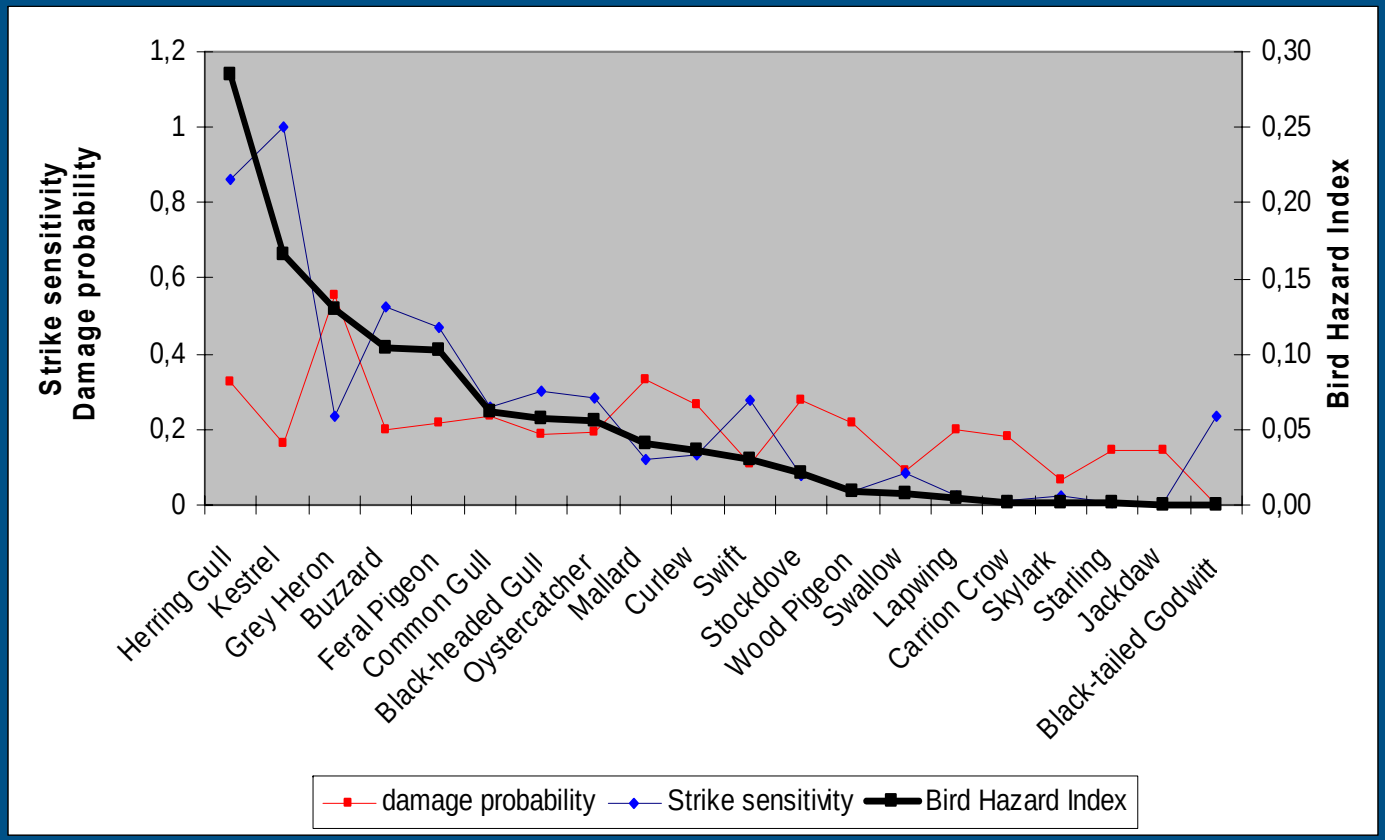

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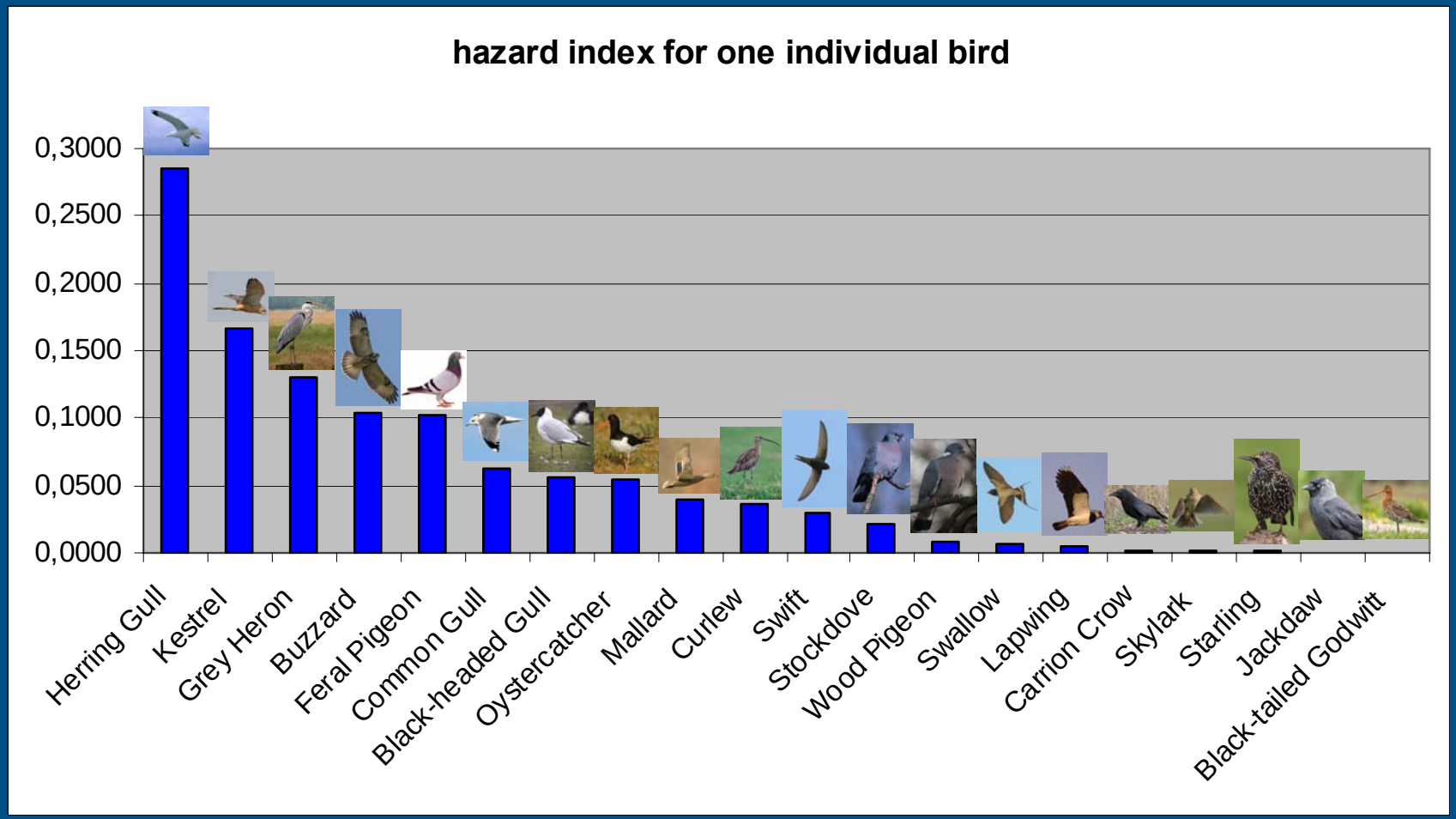
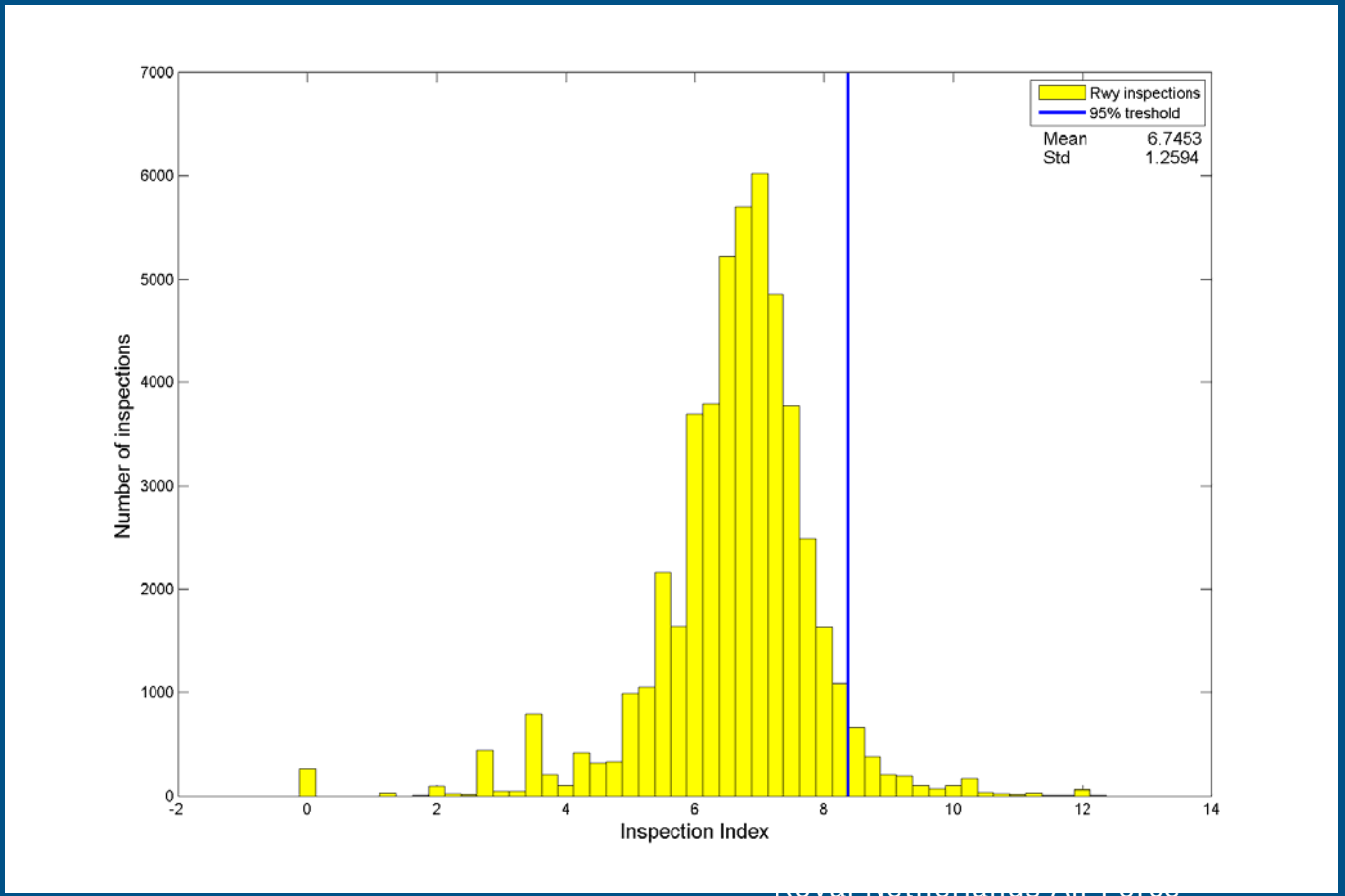


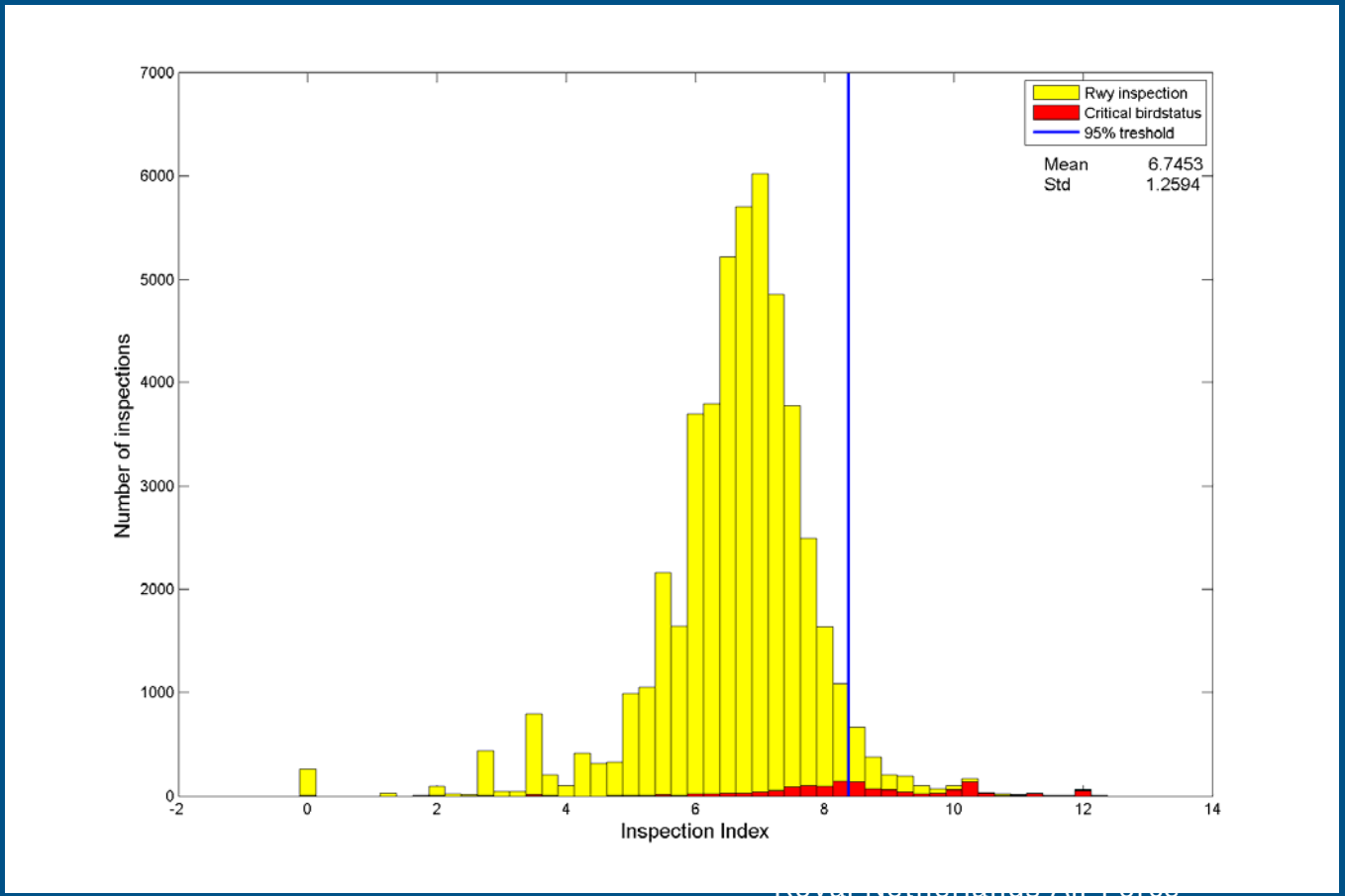
Calculation of an inspection index LWD airbase 29-11-2009

Bird species	Number	BHI	Index
Grey Heron	8	0,1301	1,0408
Kestrel	4	0,1660	0,6640
Black-headed gull	9	0,0567	0,5103
Jackdaw	11	0,0007	0,0077
Carrion Crow	22	0,0020	0,0440
Starling	102	0,0009	0,0918
∑(Index)			2,3586
Insp. Index =	$\ln\left[\left(\sum_{i=1}^{i=s}(n_i \times BHI_i)\right) \times 1000 + 1\right]$		3,3728

Distribution of 49,206 inspection indexes 7 airbases, 15 years including 95% threshold (=index 8,37)



Distribution of 49,206 inspection indexes 7 airbases, 15 years plus assigned bird status by BCU (red)

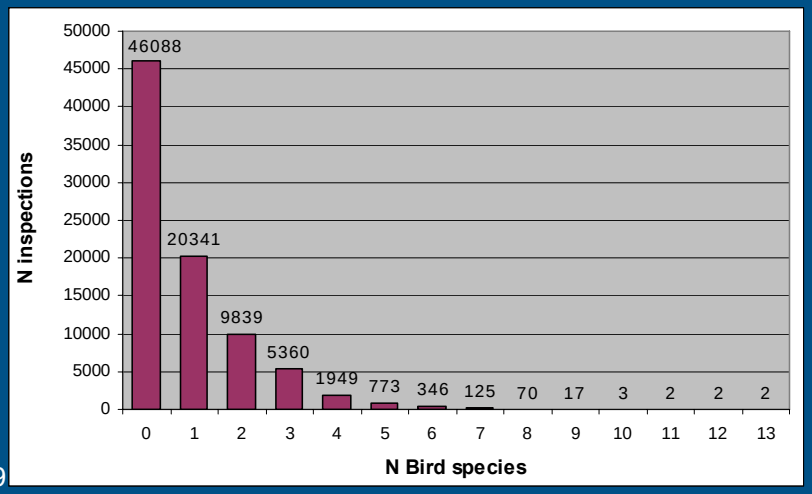


Inspection Index and Bird Status

No perfect fit between Inspection Index and Bird Status:

- Inspections during non-ops periods ->no bird status
- Threshold is not site specific (95% varies between airbases)
- Overflying birds obscures the picture
- BHI does not account for a-typical behaviour

Species without BHI hardly influence the situation



In 45,7% of inspections 1 or more species without BHI are included. But numbers are very low:

99.3% less than 100 birds

0.6% between 100 -200 birds

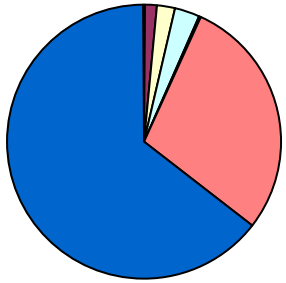
0.1% more than 200 birds

Inspection Index examples

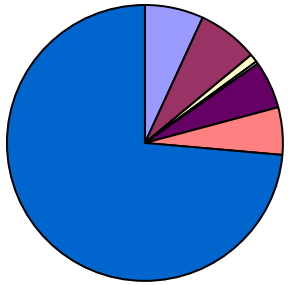
Situation 1
Total = 700 bird
Inspection Index = 8.0

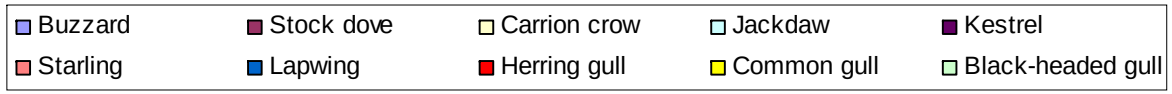
Species	Numbers
Buzzard	2
Stock dove	10
Carrion crow	15
Jackdaw	20
Kestrel	1
Starling	200
Lapwing	450

Numbers



Contribution to Inspection Index





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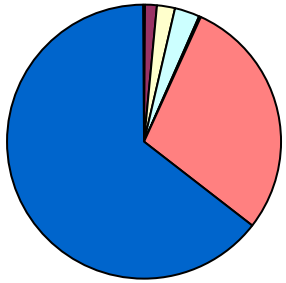

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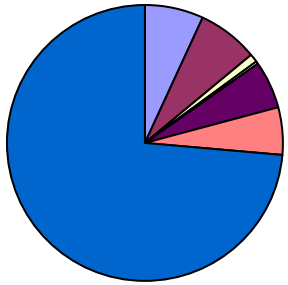
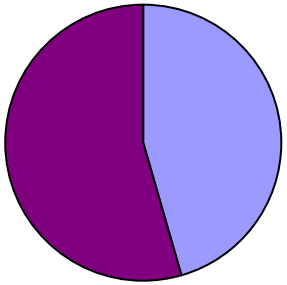


Situation 2
Total = 22 birds
Inspection Index = 8.0

Species	Numbers
Buzzard	10
Kestrel	12

Numbers



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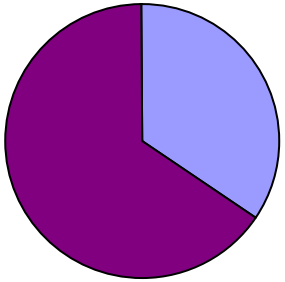

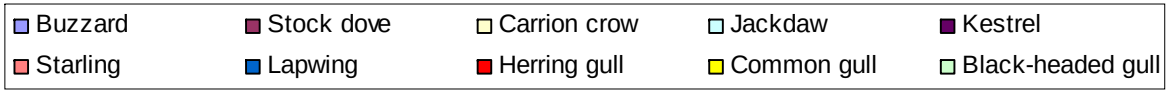

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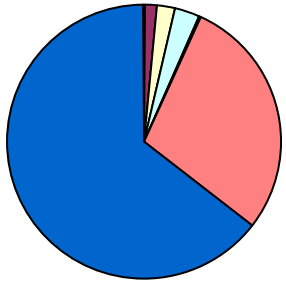

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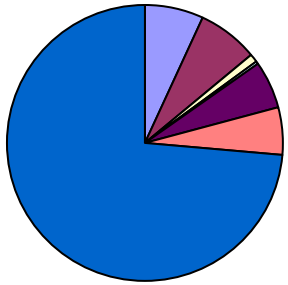

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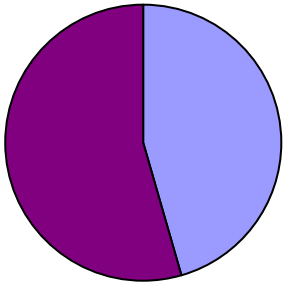

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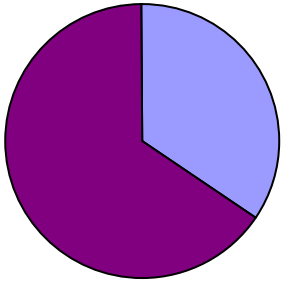
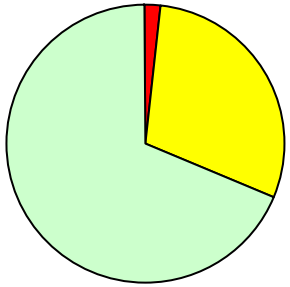


Situation 3
Total = 51 birds
Inspection Index = 8.0

Species	Numbers
Herring gull	1
Common gull	15
Black-headed gull	35

Numbers



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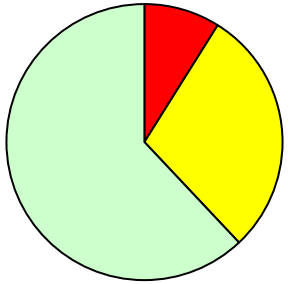


Buzzard | Stock dove | Carrion crow | Jackdaw | Kestrel
Starling | Lapwing | Herring gull | Common gull | Black-headed gull

Use of Bird Hazard Index in a Decision Support System

- Direct logging of RWY inspections
- Direct calculation of **Inspection Index**
- Direct warning to BCU when index exceeds 95% threshold
- Helps BCU in assigning Bird Status of airbase

Use of Bird Hazard Index as auditing tool

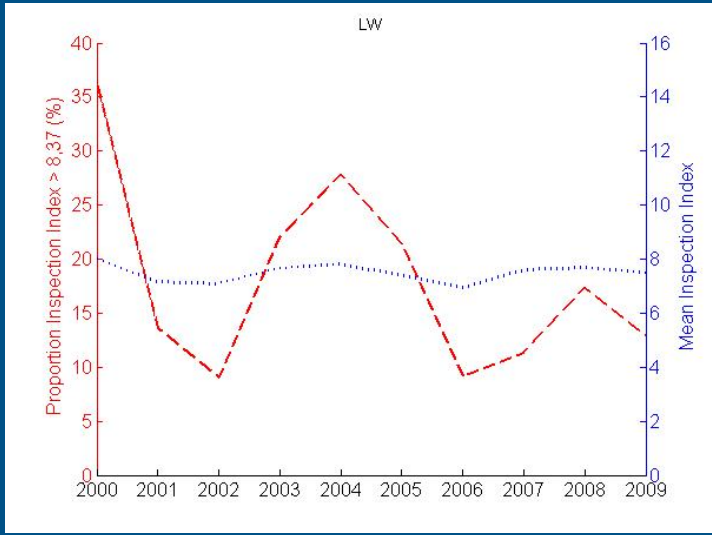
Use proportion of Inspection Indexes above threshold as first indication

Use Inspection Indexes to compare airbases

Analyze Inspection Indexes

- For most hazardous species
- For most hazardous season
- For most hazardous time of day
- In relation to scaring operations

Inspection indexes, yearly mean (blue) and % over threshold (red)



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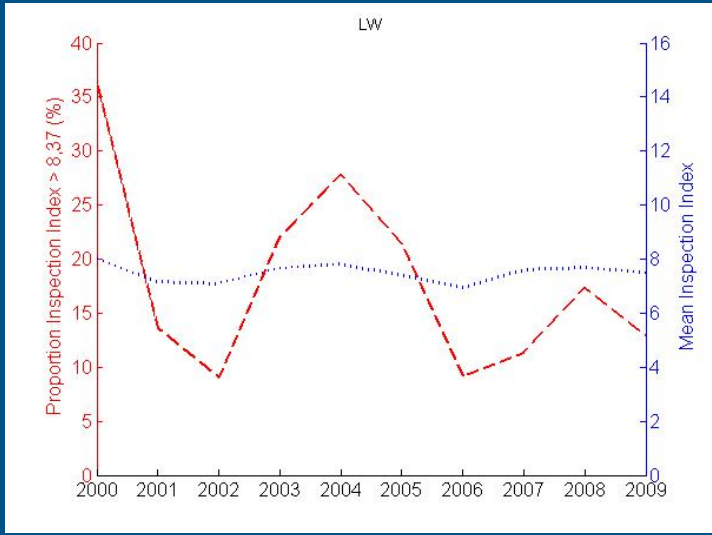

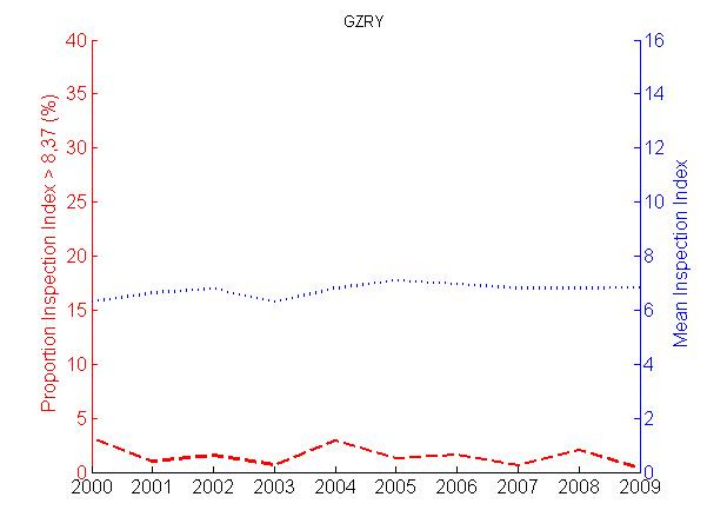

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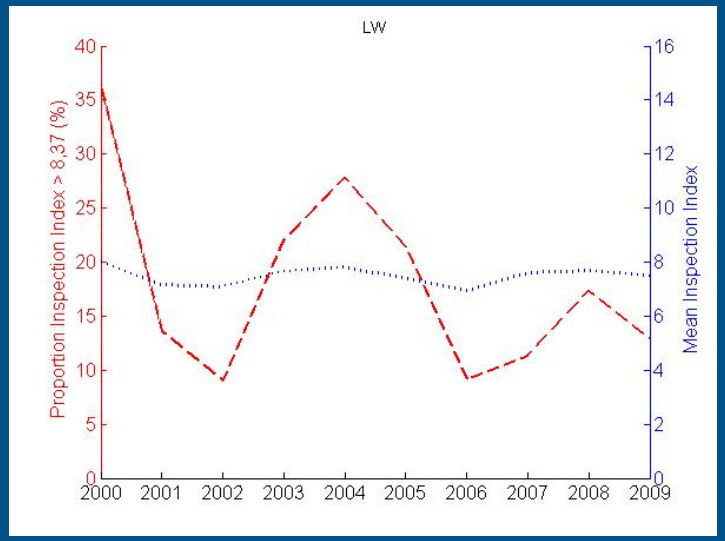

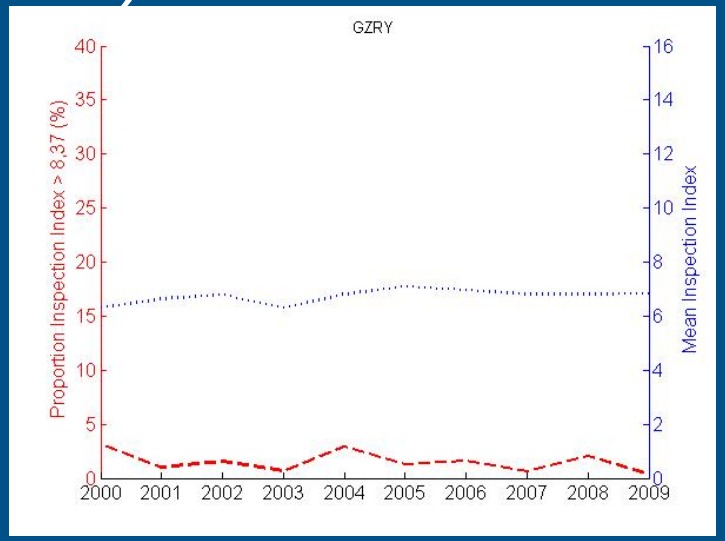

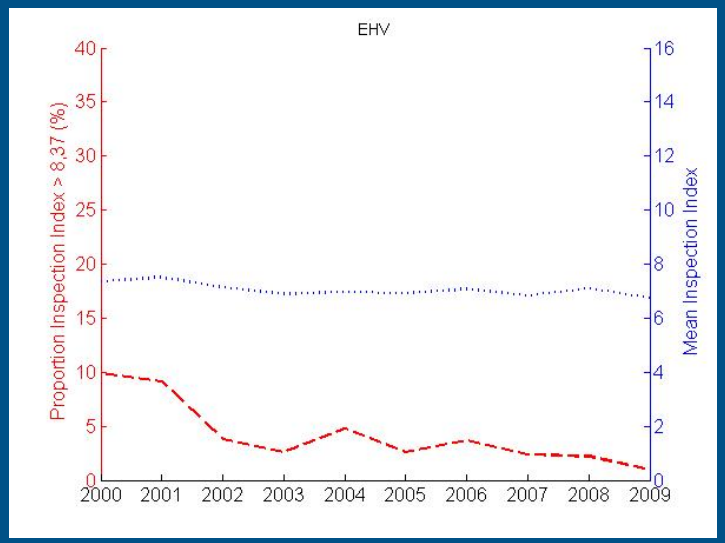

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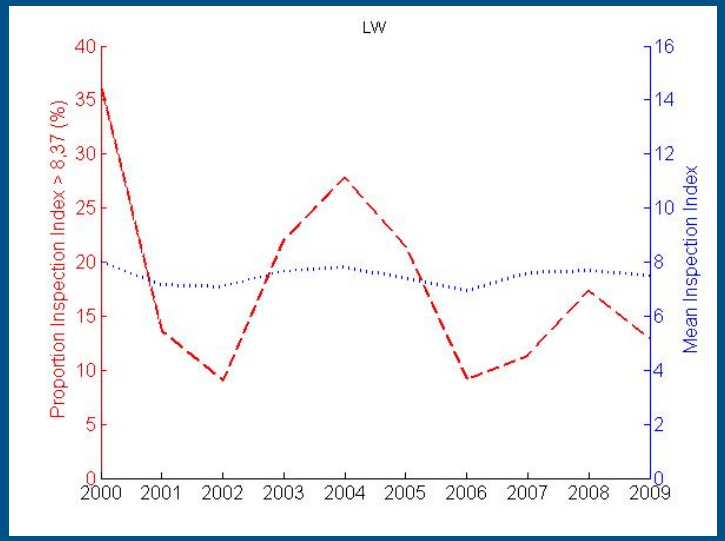

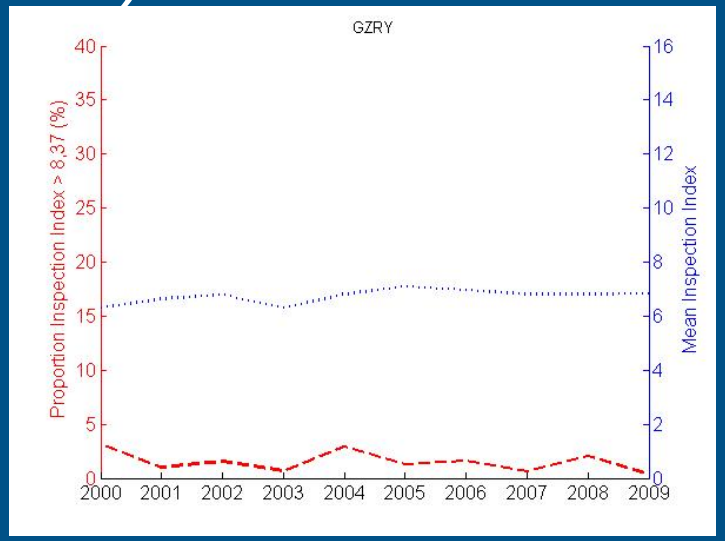

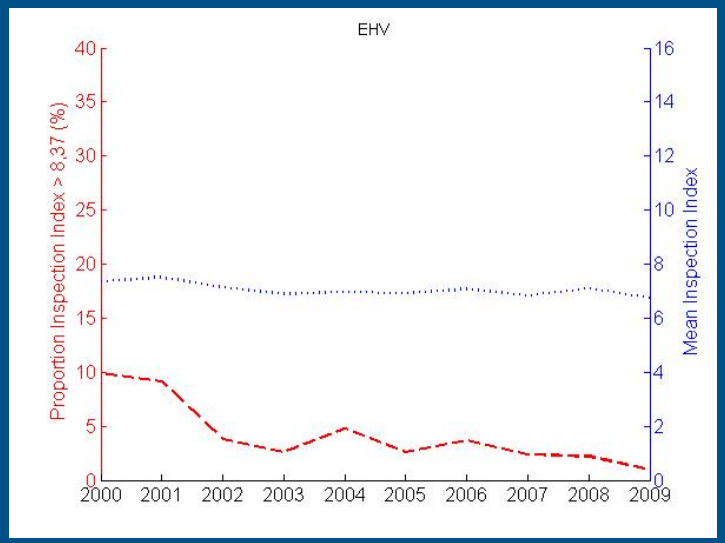

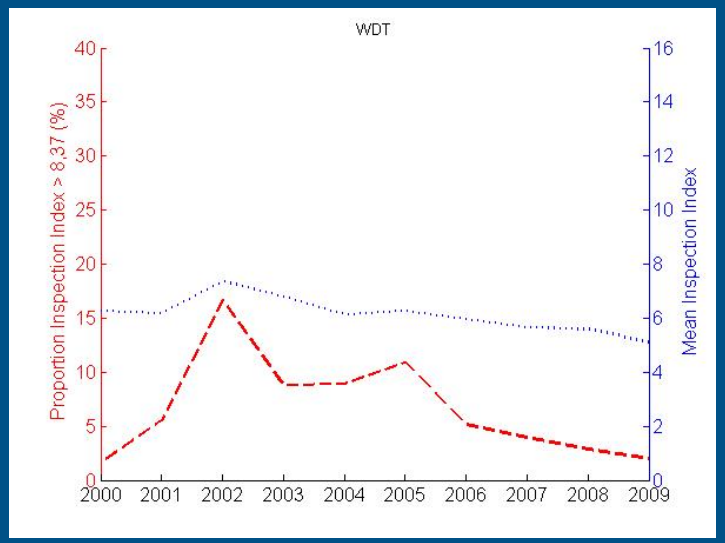

Acknowledgements

- The RNLAF for facilitating me being here

- All RNLAF Bird Controllers for their perseverance in recording birds and bird strikes

- Belgian, German, British, Danish and Dutch Air Forces for contributing their Bird Strike data to EURBASE