

Mortality from collisions with wind turbines

Long-term population effects on three raptor species



Supported by:



Federal Ministry
for Economic Affairs
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PROGRESS

Astrid Potiek, March 9th 2015

Introduction

- Different bird species collide with turbines
- Species are expected to differ in collision risk



Long-term population effects on three raptor species
Astrid Potiek

Introduction

- Different bird species collide with turbines
- Species are expected to differ in collision risk

Marques et al. 2014:

- Morphological features: size, wing loading
- Sensorial perception
- Avoidance behaviour

Introduction

- Effect of additional mortality
- Many studies: number of collisions / additional mortality
- What is the effect on the population level?

Introduction



Introduction

- Drewitt & Langston 2006

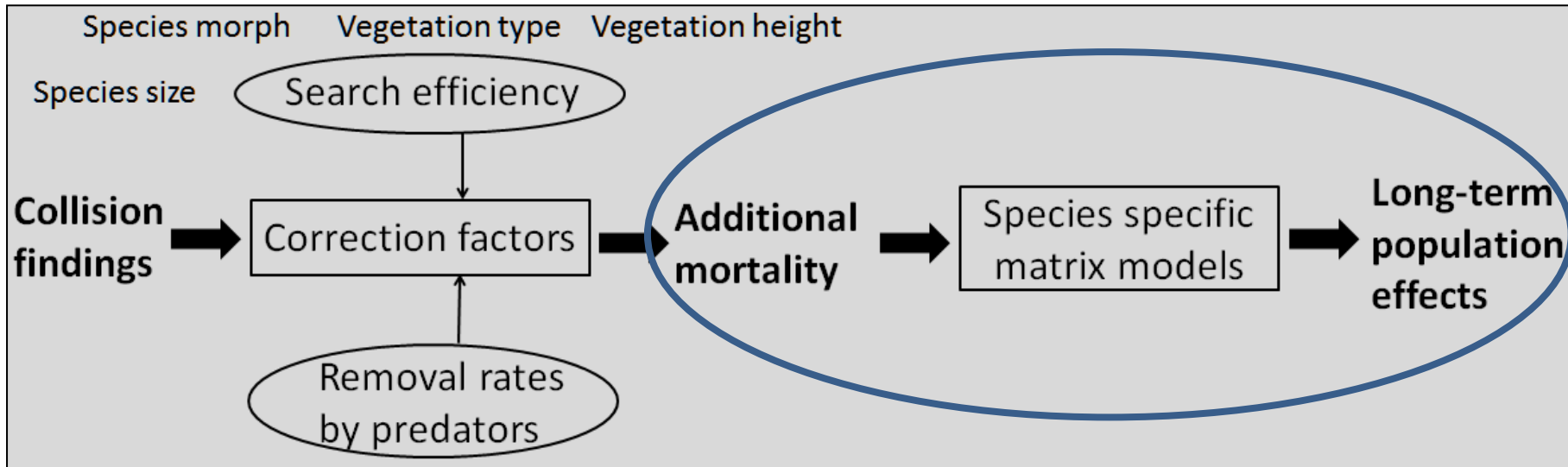
“... even low levels of additional mortality may be significant for long-lived species with low productivity and slow maturation rates, especially when rarer species of conservation concern are affected”

Introduction

- → Focus on raptors



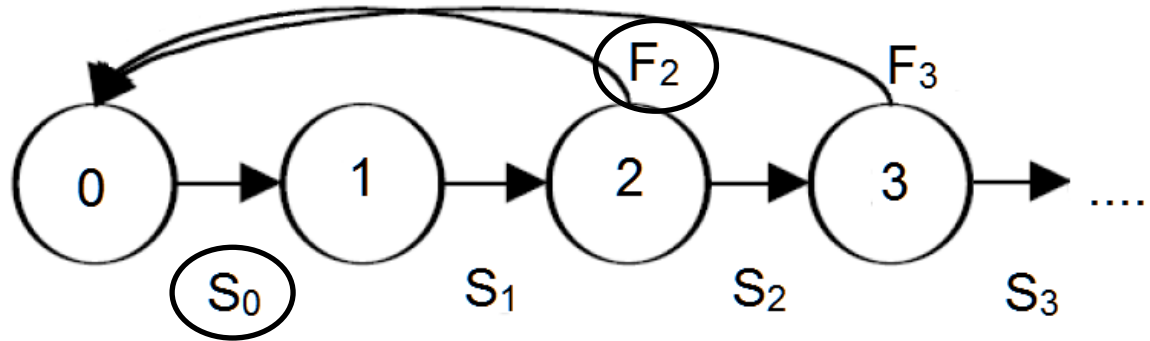
Methods



Methods

- Matrix models:
 - Prediction of population trends
 - Input:
 - Survival
 - Reproduction

Methods



- Immigration/emigration balance
- Assume no variation among individuals within a stage class
- Prediction of population growth: λ

$$N_{t+1} = \lambda N_t$$

Methods

- Common buzzard:
Data from Kreis Gütersloh, 1989 – now
Less than 1 wind turbine per 100 km²
- White-tailed Eagle
Data from SH, 1947-now
Mostly before wind turbine boom
- Red Kite:
Zang et al. (1989); Glutz et al. (1971)
Before wind turbine boom



Methods

- Common buzzard:

Data from Kreis Gütersloh, 1989 – now
Less than 1 wind turbine per 100 km²

Age

- White-tailed Eagle

Data from SH, 1947-now
Mostly before wind turbine boom

Age

- Red Kite:

Zang et al. (1989); Glutz et al. (1971)
Before wind turbine boom

Juv vs.
Adult

Methods

- Input matrix model:
 - Fertility and survival without additional mortality

Methods

- Input matrix model:
 - Fertility and survival without additional mortality
 - Additional mortality per wind turbine
 - Turbine density

Methods

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$$N_{t+1} = \lambda_1 N_t$$

Methods

- Input matrix model:
 - Fertility and survival without additional mortality
 - Additional mortality per wind turbine
 - Turbine density

$$N_{t+1} = \lambda_1 * y * N_t$$

$\lambda < 1$ = population decreases

$\lambda > 1$ = population increases

– Density-dependent

Results

Species	Found	Estimate
Common Buzzard	12	63 (35-110)
Red Kite	3	16 (5-44)
Kestrel	3	20 (6-55)
Lapwing	9	60 (31-112)
Eur. golden plover	5	28 (11-64)
Common crane	1	4 (1-57)
White-tailed Eagle	0	1 (0-36)
Barnacle goose	2	11 (3-47)

Results

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Results

Species	Estimate	# seasons	# turbines	Turbine days	Estimate/turb/year (lower – upper CI)
Common Buzzard	63 (35-110)	55	568	47712	0.48 (0.27-0.84)
Red Kite	16 (5-44)	36	284	23856	0.18 (0.057-0.50)
White-tailed Eagle	1 (0-36)	12	124	10416	0.035 (0-1.26)



Only areas where species is observed

Results



- Current situation Common Buzzard:
 - Wind turbine density = 11.96 / 100km²
 - NI, SH, MV, BB

Results

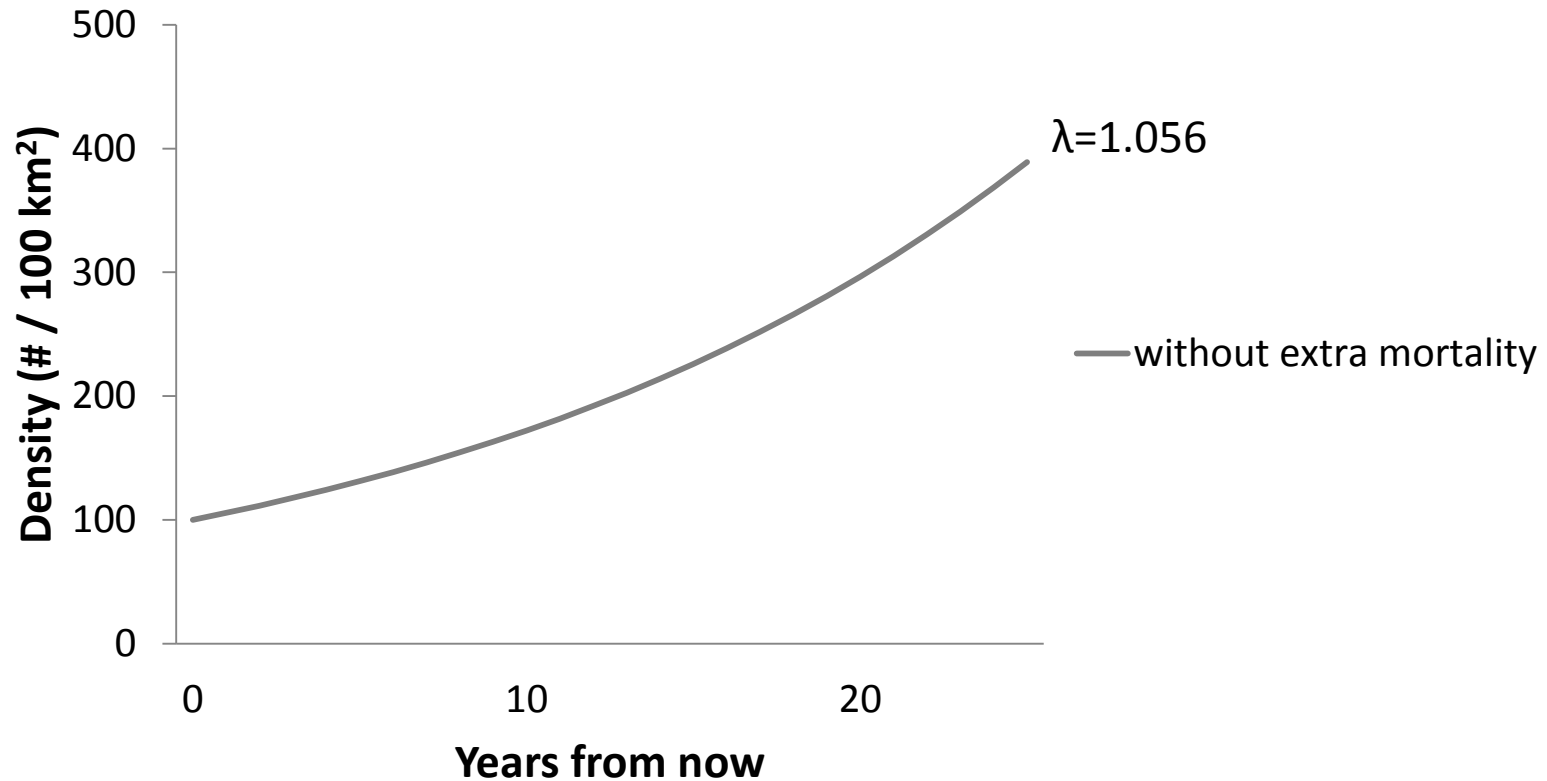


- Current situation Common Buzzard:
 - Wind turbine density = 11.96 / 100km²
 - Additional mortality buzzard = 0.48 (0.27-0.84) per turbine per year
 - Average density buzzard = 100 / 100km² (60-140)

Results



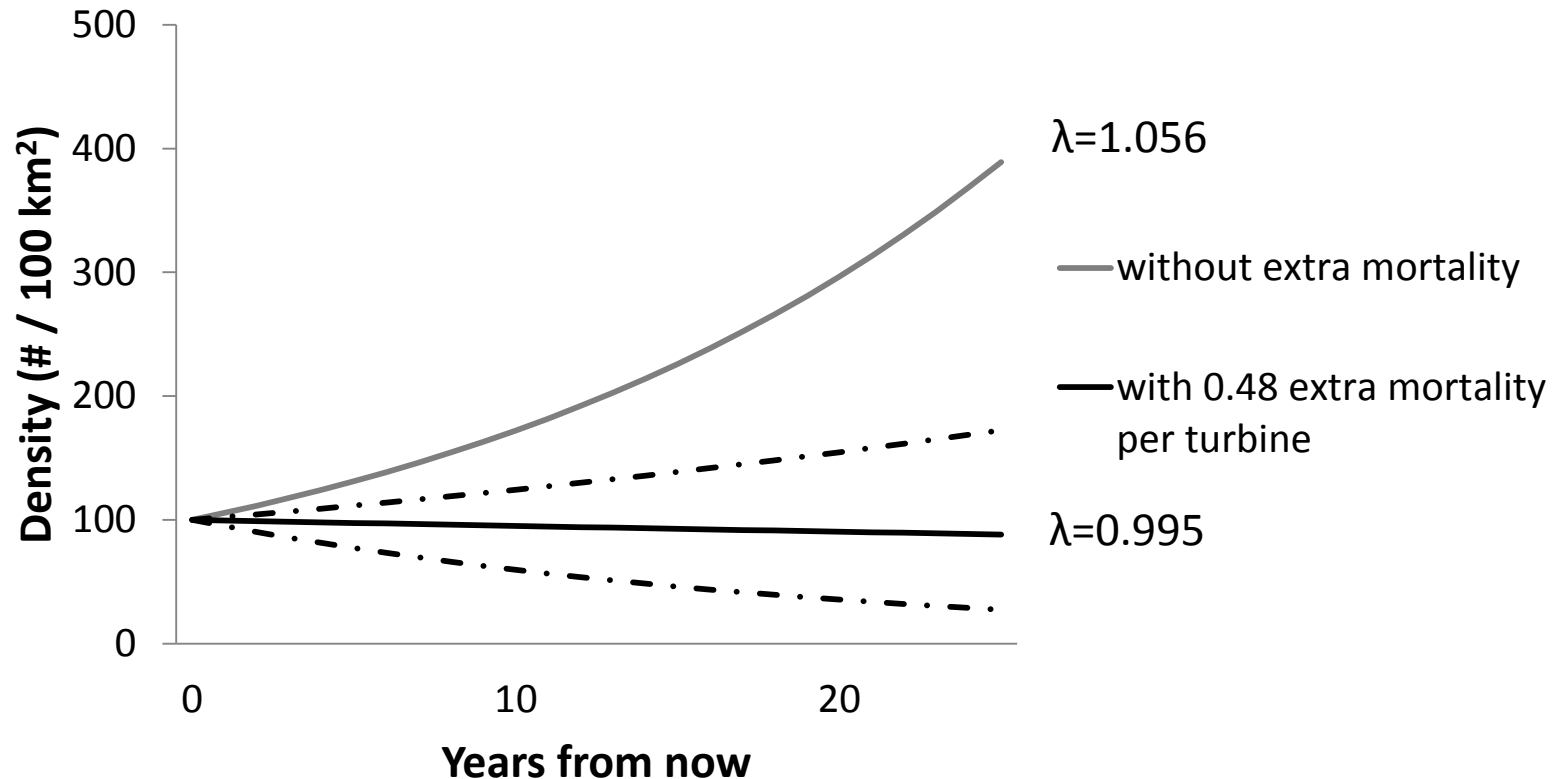
Population effects Common Buzzard



Results



Population effects Common Buzzard



Results

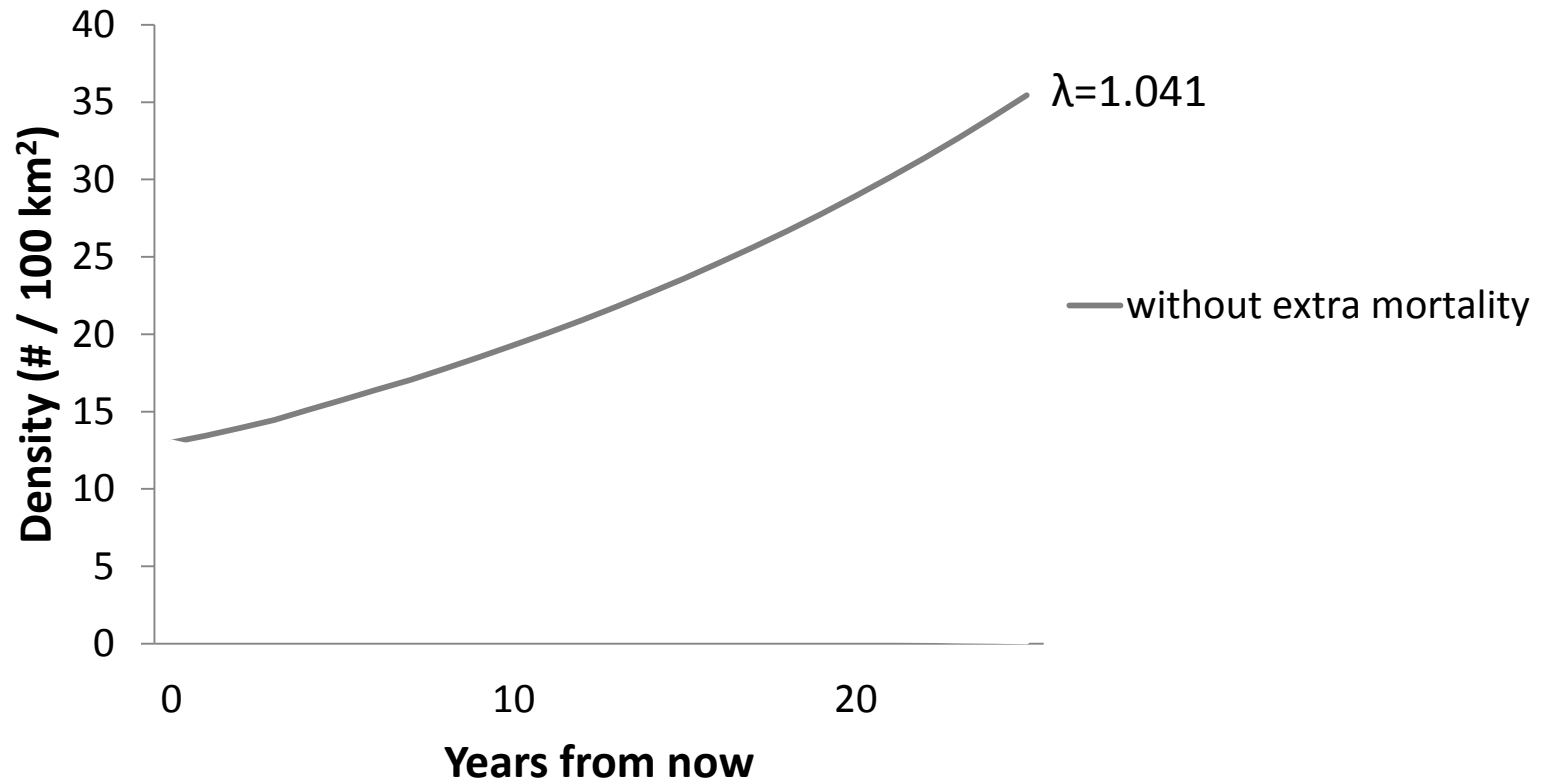


- Current situation Red Kite:
 - Wind turbine density = 11.96 / 100km²
 - Assuming 9 months presence in the area
 - Additional mortality Red Kite = 0.18 (0.06-0.50) per turbine per year
 - Average density Red Kite = 13 / 100km² (6-20)

Results



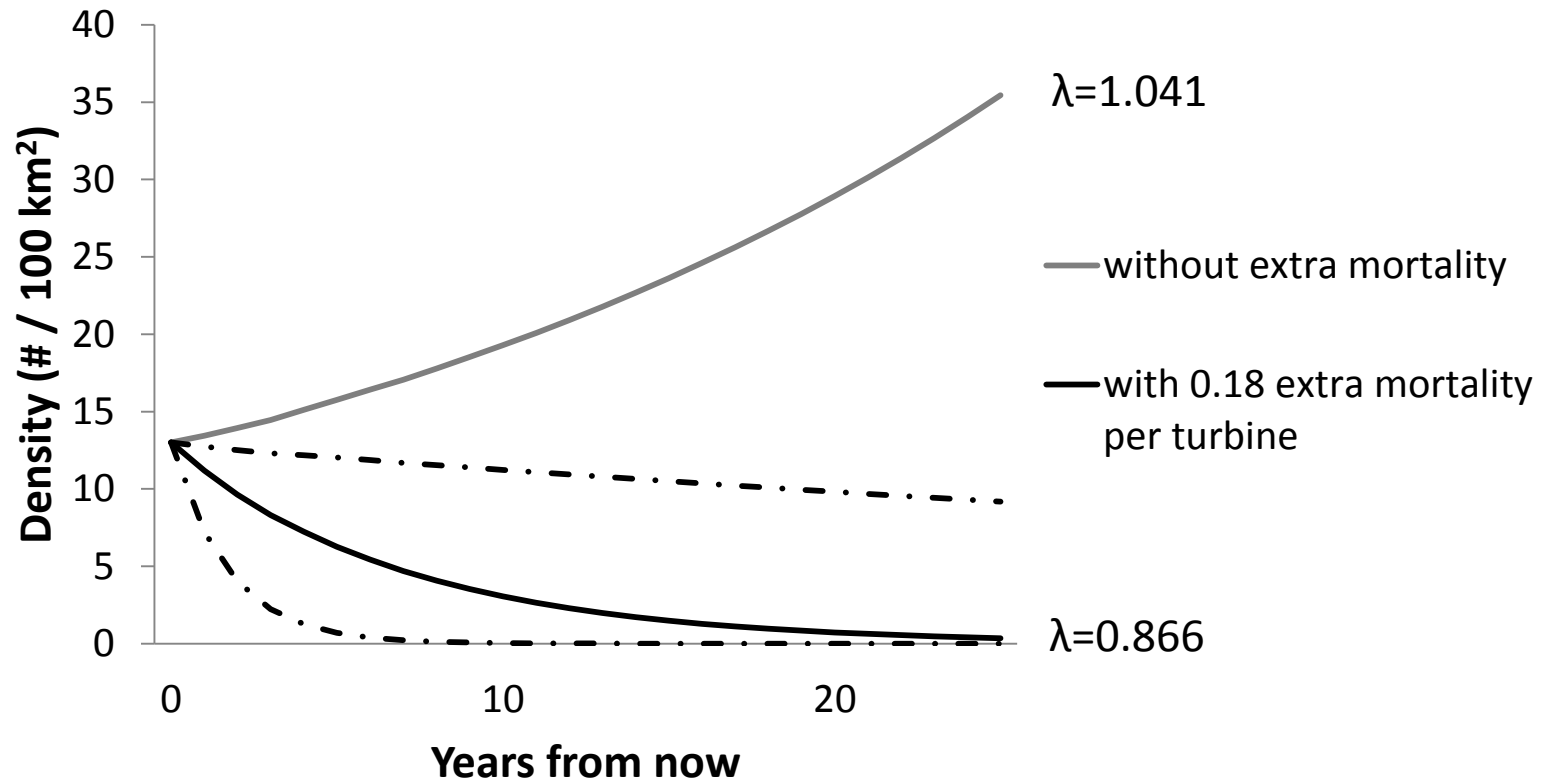
Population effects Red Kite



Results



Population effects Red Kite



Results

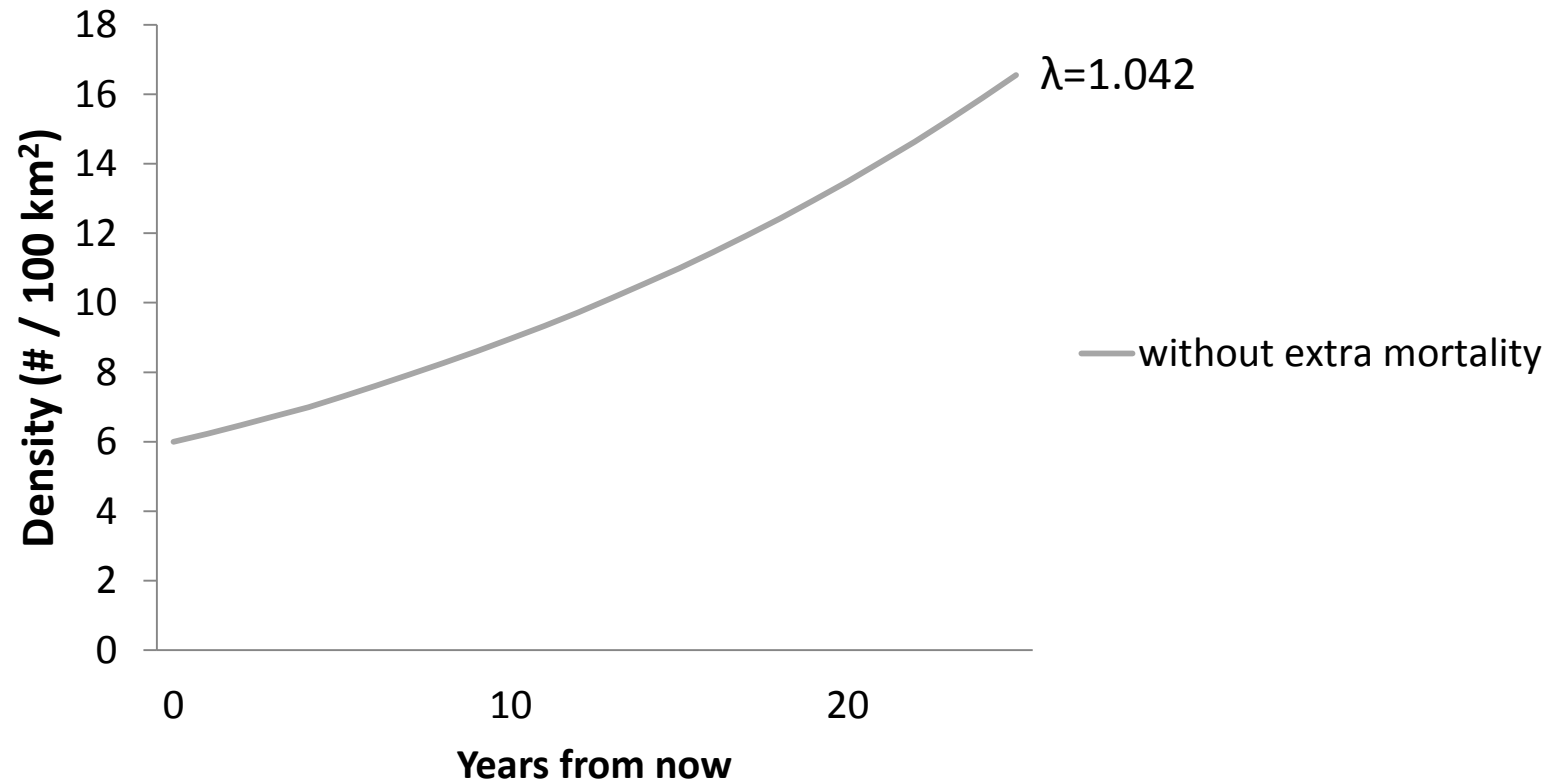


- Current situation White-tailed Eagle
 - Wind turbine density = 11.96 / 100km²
 - Additional mortality WTE = 0.035 (0.0-1.26) per turbine per year
 - Average density WTE = 6 / 100km² (2-10)

Results



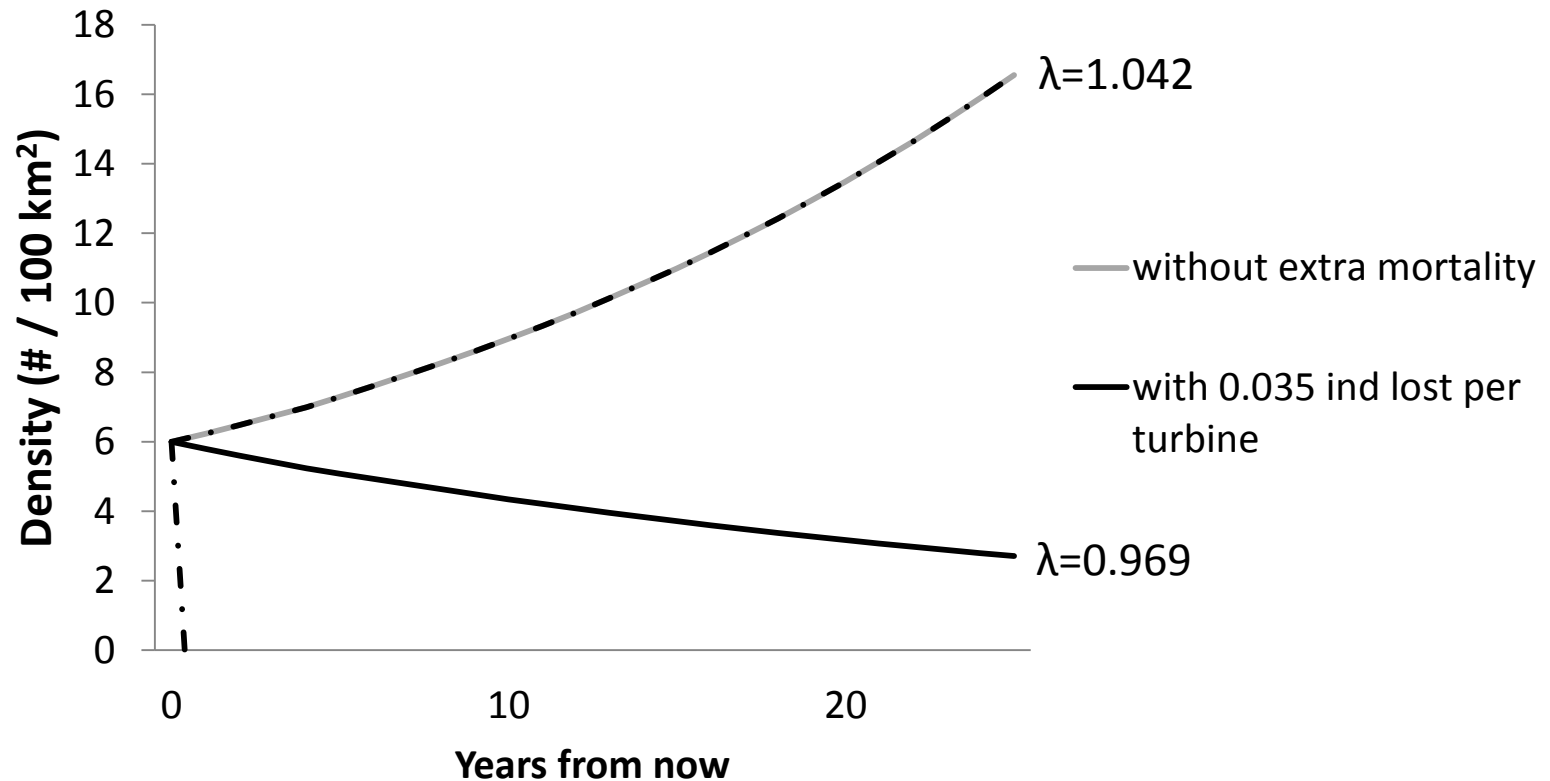
Population effects White-tailed Eagle



Results



Population effects White-tailed Eagle



Conclusions

At least Common Buzzard and Red Kite seem to be affected

- Common Buzzard: λ was 1.056 \rightarrow 0.995
- Red Kite: λ was 1.041 \rightarrow 0.866
- White-tailed Eagle: λ was 1.042 \rightarrow 0.969

But high uncertainty

Discussion

- Survival and fertility values Common Buzzard relatively high compared with other areas

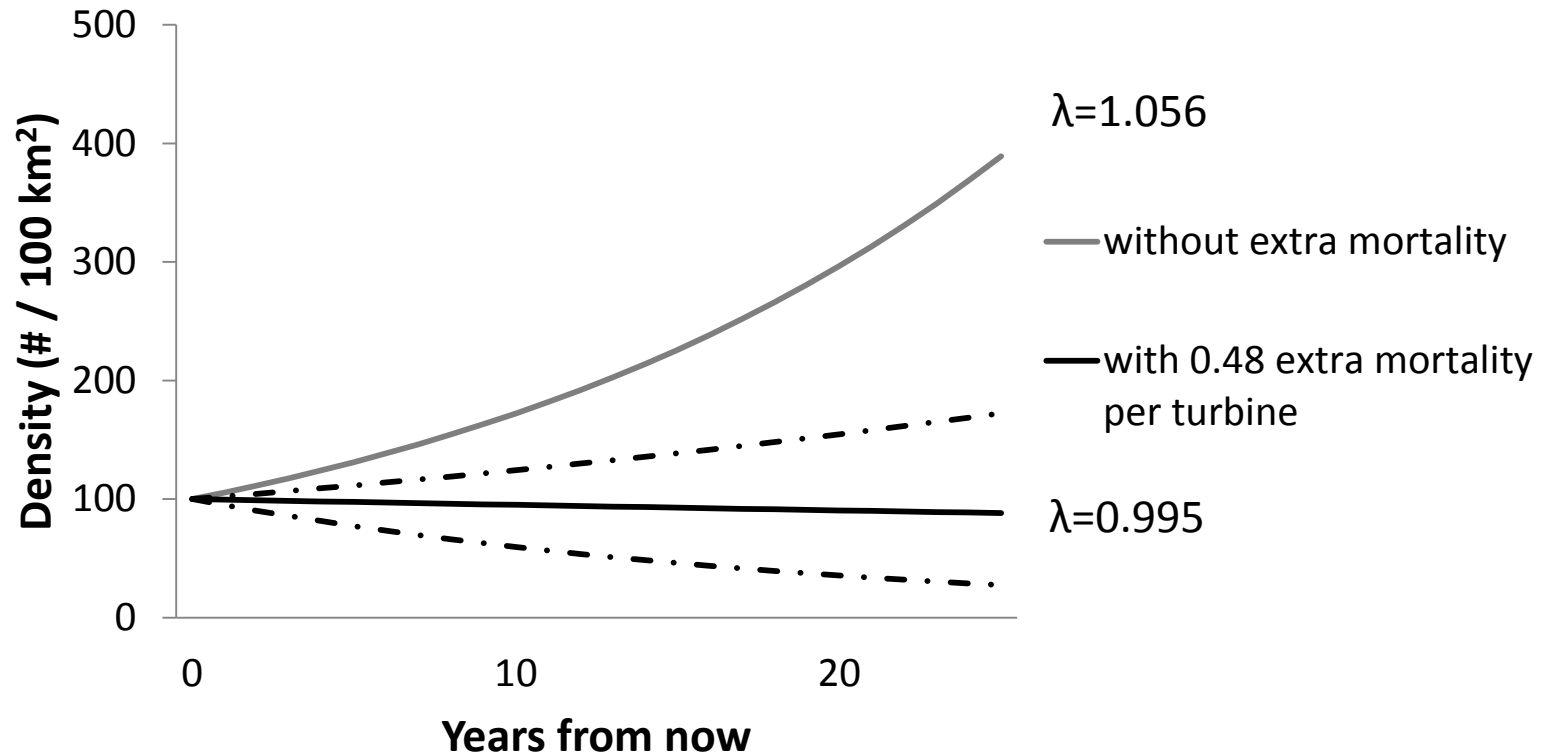
Discussion

- Survival and fertility values Common Buzzard relatively high compared with other areas
- Monitoring of European Raptors and Owls, annual report (Mammen and Thümmler, 2014): trend is 1.1% (1986-2006)
 - Adjusted survival and fertility with a factor 0.965 to get a lambda of 1.011

Discussion



Population effects Common Buzzard Bielefeld

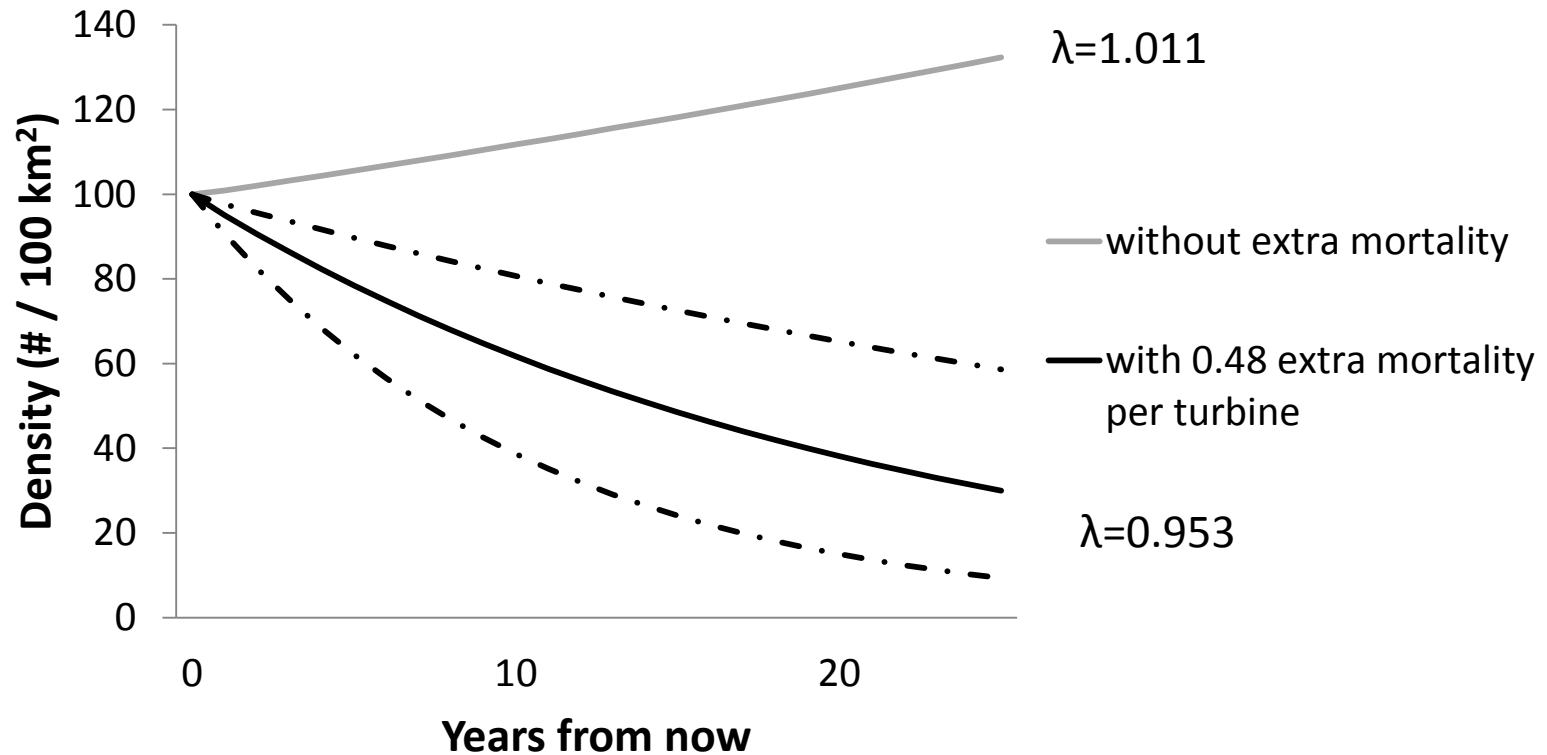


Discussion



Population effects Common Buzzard
Mammen and Thümmler 2014

Data from 1986-2006



Discussion

- Also adjusted survival and fertility for Red Kite

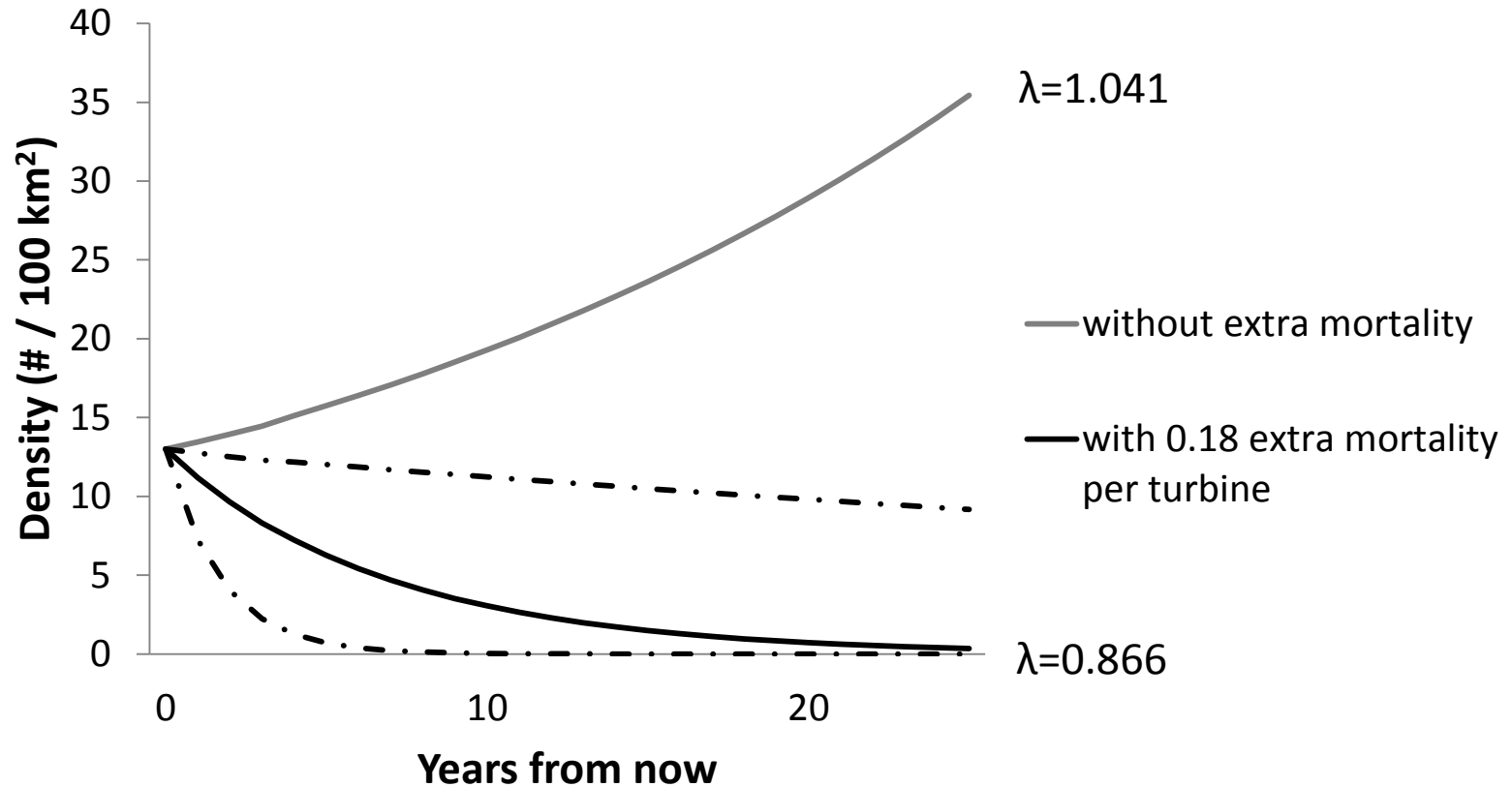
Discussion

- Also adjusted survival and fertility for Red Kite
- Monitoring of European Raptors and Owls, annual report 2014: trend is -2.2% (data from 1987-2006)
 - Adjusted survival and fertility with a factor 0.94 to get a lambda of 0.978

Discussion



Population effects Red Kite

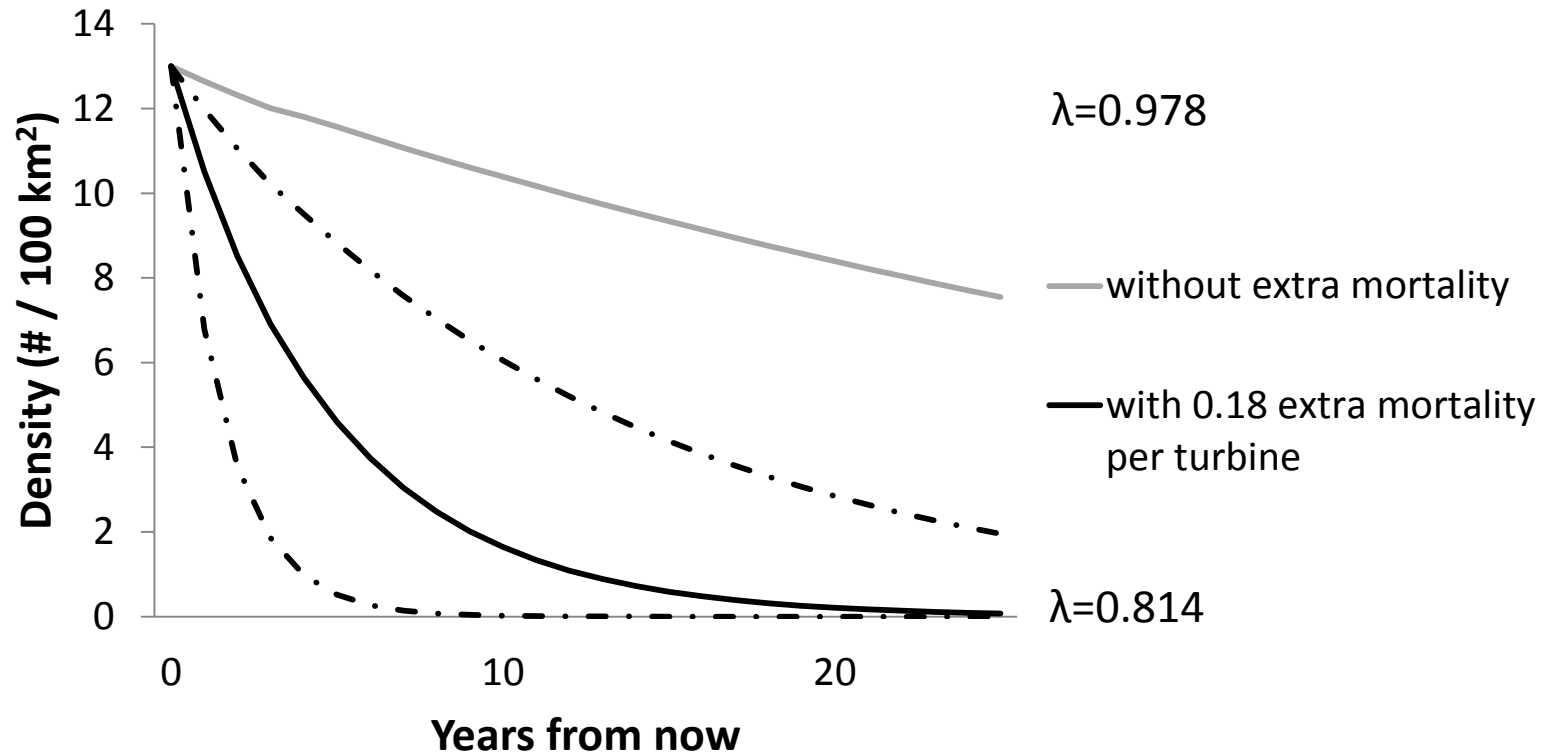


Discussion



Population effects Red Kite Mammen and Thümmler 2014

Data from 1987-2006



Discussion

- Different populations will be differently affected by additional mortality
- Adding stochasticity will lead to even worse projections
- Possibility to vary density of wind turbines

Outlook

- Which factors explain variation in collision risk?

Outlook

- Which factors explain variation in collision risk?
- Multivariate analysis
 - Turbine characteristics: height
 - Habitat characteristics:
 - QGIS
 - Corine land cover

→ Important for planning

Outlook

In addition to number of collided birds:

- number of individuals of red list species,
- species diversity
- species vulnerability

Thanks for your attention

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