

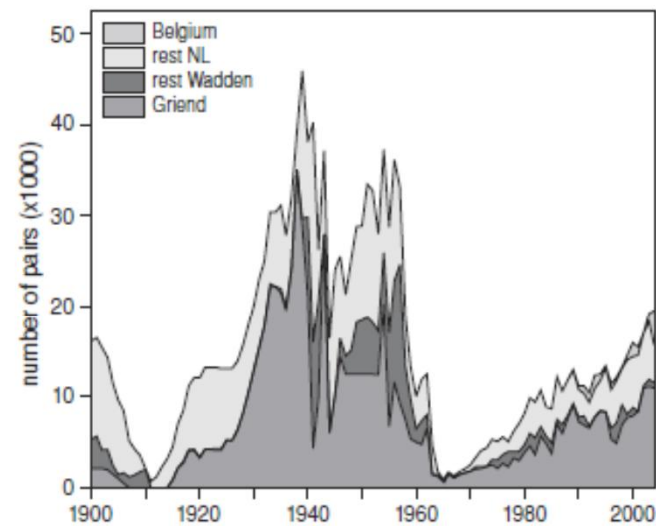
# Offshore Wind Farms (OWFs) and Seabirds

Preliminary assessment of the effect of habitat loss of the Sandwich Tern  
(population model)

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# Sandwich tern in the Netherlands



**Figure 9.4.** Number of breeding Sandwich Terns (pairs) in The Netherlands and Belgium during 1900-2004 (completed from Brenninkmeijer & Stienen 1992, data summarised in appendix 9.I).

# Life history of Sandwich tern



Breeding in dense colonies (April - July)  
(Photo Texel)



Migrating/ flying around  
(August – October) – ??



Wintering (November – March)  
(Photo Kruger Park website)

# Model parameterization



Reproductive Success –  
how many offspring  
does an adult produce?



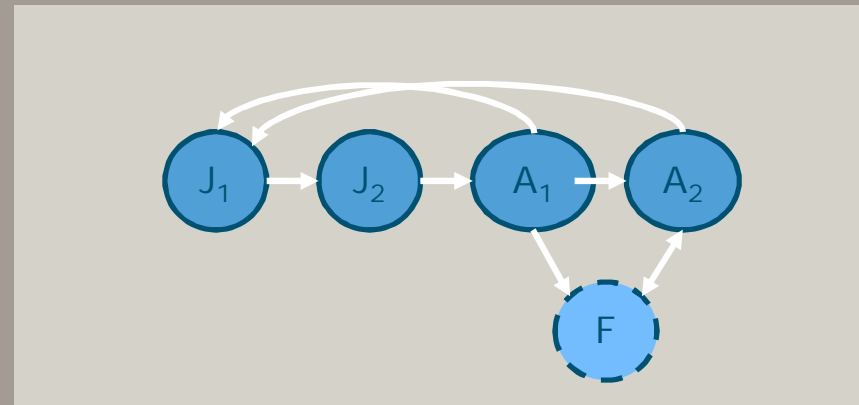
Age at maturation – at  
what age do individuals  
start reproduction?



Survival – what is the  
probability of survival in  
each age/stage class?

# Parameter knowledge – Model structure

- Survival
  - $J_0$ , immatures, adults.
- Maturation (recruitment)
  - age 3
- Age-dependent reproductive success (age 3-4 vs. >5)
- Non-reproducing adults??



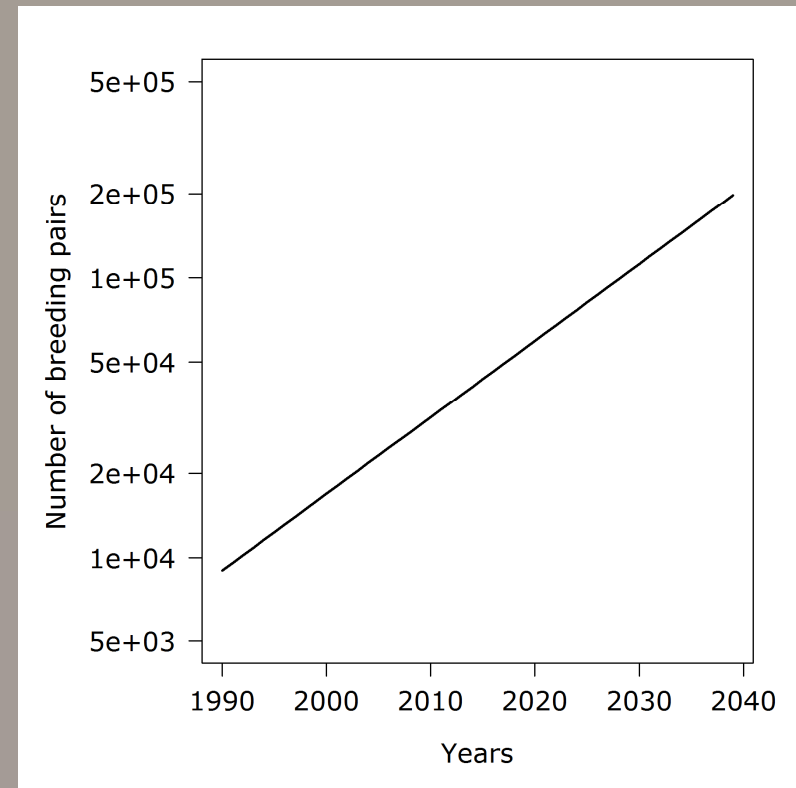
## Results - Deterministic Projection Matrix

		From			
		J0	J12	A34	A5+
To	J0	0	0	0.1608	0.584
	J12	0.3	0.4898	0	0
	A34	0	0.4702	0.4872	0
	A5+	0	0	0.4628	0.95

- Parameter values based on mean values measured in the Wadden Sea colonies (Jeugd et al. 2013, Veen 1977)

# Results - Projection and Population growth rate

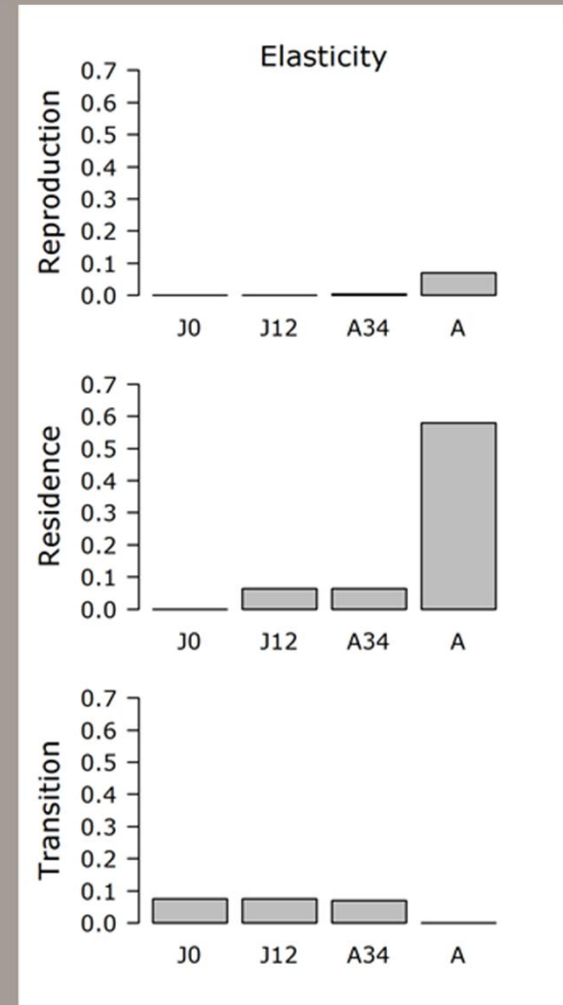
- Population growth rate:  
0.065
- Population grows exponentially
- PGR says something about:
  - Resilience
  - Robustness



# Results - Elasticity

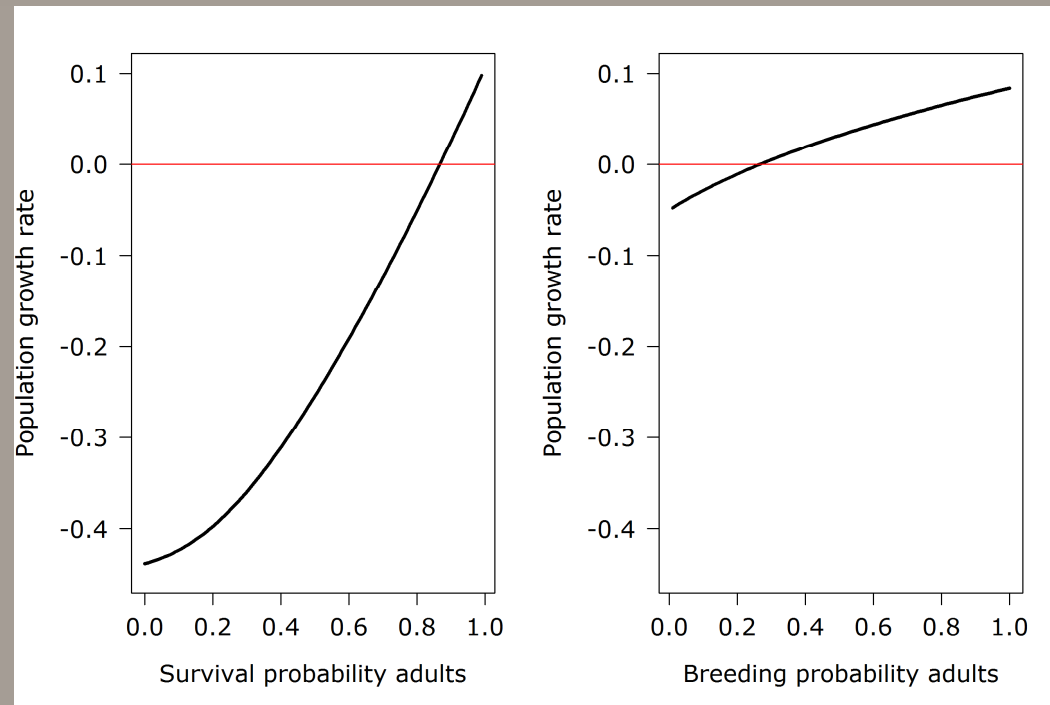
## Elasticity:

- The change in PGR of a small change in parameter value
- Adult survival is by far the most sensitive parameter
- All other parameters have ~8 times lower sensitivity





# Results – Adult survival and breeding



# Conclusions

- Sandwich Tern population currently seems to be “healthy”
- Population growth rate is especially sensitive to:
  - The probability that adults return to breed (survival)
  - The transition probabilities of juveniles and immatures (chance to reach maturity)
- Sensitive matrix elements depend on:
  - Adult Survival
  - Migration? ->analysis of international ringreading data

# Questions?

## References

Horswill, C., & Robinson, R. A. (2015). Review of Seabird Demographic Rates and Density Dependence. JNCC Report 552. Peterborough, UK.

Jeugd, H. Van Der, Schekkerman, H., Versluijs, M., Hallmann, C., Coehoorn, P., Ebbinge, B., ... Spaans, B. (2013). Geïntegreerde monitoring van vogels van de Nederlandse waddenzee. Vogeltrekstation Rapport, 208.

Stienen, E. W. M. (2006). Living with gulls. Trading off food and predation in the Sandwich Tern *Sterna sandvicensis*. Rijksuniversiteit Groningen.

Veen, J. (1977). Functional and Causal Aspects of Nest Distribution in Colonies of the Sandwich Tern (*Sterna s. sandvicensis* Lath.). Behaviour, Suppl. XX(20), 1–193.

