CV Rainer M. Krug

Personal Details

Name	Rainer M. Krug
Address	Soorhaldenstr. 12 8308 Illnau Switzerland
Telephone	+41 52 534 65 13
Mobile	+41 78 630 66 57
E-mail	Rainer@krugs.de Rainer.Krug@uzh.ch
Date of birth	12 April 1968
Civil status	married, one daughter

Qualifications

Postgraduate

2008 **PhD in Conservation Ecology**, Stellenbosch University, South Africa

Thesis Title: Modelling seed dispersal in restoration and biological invasion.

1997 **MSc Conservation Biology**, University of Cape Town, South Africa

Thesis topic: The Genetic Diversity in a Founded Population of the African buffalo (*Syncerus caffer*): an example of an Artificial Bottleneck.

1995 **Diplom (MSc equivalent) in Physics**, Philips-Universität Marburg, Germany

Thesis Title: Der Einfluss von Habitat Heterogenität auf die mittlere Überlebensdauer von Populationen (The influence of habitat heterogeneity on the mean survival time of populations)
Subjects for oral examination: Experimental Physics, Theoretical Physics, Ecological Modelling, Biology

Undergraduate

1992 **Vor-Diplom (BSc equivalent) in physics**, Philips-Universität Marburg, Germany

Subjects for oral examination: Experimental Physics, Theoretical Physics, Mathematics, Chemistry.

Positions held

03/2017 – present **Department of Evolutionary Biology and Environmental Studies, University Zürich**

Data Management planner, Scientific Programmer, Researcher

08/2015 – 09/2015 **Laboratoire Ecologie, Systematique et Evolution, Paris Sud**

Postdoctoral Researcher

11/2014 – 12/2014	**Laboratoire Ecologie, Systematique et Evolution, Paris Sud**
	Postdoctoral Researcher
09/2013 – 11/2013	**Laboratoire Ecologie, Systematique et Evolution, Paris Sud**
	Postdoctoral Researcher
08/2011 – 12/2016	**DST-NRF Centre of Excellence for Invasion Biology, Stellenbosch University**
	Research Associate
06/2008 – 06/2008	**DST-NRF Centre of Excellence for Invasion Biology, Stellenbosch University**
	Postdoctoral Research Fellow, hosted by Prof. Dave Richardson.
06/2007 – 06/2008	**Plant Conservation Unit, University of Cape Town**
	Postdoctoral Research Fellow, hosted by Prof. Timm Hoffman.

Areas of Interest and expertise

Keywords data and metadata management; open source tools; R; ecological modelling; statistical computing; combined modelling and experimental approaches; invasive species management; decision support

Details My current focus of research is in the field of data and metadata management, and data preparation and analysis workflows. Recent work activities include the development of a framework for continuous data analysis and archival (ongoing), development of data management guidelines for our working group (ongoing), development of a domain specific metadata scheme to make entering of rich metadata as easy as possible for the researcher while at the same providing all the information needed for a useful re-use of the archived data (ongoing in maintenance mode); management of the large scale literature review of the IPBES Global Assessment Chapter 4, including data collection, quality control, analysis, graphing and archival (finalised).

In my role as a member of the IPBES Data and Knowledge Task Force, I drafted a data management policy and was the head of the group finalising the policy which got approved in January 2020. Further work in that capacity will include revisions of the policy, development of data management guidelines and guidance in questions regarding data technologies to be used in IPBES to make the production of the assessments more reproducible and dynamic.

My previous research focus was on 1) spatial modelling and analysis of pattern and processes and their integration with field experiments and observations, ranging from population (local) to ecosystem (regional) scale, 2) the impact of change (climate change, human impacts, alien spread, ...) and conscious human actions (management) on these pattern and ultimately on the function of these ecosystems and ecosystem services, and 3) the use of models in decision support of the management of natural resources.

During my research career I have developed and used different types of models, ranging from individual based models, over hybrid models using individual based approaches together with grid based elements, to pure grid based models. The systems studied ranged from populations and communities on the local scale to community dynamics (e.g. grassland - shrubland dynamics, two biocontrol species one invasive species system, spread of three alien invasive species) on the local scale and spread simulations of individual species on the national scale under different climate change scenarios. Most of my research

included different management scenarios in the form of alien plant management actions.

I developed an extensive knowledge of all aspects of R, ranging from interfacing R with other languages, developing of pipelines for data preparation and analysis, to package development and version management.

Nearly all the simulation and analysis tools I use (and used) are Open Source software (R, GRASS GIS, QGIS). This provides the flexibility to develop the simulation models and analysis protocols without additional costs, distribute them freely and to enable others (scientists as well as implementing agencies like nature conservation agencies) to use and evaluate the code without limitations and without having to purchased specific software, i.e. reproducible research. Reproducible research includes for me to use scripts in analysis and generation of graphs and to make these as well as the simulation models available (as far as funder conditions allow this).

Research Projects

- Development of a data management strategy for our research group and of tools to facilitate the provision and improve the quality of metadata. Also developing of data workflows to make the workflow from data generation to archival as smooth and reproducible as possible.
- Predictions in Chaotic systems
- Management of the Literature Analysis (**IPPBES Global Assessment Chapter 4**) and the generated data for archiving.
- Analyze measured vertical wind profiles to improve the performance of a forest growth model (CASTANEA) in regards to energy balance
- modelling temporal and spatial dynamics of a range of different different alien species, alien control agents and management strategies
- Optimising alien invasive plant management through modelling of temportal and spatial modelling
- Modelling the role of seed dispersal in restoration and biological invasion

Other Responsibilities

IPBES Chapter Scientist I was co-ordinating the large scale literature review for chapter 4 of the Global Assessment and was responsible for the overall co-ordination of the review, the collection and quality control of the reviews by the more than 20 authors, the preparation of the data for analysis, as well as the analysis itself and graphing of the results in a reproducible manner.

Member IPBES Task Force for Data and Knowledge Since 2019, I am one of the eleven elected members of the IPBES Task Force for Data and Knowledge, an advisory body for IPBES in regards to data management and knowledge generation. For this position, I was nominated by Switzerland. In this capacity, I was leading the development of the data management policy from IPBES (adopted January 2020). Further aspects of the work of this Task Force include the advance of the data analysis approaches and technologies used to advance IPBES assessments to become easier reproducible and dynamic, as well as the catalysis of knowledge generation based on gaps identified during the process of the production of the assessments.

Additional skills

Computer	**Operating System** Expert Linux user; advanced Mac and Windows user
	Programming Languages Extensive experience in programming in R, Delphi / Pascal; user of LaTeX; basic usage of C
	Programs Extensive experience in R, GRASS; Previous Emacs user; MS Office programs / Libre Office; basic experience of QGIS and Arc-GIS
Language	**German** native language
	English reading, writing and speaking fluent
	French reading, writing and speaking fair

Grants

2009 – 2010	NRF Freestanding Postdoctoral Fellowship
1999 – 2000	Deutscher Akademischer Austauschdienst (DAAD: German Academic Exchange Service) grant to conduct fieldwork for PhD at Gobabeb, Namibia.
1996 – 1997	Deutscher Akademischer Austauschdienst (DAAD: German Academic Exchange Service) grant to attend MSc in Conservation Biology course at UCT.

Publications

Peer-reviewed Journals

Krug, R.M., Richardson, D.M., 2014. Modelling the effect of two biocontrol agents on the invasive alien tree Acacia cyclops—Flowering, seed production and agent survival. Ecological Modelling 278, 100–113. doi:10.1016/j.ecolmodel.2014.01.028.

Krug, R.M., Roura-Pascual, N., Richardson, D.M., 2010. Clearing of invasive alien plants under different budget scenarios: Using a simulation model to test efficiency. Biological Invasions 12, 4099–4112. doi:10.1007/s10530-010-9827-3.

Le Maitre, D.C., Krug, R.M., Hoffmann, J.H., Gordon, A.J., Mgidi, T.N., 2008. Hakea sericea: Development of a model of the impacts of biological control on population dynamics and rates of spread of an invasive species. Ecological Modelling 212, 342–358. doi:10.1016/j.ecolmodel.2007.11.011.

Marques, A., Pereira, H.M., Krug, C., Leadley, P.W., Visconti, P., Januchowski-Hartley, S.R., Krug, R.M., Alkemade, R., Bellard, C., Cheung, W.W., Christensen, V., Cooper, H.D., Hirsch, T., Hoft, R., van Kolck, J., Newbold, T., Noonan-Mooney, K., Regan, E.C., Rondinini, C., Sumaila, U.R., Teh, L.S., Walpole, M., 2014. A framework to identify enabling and urgent actions for the 2020 Aichi Targets. Basic and Applied Ecology 15, 633–638. doi:10.1016/j.baae.2014.09.004.

Martinez-Harms, M.J., Gelcich, S., Krug, R.M., Maseyk, F.J.F., Moersberger, H., Rastogi, A., Wambugu, G., Krug, C.B., Spehn, E.M., Pascual, U., 2018. Framing natural assets for advancing sustainability research: Translating different perspectives into actions. Sustainability Science doi:10.1007/s11625-018-0599-5.

Privett, S., Krug, R., Forbes, G., Gaertner, M., 2014. Wild flower harvesting on the Agulhas Plain, South Africa: Impact of harvesting intensity under a simulated commercial harvesting regime for two re-seeding and two re-sprouting fynbos species. South African Journal of Botany 94, 270–275. doi:10.1016/j.sajb.2014.06.015.

Richardson, D.M., Iponga, D.M., Roura-Pascual, N., Krug, R.M., Milton, S.J., Hughes, G.O., Thuiller, W., 2010. Accommodating scenarios of climate change and management in mod-

elling the distribution of the invasive tree Schinus molle in South Africa. Ecography 33, 1049–1061. doi:10.1111/j.1600-0587.2010.06350.x.

Roura-Pascual, N., Bas, J.M., Thuiller, W., Hui, C., Krug, R.M., Brotons, L., 2009. From introduction to equilibrium: Reconstructing the invasive pathways of the Argentine ant in a Mediterranean region. Global Change Biology 15, 2101–2115. doi:10.1111/j.1365-2486.2009.01907.x.

Roura-Pascual, N., Krug, R.M., Richardson, D.M., Hui, C., 2010. Spatially-explicit sensitivity analysis for conservation management: Exploring the influence of decisions in invasive alien plant management: Sensitivity analysis of decision-support models. Diversity and Distributions 16, 426–438. doi:10.1111/j.1472-4642.2010.00659.x.

Roura-Pascual, N., Richardson, D.M., Arthur Chapman, R., Hichert, T., Krug, R.M., 2011. Managing biological invasions: Charting courses to desirable futures in the Cape Floristic Region. Regional Environmental Change 11, 311–320. doi:10.1007/s10113-010-0133-5.

Roura-Pascual, N., Richardson, D.M., Krug, R.M., Brown, A., Chapman, R.A., Forsyth, G.G., Le Maitre, D.C., Robertson, M.P., Stafford, L., Van Wilgen, B.W., Wannenburgh, A., Wessels, N., 2009. Ecology and management of alien plant invasions in South African fynbos: Accommodating key complexities in objective decision making. Biological Conservation 142, 1595–1604. doi:10.1016/j.biocon.2009.02.029.

Singer, A., Johst, K., Banitz, T., Fowler, M.S., Groeneveld, J., Gutiérrez, A.G., Hartig, F., Krug, R.M., Liess, M., Matlack, G., Meyer, K.M., Pe'er, G., Radchuk, V., Voinopol-Sassu, A.J., Travis, J.M., 2016. Community dynamics under environmental change: How can next generation mechanistic models improve projections of species distributions? Ecological Modelling 326, 63–74. doi:10.1016/j.ecolmodel.2015.11.007.

Book Chapters

Hui, C., Krug, R.M., Richardson, D.M., 2010. Modelling Spread in Invasion Ecology: A Synthesis, in: Richardson, D.M. (Ed.), Fifty Years of Invasion Ecology. Wiley-Blackwell, Oxford, UK, pp. 329–343.

Krug, C.B., Krug, R.M., 2007. Restoration of old fields in Renosterveld : A case study in a Mediterranean-type shrubland of South Africa, in: Cramer, V.A., Hobbs, R.J. (Eds.), Old Fields: Dynamics and Restoration of Abandoned Farmland. Island Press, Washington. The Science and Practice of Ecological Restoration.

Maertens, B., Henle, K., Kuhn, W., Krug, R., Jost, K., Grosse, W.R., Wissel, C., 1996. Survival of the Sand Lizard (Lacerta Agilis Linnaeus, 1758) (Sauria, Lacertidae) in Relation to Habitat Quality and Heterogeneity, in: Species Survival in Fragmented Landscapes. Springer Netherlands, Dordrecht, pp. 241–271.

Marques, A., Krug, C., Regan, E., Bowles-Newark, N., Burgess, N., Visconti, P., Walpole, M., Tittensor, D., Pereira, H., Leadley, P., Krug, R.M., 2014. Integrated Analysis of the 2020 Strategic Goals: Time Lags, Indicators and Interactions, in: Leadley, P., Krug, C., Alkemade, R., Pereira, H., U.R., S., Walpole, M., Marques, A., Newbold, T., Teh, L., van Kolck, J., Bellard, C., Januchowski-Hartley, S., Mumby, P. (Eds.), Progress towards the Aichi Biodiversity Targets: An Assessment of Biodiversity Trends, Policy Scenarios and Key Actions. Secretariat of the Convention on Biological Diversity, Montreal, Canada., pp. 441–467.

Conference proceedings

Krug, C.B., Krug, R.M., Iponga, D.M., Walton, B.A., Milton, S.J., Shiponeni, N.N., 2004a. Restoration of West Coast Renosterveld: Facilitating the return of a highly threatened vegetation type , 12.

Krug, R., Roura-Pascual, N., Richardson, D., 2009. Prioritising areas for the management of

invasive alien plants in the CFR: Different strategies, different priorities? South African Journal of Botany 75, 408–409. doi:10.1016/j.sajb.2009.02.072.

Krug, R.M., Johst, K., Wissel, C., Maertens, B., 1996. Wirkung der raeumlichen Heterogenitaet innerhalb eines Habitats auf die mittlere Ueberlebensdauer einer Zauneidechsen-Population. Verhandlungen der Gesellschaft fuer Oekologie .

Krug, R.M., Krug, C.B., Midoko-Iponga, D., Walton, B.A., Milton, S.J., Newton, I.P., Farley, N., Shiponeni, N.N., 2004b. Reconstructing West Coast Renosterveld: Past and present ecological processes in a Mediterranean shrubland of South Africa. Ecology, Conservation and Management of Mediterranean Ecosystems. Proceedings of the 10th International Conference on Mediterranean Ecosystems, April 25 – May 1, 2204, Rhodes, Greece. , 1–12.

Roura-Pascual, N., Krug, R., Richardson, D., 2009. Identifying priority areas for the management of invasive alien plants in the Cape Floristic Region. South African Journal of Botany 75, 439. doi:10.1016/j.sajb.2009.02.161.

Conference presentations Only first author, except invited keynote presentations

Krug, R., Roura-Pascual, N., Richardson, D., 2009a. Prioritising areas for the management of invasive alien plants in the CFR: Different strategies, different priorities? South African Journal of Botany 75, 408–409. doi:10.1016/j.sajb.2009.02.072.

Krug, R.M., a. Bringing Science to Management: Using Simulation- and Scenario-Based Approaches to Guide Decision Making in Invasive Species Management — one tool which can do both.

Krug, R.M., b. Population size, sample size and Microsatellites.

Krug, R.M., 2007. Two Approaches — same Answer?

Krug, R.M., 2011. Spatial modelling with the R-GRASS Interface.

Krug, R.M., Le Maitre, D.C., Richardson, D.M., 2012. The Impact of two biological control agents at the landscape scale: Implications for management.

Krug, R.M., Petchey, O.L., 2019a. MetaData can be easy!

Krug, R.M., Petchey, O.L., 2019b. MetaData made easy!

Krug, R.M., Richardson, D.M., 2011. Biocontrol Agents, Aliens and Energy.

Krug, R.M., Roura-Pascual, N., Richardson, D.M., 2009b. Towards more efficient management of invasive alien plants: Spatial prioritisationse.

Krug, R.M., Roura-Pascual, N., Richardson, D.M., 2009c. Towards more Eficient Management of Invasive Alien Plants (AIPs): Spatial Prioritisation.

Krug, R.M., Roura-Pascual, N., Richardson, D.M., 2016. From Scenarios over Models to Management — Alien Spread Management.

Software Packages

Krug, R.M., Eddelbuettel, D., . Earthmovdist: Wrapper to the Emd-L1 library by Haibin Ling and Kazunori Okada.

Krug, R.M., Petchey, O., 2019a. emeScheme: A Package for Working with Ecological Microbial Experimental MetaData. Zenodo. doi:10.5281/zenodo.1544945.

Krug, R.M., Petchey, O.L., 2019b. dmdScheme: An r Package for Working with Domain Specific MetaData Schemes. doi:10.5281/zenodo.3581970.

Guest lectures

Krug, C.B., Krug, R.M., 2004. West Coast Renosterveld: Ökologische Prozesse und Restaurierung (West Coast Renosterveld: Ecological Processes and Restoration).

Krug, R.M., 2004. Ecological Modelling — A Taxonomy.