G-RAID CASE STUDY SCENARIOS USING A SPECIFIC (NON-GENERIC) MODEL

sebastian.napp@irta.es

Napp S.[1]

[1]IRTA-CReSA, Barcelona, Spain

MODELLING THE RISK OF ASF BY IMPORTATION OF DOMESTIC PIGS

THE MODEL

1.1. Estimating the probabilities of ASFV infection of domestic pigs in the countries of origin

a) Annual probability of an epidemic of ASF in the country of origin (P_{Ei})

$$P_{Ei} = beta(x+1, n-x+1)$$

n is the number of years since the last epidemic, and x is 1 if an epidemic had occurred, and 0 otherwise.

b) Probability of a pig being infected in the case of an epidemic (p_{Ii})

$$p_{Ii} = \frac{n_i}{N_i}$$

n_i is the number of pigs infected in country *i*, and N_i is the number of pigs in the country.

$$n_i = F_{HRP} \times W \times C_i$$

- F_{HRP} is the number of farms infected in country *i* during the high risk period[1].
- W is the within-farm prevalence in the case of an outbreak of ASF in a farm[1].
- C_i is the average census of a pig herd in country *i*

c) Probability of a pig infected with ASFV not being detected (P_{ND})

$$P_{ND} = \frac{IP}{CD}$$

IP is the incubation period, and CD is the course of disease[2].

d) Probability of a pig selected for export being infected with ASFV in country *i* (P_{Ii})

$$P_{Ii} = P_{Ei} \times p_i \times P_{ND}$$

P_{Ei} is the probability of an epidemic, p_i is the probability of a pig being infected in case of an epidemic, and P_{ND} is the probability of an infected pig not being detected.

1.2. Estimating the probability of ASFV introduction in the country of destination by importation of domestic pigs (P_{Dij})

$$P_{Dij} = 1 - (1 - P_{Ii})^{N_{ij}}$$

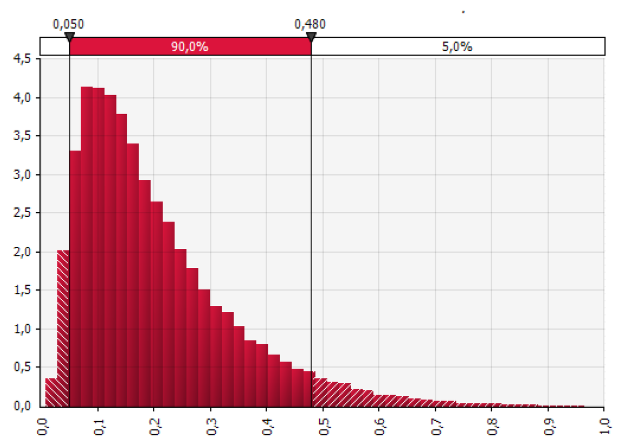
N_{ij} is the number of pigs imported from country *i* to country *j* that year.

As pigs imported from different countries, the overall probability of ASF introduction into the country of destination by importation of domestic pigs (P_{Di}) is:

$$P_{Di} = 1 - \prod_{j=country\ 1}^{country\ n} (1 - P_{Dij})$$

RESULTS

For example, the annual risk of introduction of ASFV into the Netherlands by importation of domestic pigs (scenario 1) was 0.20.



@RISK

Figure 1: Probability distribution of the annual risk of introduction of ASFV into the Netherlands by importation of domestic pigs (scenario 1).

Exporting country	Graph	Min	Mean	Max	5%	95%
Belgium		0.000001	0.13	0.95	0.01	0.39
Denmark		0.000000	0.04	0.53	0.00	0.13
Luxemburg		0.000000	0.02	0.29	0.00	0.06
Estonia		0.000011	0.01	0.05	0.00	0.02
Germany		0.000000	0.01	0.13	0.00	0.02
Poland		0.000014	0.01	0.03	0.00	0.01

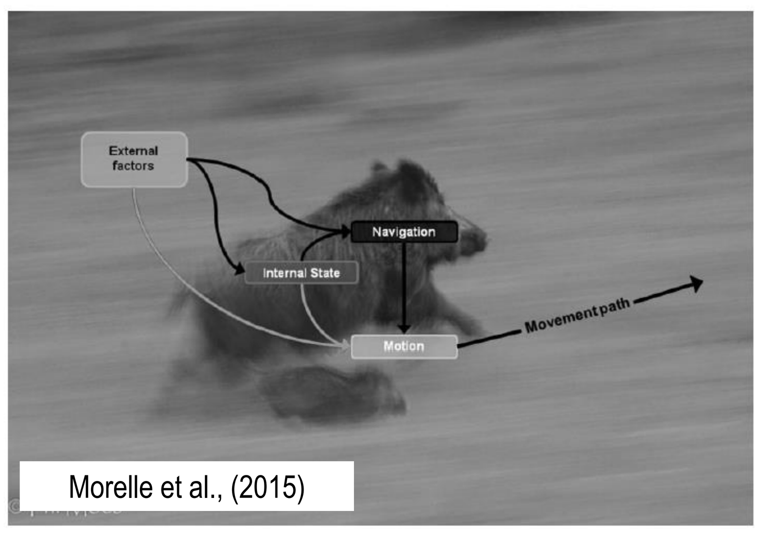
Table 1: Main risk countries for the introduction of ASFV into the Netherlands by importation of domestic pigs (scenario 1).

MODELLING THE RISK OF ASF BY MOVEMENT OF WILD BOAR

THE MODEL

Introduction

Only risk by active movement of wild boars was considered. Other risk by wild boars (e.g. eating contaminated pork products) not estimated.



Several factors drive the movement of wild boars (WB), e.g. search for food, escaping predators or reproduction. If wild boars infected by ASFV cross the border => **Introduction of ASF into a country.**

Modelling wild boar movement

Standard methods in spatial ecology consider that animal movements can be modeled as **uncorrelated random walks (URW).**

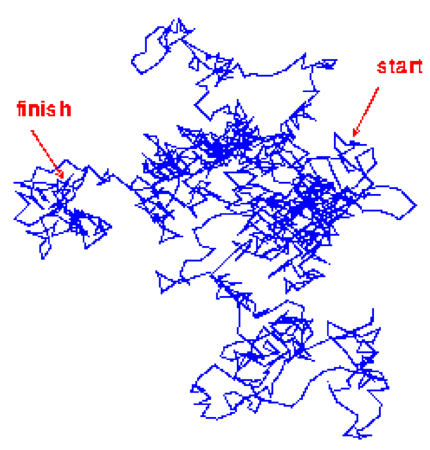


Figure 2: Example of random walk

URW do not account for directional persistence in the movement. Such limitation may be overcome with Lévy walks[3] => For modelling the movement of infected wild boars, we used the Lévy walk algorithm with some modifications (implemented in R).

a) For direction: Cauchy distribution for the turning angles (between -180º and +180º).

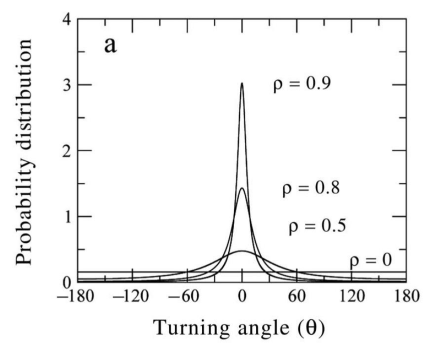


Figure 3: Cauchy distribution for the turning angles

b) For distance: we modelled the linear distance travelled by a WB per day as:

$$dist = pert(d_{min}, d_{mean}, d_{max})$$

where $d_{min}, d_{mean}, d_{max}$ are the minimum, mean and maximum distances, obtained from studies on the spatiotemporal behavior of wild boar[4].

RESULTS

For example, the annual risk of introduction of ASFV into the Netherlands by movement of WB (scenario 2) was 0.0016.

Figure 4: Annual risk of introduction of ASFV into the Netherlands by movement of wild boars (for scenario 2) examples of trajectories with positive result (A) and negative result (B).

Limitations

- A chronic form of ASF was assumed (to allow infected wild boars to move).
- No under-reporting of ASF assumed for scenarios tested.
- Results very sensitive to the parameters of the distributions used to model direction and distance => **More knowledge of drivers of wild boars movements needed.**

REFERENCES

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