The title of the dissertation

Inaugural-Dissertation
to obtain the academic degree
Doctor rerum naturalium (Dr. rer. nat.)

submitted to the Department of Biology, Chemistry, Pharmacy
of Freie Universität Berlin

by MY NAME

Berlin, 2021

Here may stand some information on the research project and project partners.

First Reviewer: Prof. Dr. Name Surname
Second Reviewer: Prof. Dr. Name Surname

Day of defense: _____

Contents

Summary

Here is the space for a summary in the original language of the document. In most cases, the summary will cover 1 to 2 pages. The command "cleardoublepage" will ensure that the next chapter starts on a right side of the thesis book and eventually insert a blank side at the left.

Zusammenfassung

Here one may include a translation of the thesis summary. One may change the language setting of the dokument in this paragraph with "selectlanguage" to allow for optimal hyphenation etc. Again, use "cleardoublepage" to let start the next chapter on a right side, and don’t forget to reset the original language of the document.

List of Figures

List of Tables

List of Equations

Chapter 2

Chapter 3

Thesis Outline

Here one may define how much chapter the thesis has and how the work is generally structured. Since sometimes individual chapters have relatively long titles (especially if the titles come from a publication and you can't shorten them afterwards), one can set short titles for each chapter that appear in the chapter overview and page headers. I found it convenient to list the short titles briefly here in this section as well, as follows:

Chapter 1
General Introduction

Chapter 2
Short title: Short title of Chapter 2
Long title: This is a long title of Chapter 2 that does not fit in the page header

Chapter 3
Short title: Short title of Chapter 3
Long title: This is a long title of Chapter 3 that does not fit in the page header

Chapter 4
General Discussion and Conclusions

List of Publications with Author Contributions

Name, My, Co-Author 1, Co-Author 2. Title *Journal Name* 12, no. 1 (14 March 2019): 106. https://doi.org/10.1186/s13071-019-3368-0.

MN and C1 were responsible for the conception and design of the study. Mn draftred the manuscript. C2 contributed expert knowledge. MN, C1 and C2 critically revised the manuscript. All authors read and approved the final manuscript.

Name, My, Co-Author 1, Co-Author 2. Title *Journal Name* 12, no. 1 (14 March 2019): 106. https://doi.org/10.1186/s13071-019-3368-0.

MN and C1 were responsible for the conception and design of the study. Mn draftred the manuscript. C2 contributed expert knowledge. MN, C1 and C2 critically revised the manuscript. All authors read and approved the final manuscript.

Chapter 1

General Introduction

Here stands an introduction. In my case, I explained a lot about health risks posed by mosquitoes, especially invasive mosquitoes in Europe. Introductions are always full of citations [1–3] and subchapters (see e.g. section 1.1. Sometimes you may find tables (see e.g. Tab.1.1) and figures ().

Table 1.1: Citizen science programmes for studying the mosquito fauna in Europe [1–3]

Country	Name	Submissions
France	iMoustique	photograph via smart-phone application
Germany	Mückenatlas	physically via mail
Italy	ZanzaMapp	online questionnaire
Portugal	MosquitoWEB	physically via mail
Spain	Mosquito Alert (former “Atrapa el Tigre”)	photograph via smart-phone application
The Netherlands	Muggenradar	physically via mail
UK	Mosquito Reporting Scheme	physically via mail

Generally, in the LaTex book class, the sections hierarchie is: chapter, section, subsection, subsubsection, paragraph and finally subparagraph:

1.1 Example section title

1.1.1 Example subsection title

Example subsubsection title

Example paragraph title

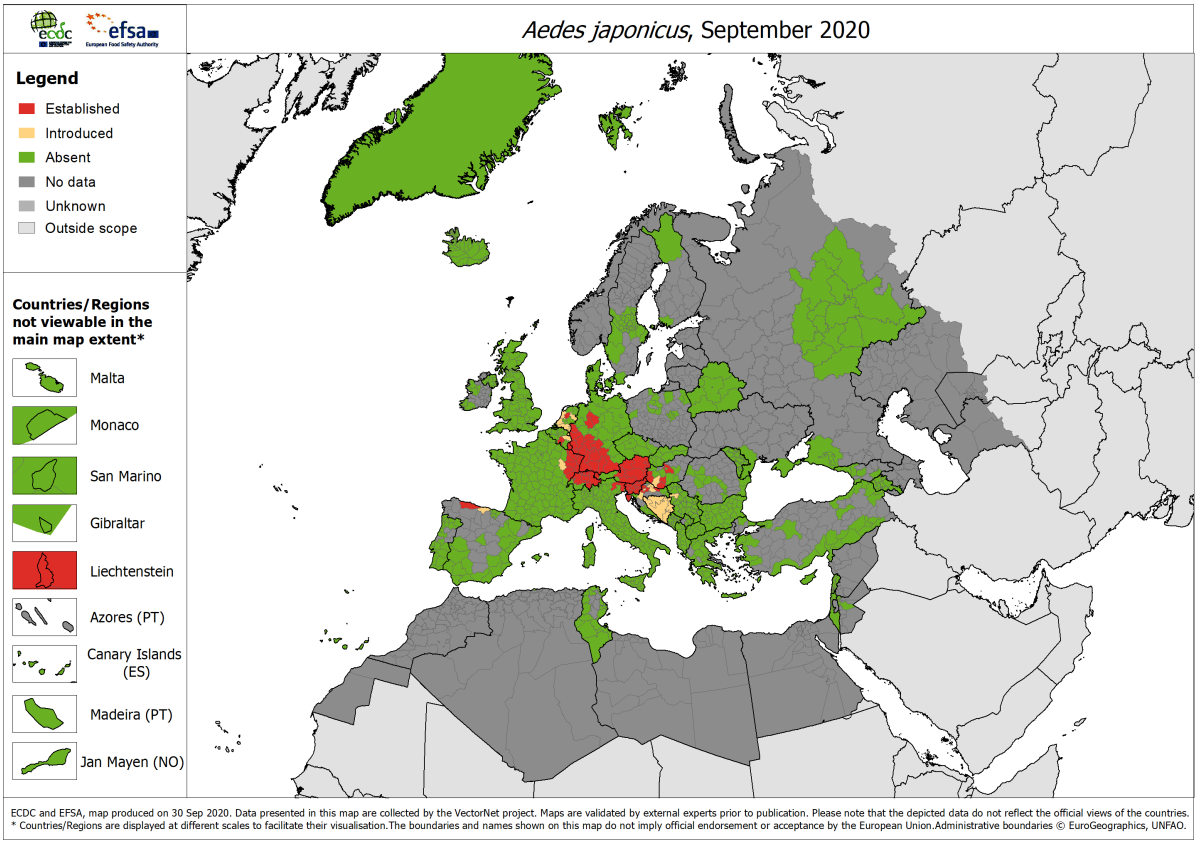

Figure 1.1: Current known distribution of *Aedes japonicus japonicus* in Europe at the 30th of September 2020 [4].

1.2 Research questions

In summary, the leading questions of my work were:

(i) Leading question 1

(ii) Leading question 2

1.3 References

[1] Kampen H, Medlock JM, Vaux AG, Koenraadt CJ, Vliet AJ van, Bartumeus F et al. Approaches to passive mosquito surveillance in the EU. Parasites & Vectors 8 (1) (2015) 9. DOI: 10.1186/s13071-014-0604-5.

[2] Bartumeus F, Oltra A, Palmer JRB. Citizen science: A gateway for innovation in disease-carrying mosquito management? Trends in Parasitology 34 (9) (2018) 727–729. DOI: 10.1016/j.pt.2018.04.010.

[3] Caputo B, Manica M, Filipponi F, Blangiardo M, Cobre P, Delucchi L et al. ZanzaMapp: A scalable citizen science tool to monitor perception of mosquito abundance and nuisance in Italy and beyond. International Journal of Environmental Research and Public Health 17 (21) (2020). DOI: 10.3390/ijerph17217872.

[4] ECDC. Aedes Japonicus - Current Known Distribution: September 2020. 2020. URL: https://www.ecdc.europa.eu/en/publications-data/aedes-japonicus-current-known-distribution-september-2020 (visited on 15/02/2021).

Chapter 2

Short title of Chapter 2

This is a long title of Chapter 2 that does not fit in the page header

Authors My Name[a,b], Co-Author 1[a], Co-Author 2[c]

a Adress first institution
b Adress second institution
c Adress third institution

Keywords Keyword 1, Keyword 2, Keyword 3, Keyword 4

Journal Parasitology Research (Springer Nature), published in print in issue 119:31–42 (2020). https://doi.org/10.1007/s00436-019-06513-5

2.1 Abstract

Here stands the abstract.

2.2 Introduction

Here is the introduction of Chapter 2. The introduction is full of references [1, 2].

2.3 Materials and methods

Here, the methodology is explained in detail. Sometimes, it is necessary to include equations. I set up an overview of the equations after the "List of Figures" caption (see 2.1 and 2.2).

$$A = \frac{B}{C} \tag{2.1}$$

$$E = mC^2 \tag{2.2}$$

2.4 Results

Here will stand the results. They may include lots of figures and tables.

2.5 Discussion

A discussion chapter usually has a lot of references [3, 4].

2.6 Conclusions

Our model approach appears to be suitable for ...

Acknowledgements We thank two anonymous reviewers for their helpful comments on the manuscript.

Funding information This paper was funded by ...

Data availability Explanation of the data availability.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

2.7 References

[1] Medlock JM, Hansford KM, Versteirt V, Cull B, Kampen H, Fontenille D et al. An entomological review of invasive mosquitoes in Europe. Bulletin of Entomological Research 105 (6) (2015) 637–663. DOI: 10.1017/S0007485315000103.

[2] Becker N, Krueger A, Kuhn C, Plenge-Boenig A, Thomas S, Schmidt-Chanasit J et al. Mosquitoes as vectors for exotic pathogens in Germany. Bundesgesundheitsblatt, Gesundheitsforschung, Gesundheitsschutz 57 (5) (2014/05, 2014) 531–540. DOI: 10.1007/s00103-013-1918-8.

[3] Kerkow A, Wieland R, Koban MB, Hölker F, Jeschke JM, Werner D et al. What makes the Asian bush mosquito *Aedes japonicus japonicus* feel comfortable in Germany? A fuzzy modelling approach. Parasites & Vectors 12 (1) (2019) 106. DOI: 10.1186/s13071-019-3368-0.

[4] Koban MB, Kampen H, Scheuch DE, Frueh L, Kuhlisch C, Janssen N et al. The Asian bush mosquito *Aedes japonicus japonicus* (Diptera: Culicidae) in Europe, 17 years after its first detection, with a focus on monitoring methods. Parasites & Vectors 12 (1) (2019) 109. DOI: 10.1186/s13071-019-3349-3.

Chapter 3

Short title of Chapter 3

This is a long title of Chapter 3 that does not fit in the page header

Authors My Name[a,b], Co-Author 1[a], Co-Author 2[c]

a Adress first institution
b Adress second institution
c Adress third institution

Keywords Keyword 1, Keyword 2, Keyword 3, Keyword 4

Journal Submitted to Ecological Modelling (Elsevier) on 12 March 2021 in an abbreviated form.

3.1 Abstract

Here stands the abstract.

3.2 Introduction

3.2.1 Background

Here is a text full of references [1, 2].

Objectives

Here is more text with more citations [3, 4].

3.2.2 Summary of model innovations

Our work presents the following innovations to existing models:

(i) innovation 1

(ii) innovation 2

3.3 Materials and Methods

3.3.1 Study regions

We selected three subregions of the grid based habitat suitability map with sizes of 25 km $\times$ 25 km for model applications (Fig. 3.1). In each of them, the occurrence of *Ae. j. japonicus* has been documented for several years [5, 6].

3.3.2 Calculation of the day length

For the calculation of the day lengths, we apply the Brock model [7] which maps the latitude (l) of the location and the day (d) of the year on the day length as follows:

$$D(l,d) = 2\frac{cos^{-1}\left(-tan(l)tan\left(23.45sin\left(360\frac{283+d}{365}\right)\right)\right)}{15} \tag{3.1}$$

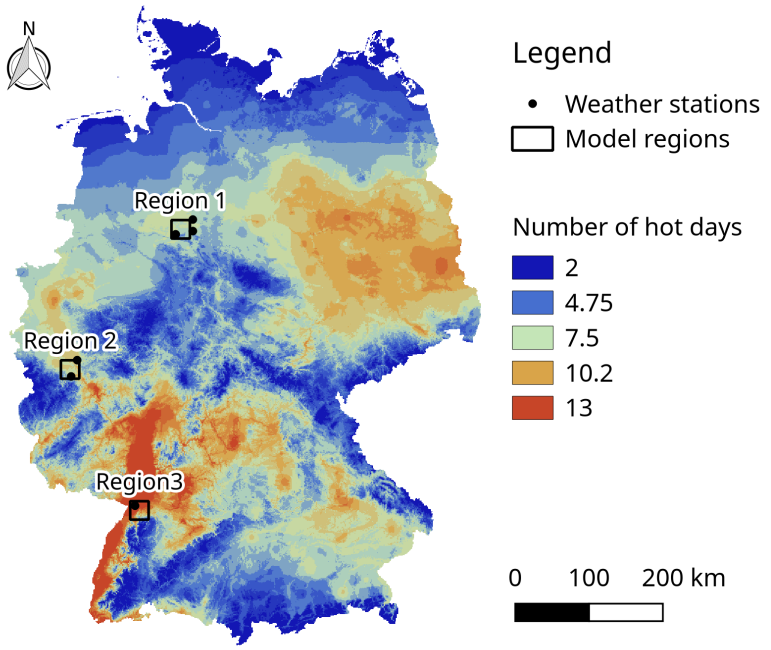

Figure 3.1: Location of the study regions, their nearest weather stations, and illustration of the number of local hot days defined by a maximum air temperature higher than 30°C (annual mean of the long-term period 1981-2010). Geodata source: German Weather Service.

3.3.3 Sub-models

Time component

The model is based on 9 compartments (ordinary differential equations) that describe the populations and infection stages of mosquitoes and birds by means of a density-dependent approach (equations 3.2.1-3.3.5). The mosquito compartments include larvae (L_M), susceptible (S_M), exposed (E_M) and infectious mosquitoes (I_M). The bird compartments are susceptible (S_B), exposed (E_B), infectious (I_B), recovered (R_B) and dead birds (R_B). Recovered birds have always acquired immunity and the dead birds refer only to those that have succumbed to WNV.

The equations are taken from previous compartment models for Usutu virus and WNV [8, 9], but we introduced a species specific probability of the mosquitoes taking a blood meal on a bird and an additional probability of taking blood meals on a host bird when feeding on a bird. Both factors affect the virus transmission rates. We have also changed parameters that describe the

characteristics of host birds and vector mosquitoes. All fix parameters of the differential equations are summarised in table 3.1.

Mosquito compartments

$$\frac{dL_M}{dt} = (b_L(T)\delta_M(D)N_M - m_M(T)L_M)\left(1 - \frac{L_M}{K_M}\right) - b_M(T)L_M \tag{3.2.1}$$

$$\frac{dS_M}{dt} = b_M(T)L_M - m_M(T)S_M - \lambda_{BM}(T,D)S_M \tag{3.2.2}$$

$$\frac{dE_M}{dt} = \lambda_{BM}(T,D)S_M - \gamma M(T)E_M - m_M(T)E_M \tag{3.2.3}$$

$$\frac{dI_M}{dt} = \gamma M(T)E_M - m_M(T)I_M \tag{3.2.4}$$

Bird compartments

$$\frac{dS_B}{dt} = \left(b_B - (b_B - m_B)\frac{N_B}{K_B}\right)N_B - \lambda_{MB}(T,D)S_B - m_B S_B \tag{3.3.1}$$

$$\frac{dE_B}{dt} = \lambda_{MB}(T,D)S_B - \gamma_B E_B - m_B E_B \tag{3.3.2}$$

$$\frac{dI_B}{dt} = \gamma_B E_B - \alpha_B I_B - m_B I_B \tag{3.3.3}$$

$$\frac{dR_B}{dt} = (1 - \nu_B)\alpha_B I_B - m_B R_B \tag{3.3.4}$$

$$\frac{dD_B}{dt} = \nu_B \alpha_B I_B \tag{3.3.5}$$

3.4 Results

Here the results are presented.

Table 3.1: State variables

Term	Description	Value
m_B	Average mortality rate of magpies	$0.001404\,\mathrm{d}^{-1}$
γ_B	Rate infected–infectious magpies	$0.333\,\mathrm{d}^{-1}$
ν_B	Portion of magpies dying due to WNV infection	0.43
p_M	Transmission efficiency from infectious mosquito to bird	1.0
α_B	Removal rate of magpies due to WNV infection	$0.28\,\mathrm{d}^{-1}$
p_{B_J}	Transmission efficiency from infectious bird to *Ae. j. japonicus*	0.17
p_{B_C}	Transmission efficiency from infectious bird to *Culex agg.*	0.06
P_J	Proportion of *Ae. j. japonicus* blood meals taken on birds	0.18
P_C	Proportion of *Culex agg.* blood meals taken on birds	0.33, 0.66, 0.96

3.5 Discussion

Here will be the discussion.

3.6 Conclusions

...

3.7 References

[1] Chancey C, Grinev A, Volkova E, Rios M. The global ecology and epidemiology of West Nile virus. BioMed Research International 2015 (376230) (2015) 20. DOI: https://doi.org/10.1155/2015/376230.

[2] Gray TJ, Webb CE. A review of the epidemiological and clinical aspects of West Nile virus. International Journal of General Medicine 7 (2014) 193–203. DOI: 10.2147/IJGM.S59902.

[3] Yaremych SA, Warner RE, Mankin PC, Brawn JD, Raim A, Novak R. West Nile virus and high death rate in American crows. Emerging Infectious Diseases 10 (4) (2004) 709–711. DOI: 10.3201/eid1004.030499.

[4] Oya NJ de, Camacho MC, Blázquez AB, Lima-Barbero JF, Saiz JC, Höfle U et al. High susceptibility of magpie (*Pica pica*) to experimental infection with lineage 1 and 2 West Nile virus. PLOS Neglected Tropical Diseases 12 (4) (2018) e0006394. DOI: 10.1371/journal.pntd.0006394.

[5] Werner D, Kampen H. The further spread of *Aedes japonicus japonicus*. Parasitology Research 112 (10) (2013) 3665–3668. DOI: 10.1007/s00436-013-3564-3.

[6] Walther D, Kampen H. The citizen science project 'Mueckenatlas' helps monitor the distribution and spread of invasive mosquito species in Germany. Journal of Medical Entomology 54 (6) (2017) 1790–1794. DOI: 10.1093/jme/tjx166.

[7] Brock TD. Calculating solar radiation for ecological studies. Ecological Modelling 14 (1) (1981) 1–19. DOI: 10.1016/0304-3800(81)90011-9.

[8] Rubel F, Brugger K, Hantel M, Chvala-Mannsberger S, Bakonyi T, Weissenböck H et al. Explaining Usutu virus dynamics in Austria: model development and calibration. Preventive Veterinary Medicine 85 (3-4) (2008) 166–186. DOI: 10.1016/j.prevetmed.2008.01.006.

[9] Laperriere V, Brugger K, Rubel F. Simulation of the seasonal cycles of bird, equine and human West Nile virus cases. Preventive Veterinary Medicine 98 (2) (2011) 99–110. DOI: 10.1016/j.prevetmed.2010.10.013.

Chapter 4

General Discussion and Conclusions

At the end of the work, the findings are put into a broader context and the significance of the outcomes is discussed. The results should be compared with those of previous studies [1, 2].

4.1 References

[1] Wieland R, Kerkow A, Früh L, Kampen H, Walther D. Automated feature selection for a machine learning approach toward modeling a mosquito distribution. Ecological Modelling 352 (2017) 108–112. DOI: 10.1016/j.ecolmodel.2017.02.029.

[2] Früh L, Kampen H, Kerkow A, Schaub GA, Walther D, Wieland R. Modelling the potential distribution of an invasive mosquito species: comparative evaluation of four machine learning methods and their combinations. Ecological Modelling 388 (2018) 136–144. DOI: 10.1016/j.ecolmodel.2018.08.011.

Appendices

Appendix A

Statement of Academic Integrity

I hereby declare that I have written the dissertation presented here independently and so on... Check the website of your university department for standardized texts!

Appendix B

Acknowledgements

Here is the place to acknowledge the supervisors, family, friends and so on.