



UvA-DARE (Digital Academic Repository)

Structural analysis of complex ecological economic optimal control problems

Kiseleva, T.

[Link to publication](#)

Citation for published version (APA):

Kiseleva, T. (2011). *Structural analysis of complex ecological economic optimal control problems*. Amsterdam: Thela Thesis.

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

1	Introduction	1
2	Bifurcations of one-dimensional optimal vector fields	9
2.1	Setting	11
2.1.1	Definitions	11
2.1.2	Indifference points	13
2.2	Bifurcations of optimal vector fields	15
2.2.1	Preliminary remarks.	15
2.2.2	Codimension one bifurcations	18
2.2.3	Codimension two bifurcations	40
3	Bifurcations of optimal vector fields in the shallow lake model	51
3.1	The shallow lake model	52
3.2	Optimal vector fields in the shallow lake model	56
3.3	Bifurcations of optimal vector fields in the shallow lake system	61
3.3.1	No discounting case	62
3.3.2	Cost of pollution versus discounting	65
3.3.3	Cost of pollution versus natural rate of decay: the discounted case . . .	70
3.4	Concluding remarks	73
	Appendix 3.A Asymptotic behavior of the cusp bifurcation curve	74
	Appendix 3.B Asymptotic behavior of the saddle-node bifurcation curves	77

4	Stochastic optimal control problems with small noise intensities	83
4.1	Formulation of the problem	84
4.2	Problems without thresholds	87
4.3	Problems with thresholds	89
4.4	Concluding remarks	94
5	Regime switching thresholds in stochastic optimal control problems	95
5.1	The concept of regime switching thresholds	96
5.1.1	Processes with constant diffusion	96
5.1.2	Transformation invariant function	98
5.1.3	Stochastic bifurcations	100
5.2	The stochastic lake model	100
5.2.1	Bifurcation analysis with respect to the noise level	105
5.3	Concluding remarks	107
6	Summary	109
	Bibliography	118
	Samenvatting (Summary in Dutch)	119