

Cycles in social-ecological systems are amplified by delays
in ecosystem state knowledge and dampened by farsighted
socioeconomic decision making

Matthew W. Adamson¹ Frank M. Hilker²

¹ *Institute of Environmental Systems Research, University of Osnabrück,
Barbarastraße 12, 49076 Osnabrück, Germany*

matthew.adamson@uni-osnabrueck.de

² *Institute of Environmental Systems Research, University of Osnabrück,
Barbarastraße 12, 49076 Osnabrück, Germany*

frank.hilker@uni-osnabrueck.de

The monitoring of ecosystems and the spread of information concerning their state among human stakeholders is often a lengthy process. The importance of mutual feedbacks between socioeconomic and ecological dynamics is being increasingly recognised in recent studies, but it is universally assumed that the feedback from the environment is instantaneous, thereby ignoring any delay in the spread of ecosystem knowledge and the resulting potential for system stability loss. On the other hand, human actors rarely make purely myopic socioeconomic decisions as is often assumed. Rather they show a degree of foresight for future utility which may have an opposing, stabilising effect to any delay in knowledge. In this paper we consider a generic resource-harvester model with delayed ecosystem knowledge and predictive behaviour by the harvesters. We show that delays in the spread of information about the resource level can destabilise the bioeconomic equilibrium in the system and induce harvesting cycles or the collapse of the resource. Predictive behaviour by the harvesters can stabilise the system again, provided they give enough consideration towards future states and their knowledge of the resource level is not too outdated. The results imply that effective monitoring of ecosystems and fast dissemination of the results are necessary for their sustainable use, and that efforts to promote foresight among ecosystem users on the personal and institutional level is also beneficial to the stability of coupled socioeconomic-ecological systems.