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Participatory modelling for understanding consequences of management choices on ecosystem services and biodiversity in protected areas

Uta Schirpke[1] & Rocco Scolozzi[2]

[1] Institute for Alpine Environment, EURAC research, Bolzano, Italy
[2] -skopìa Anticipation Services, Trento, Italy

Abstract

Complex ecological and socio-economic processes as well as management decisions influence ecosystem services (ES) and biodiversity, through complex chains of cause and effect. To facilitate a better and shared understanding of the complexities in protected areas, we propose a participatory modelling approach based on system thinking and system dynamics. We developed generic and open models for provisioning and cultural ES, using the interactive platform Insight Maker, to support to managers in involving stakeholders and developing together dynamic models of 'their' social-ecological system.

Keywords

System dynamics, participatory modelling, ecosystem services, management strategy

Introduction

Urbanisation, agricultural intensification, and industrialisation are affecting natural environments and associated ecosystem services (ES), defined as the benefits human populations derive from ecosystems (MEA, 2003). The importance of protected areas in conserving biodiversity and providing crucial ES, especially regulating and cultural services, is therefore growing (LARSEN et al., 2015). ES are co-produced by the ecosystems and human interaction through labour, technology or financial capital and depend on the socio-ecological system (PALOMO et al., 2016). Complex ecological and socio-economic processes as well as management decisions influence ES, through complex chains of cause and effect (PARTELOW et al. 2016), which may lead to unexpected results and failure of governance focused on short period. Some of these relationships are common among protected areas, others are more distinctive of specific social-ecological systems. In addition to a deeper understanding of the specific socio-ecological system, tools to evaluate possible consequences of management choices, for example introducing Payments for Ecosystem Services (PES), are needed to successfully managing ES and biodiversity on the long term, considering social network interactions and linkages among multiple ES (BENNETT et al. 2009). A key aspect is the involvement of local stakeholders accounting for their preferences and values; for example, by applying participative methodologies that allow conducting effective discussions with different stakeholder groups and supporting the decision-making process (ANTUNES et al., 2006).

Although research on ES and related methodologies has been growing rapidly, only recently, ES approaches were integrated with participatory modelling approaches. Thus, we propose a participatory modelling approach based on system thinking and system dynamics (SD) to facilitate a better and shared understanding of the complexities in protected areas and to support governance of protected areas related to ES and biodiversity. For this aim, we develop a generic and open model for recreational ES, using the interactive platform Insight Maker, which can serve as a basis for simulating different management scenarios. We discuss shortly how this model can support protected area managers in governance of ES and biodiversity, also together with local stakeholders.

Materials and methods

System dynamics modelling

SD modelling is a method to analyse feedback relationships and simulate the effects of alternative scenarios or policies to obtain insights about the causal relationships of a system and to identify management options (FORRESTER, 1994). With SD, causal loop diagrams can be developed in order to capture the dynamics of a specific system and to communicate important feedback loops (STERMAN, 2000), highlighting the variables of a system and the linkages. To improve the decision-making in protected areas by understanding the complexity of the social-ecological system and including preferences and values of local stakeholders, SD models can be developed and discussed together with the stakeholders in a 'group model building' (GMB) project (ANTUNES et al., 2006).

Developing SD models for ES

Based on common knowledge from scientific literature, experts, existing models, and experiences from the project LIFE+ Making Good Natura (www.lifemgn-serviziecosistemici.eu), we developed generic SD models for managing ES in protected areas (SCHIRPKE & SCOLOZZI, 2015; SCOLOZZI & SCHIRPKE, 2016). These models aimed to represent main variables influencing ES provision, to visualise feedbacks between management measures and system variables, to provide managers with basic but systemic information to support the development of specific models for their sites. In contrast to the previous models, here we included PES as a management option for recreational values. The model was published in the web platform Insight Maker, which is an open web-based, general-purpose simulation and modelling tool (FORTMANN-ROE, 2014).

Results

Fig. 1 depicts the SD model for assessing management choices related to recreational values in protected areas. An explanation of the single variables can be found in the interactive online version. Fig. 2 illustrates a hypothetical development under two management scenarios.

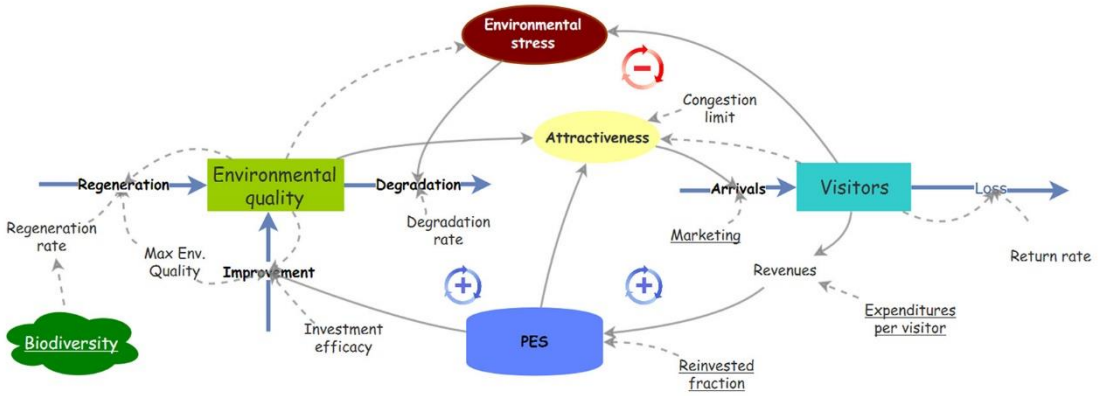

Figure 1: SD model for assessing the impacts of management choices related to recreational values in protected areas. The interactive model is available at https://insightmaker.com/insight/43840/Recreational-ES-in-Protected-Areas.

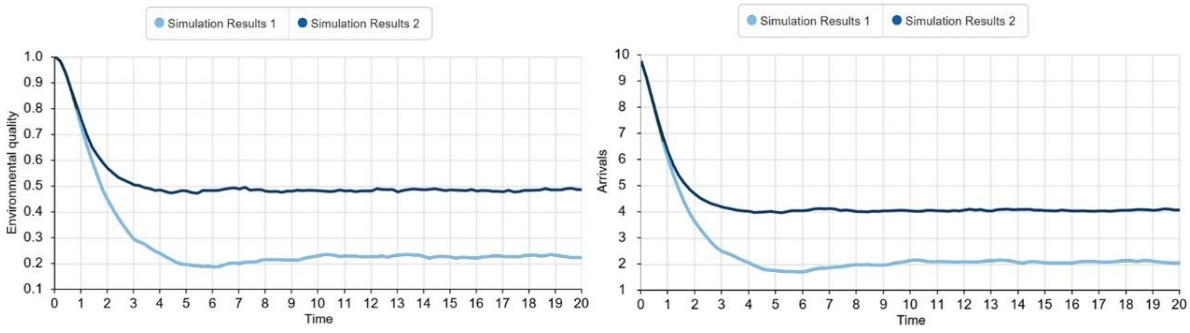

Figure 2: Development of environmental quality (left) and visitor arrivals (right) over time under two management scenarios: simulation 1 depicts the development without PES and simulation 2 assumes a reinvested fraction of 30%.

Discussion and conclusions

The understanding of the complex relationships of the underlying social-ecological system is essential for the successful management of protected areas (PARTELOW et al. 2016). We proposed a basic SD model of recreational ES to improve the understanding, communication, and management of recreational ES and biodiversity. The variables of the model represent only qualitative information, allowing to remain general enough to model ES regardless of the site, but realistic enough to help further developments at the local level, e.g. by a local panel of experts and stakeholders. The model should be further adapted to the protected area in question, as the developed model is hypothetical and generic. Thus, it need to be calibrated and verified with real data and maybe integrated with new variables. The model can be improved through GMB involving experts and stakeholders, allowing to understand and share local knowledge, to assess the dynamics of the specific system under various conditions, and to identify the impacts of management choices (VOINOV AND BOUSQUET, 2010). Stakeholders may provide knowledge, values or preferences for an initial phase, develop and discuss alternative scenarios and contribute directly to the decision-making process (LYNAM et al., 2007). Our model was presented through the storytelling tool of Insight Maker, which facilitates the understanding of the consequences of scenarios by updating the variables and showing immediately the outcomes. Next steps include the testing for operational use of the SD modelling to evaluate with real data their potential for protected area governance.

References

ANTUNES, P., SANTOS, R., VIDEIRA, N., 2006. Participatory decision making for sustainable development--the use of mediated modelling techniques. Land Use Policy 23, 44–52.

BENNETT, E. M., PETERSON, G. D., GORDON, L. J., 2009. Understanding relationships among multiple ecosystem services. Ecol. Lett. 12, 1394-1404.

FORRESTER, J.W., 1994. Learning through system dynamics as preparation for the 21st century.

FORTMANN-ROE, S., 2014. Insight Maker: A general-purpose tool for web-based modeling & simulation. Simul. Model. Pract. Theory 47, 28–45.

LARSEN, F.W., TURNER, W.R., MITTERMEIER, R.A., 2015. Will protection of 17% of land by 2020 be enough to safeguard biodiversity and critical ecosystem services? Oryx 49, 74–79.

LYNAM, T., DE JONG, W., SHEIL, D., KUSUMANTO, T., EVANS, K., 2007. A Review of Tools for Incorporating Community Knowledge, Preferences, and Values into Decision Making in Natural Resources Management. Ecol. Soc. 12.

MEA (MILLENNIUM ECOSYSTEM ASSESSMENT), 2003. Ecosystems and Human Well-being: A Framework for Assessment, Millennium Ecosystem Assessment. Island Press, Washington, DC.

PALOMO, I., FELIPE-LUCIA, M. R., BENNETT, E. M., MARTÍN-LÓPEZ, B., PASCUAL, U., 2016. Disentangling the Pathways and Effects of Ecosystem Service Co-Production. Adv. Ecol. Res. 54, 245-283.

PARTELOW, S., WINKLER, K. J., 2016. Interlinking ecosystem services and Ostrom's framework through orientation in sustainability research. Ecol. Soc. 21.3.

SCHIRPKE, U., SCOLOZZI, R., 2015. Software for assessment and quantification of ecosystem services. Part 3: Qualitative dynamic models. Report of the project Making Good Natura (LIFE+11 ENV/IT/000168), EURAC research, Bolzano, pp. 35. Available at: http://www.lifemgn-serviziecosistemici.eu/IT/Documents/doc_mgn/LIFE+MGN_Report_B10.3_en.pdf.

SCOLOZZI, R., SCHIRPKE, U., 2016. Insight Maker (S) To Support The Management Of Protected Areas And Related Ecosystem Services: Example For Recreational Value. Available at: http://www.systemdynamics.org/conferences/2016/proceed/papers/P1048.pdf

STERMAN, J.D., 2000. Business dynamics: systems thinking and modeling for a complex world. Irwin/McGraw-Hill Boston.

VOINOV, A., BOUSQUET, F., 2010. Modelling with stakeholders. Themat. Issue - Model. Stakehold. 25, 1268–1281.

Contact

Uta Schirpke
uta.schirpke@eurac.edu
EURAC research
Institute for Alpine Environment,
Viale Druso 1
39100 Bolzano
Italy

Rocco Scolozzi
rocco.scolozzi@skopia.it
skopìa Anticipation Services
Salita dei Molini 2
38123 Trento
Italy