



UvA-DARE (Digital Academic Repository)

How birds weather the weather: avian migration in the mid-latitudes

Kemp, M.U.

Publication date
2012

[Link to publication](#)

Citation for published version (APA):

Kemp, M. U. (2012). *How birds weather the weather: avian migration in the mid-latitudes*. [Thesis, fully internal, Universiteit van Amsterdam].

General rights

It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

Disclaimer/Complaints regulations

If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: <https://uba.uva.nl/en/contact>, or a letter to: Library of the University of Amsterdam, Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.

Contents

Contents	iv
List of figures	vi
List of tables	vii
1 Introduction	1
1.1 Birds and migration	1
1.2 Navigation	3
1.3 Individual weather effects	4
1.3.1 Wind	4
1.3.2 Temperature	6
1.3.3 Humidity	6
1.3.4 Precipitation	7
1.3.5 Atmospheric pressure	7
1.4 Atmospheric data	8
1.5 Radar	10
1.6 Efficient analysis	12
1.7 Synopsis	13
2 RNCEP: global weather and climate data at your fingertips	15
2.1 Summary	15
2.2 Introduction	16
2.3 NCEP data	17
2.4 R scripts	17

2.5	Data over an area	19
2.5.1	Gather	19
2.5.2	Restrict	19
2.5.3	Aggregate	19
2.6	Data interpolated	20
2.7	Data visualized	22
2.8	Conclusion	22
3	Quantifying flow-assistance and implications for movement re- search	25
3.1	Abstract	25
3.2	Introduction	26
3.3	Flow-assistance	27
3.3.1	Full drift	28
3.3.2	Complete compensation	31
3.3.3	Partial compensation	32
3.3.4	Other strategies	33
3.4	Methods	33
3.4.1	Sensitivity analysis	33
3.4.2	Simulating trajectories	34
3.5	Results	36
3.5.1	Sensitivity analysis	36
3.5.2	Simulating trajectories	38
3.6	Discussion	38
3.6.1	Compensation	40
3.6.2	Preferred direction	43
3.6.3	Speed	44
3.6.4	Range	45
3.7	Conclusion	46
4	Can wind help explain seasonal differences in avian migration speed?	49
4.1	Abstract	49
4.2	Introduction	50
4.3	Data	51
4.3.1	Wind data	51
4.3.2	Radar data	52
4.4	Methods	52
4.4.1	Wind profit analysis	53
4.4.2	Flight analysis	53
4.5	Results	55

4.5.1	Wind conditions	55
4.5.2	Flight speed	57
4.6	Discussion	58
5	The influence of weather on altitude selection by nocturnal migrants in mid-latitudes	61
5.1	Abstract	61
5.2	Introduction	62
5.3	Materials and methods	65
5.3.1	Radar data	65
5.3.2	Meteorological data	67
5.3.3	Wind and altitude	71
5.3.4	GAM analysis	72
5.4	Results	73
5.4.1	Weather	73
5.4.2	Wind and altitude	76
5.4.3	GAM analysis	79
5.5	Discussion	82
5.6	Conclusion	86
6	Predicting migration intensity at multiple sites using operational weather radar	89
6.1	Introduction	89
6.2	Materials	91
6.2.1	Radar data	91
6.2.2	Predictor variables	92
6.3	Methods	95
6.3.1	Model development	96
6.3.2	Models for one location applied to the other	98
6.4	Results	98
6.4.1	Migratory dynamics and predictor variables	98
6.4.2	Baseline intensity	99
6.4.3	Autocorrelation	99
6.4.4	Model performance	105
6.5	Discussion	111
6.5.1	Model development	111
6.5.2	Flight safety	116
6.6	Conclusion	118

7	General discussion and synthesis	121
7.1	Weather or climate?	121
7.2	Optimal migration	123
7.3	Robust decision-making	124
7.4	Assessing drift	125
7.5	Quantifying model performance	129
7.6	Migration research	132
	Bibliography	154
	Summary	155
	Samenvatting	161
	Acknowledgments	167
	Appendix A: Explicit descriptions of flow-assistance equations	171
	Appendix B: FLAT model description	181
	Appendix C: Wind maps and wind summaries for Europe	185
	Appendix D: Results of simulation model predicting avian altitude distributions	199
	Appendix E: Results of GAM model predicting avian altitude distributions	203