Adaptive co-management combines attention to matters of user participation in decision-making and ‘learning by doing’ in a scientific way to deal with uncertainty. How local knowledge is taken into account and the impact this has on natural resource management is thus critical. Most resilience scholarship addressing this issue draws on empirical findings. This paper makes a different contribution and presents results from a theoretical model that explores the role of learning and memory in natural resource management.

The social-ecological system in our study is compiled by two parts; a learning model and an ecosystem. The ecosystem is simply an archetypical case of a single species natural renewable resource. The learning model is either a model with short term memory, or a model with long term memory, which both act as self-organizing processes. The short term model uses a gradient ascent strategy to learn and handle its resource. It operates as follows; if the latest catch was more than the preceding catch it increases its harvest rate. If the latest catch was less than the preceding catch it lowers its harvest rate. It does not take any other knowledge into account.

The long term learning model is an artificially intelligent model using a combination of a neural network, and a highly successful machine learning algorithm called reinforcement learning. This long term method creates a mental model of the system and can remember previous experiences and has the ability to learn from past experiences. Hence it makes its choice of harvest depending on both future expectations and past experiences (MATLAB www.mathworks.com was used as the modeling tool).

By creating a computer model, we can explicitly define and parameterize memory, the mental model and learning. While only being simple versions of the human equivalence of these processes, we have created a computer model capturing the implications of dealing with change in an ecosystem. We study the extremely basic problem of how to maximize the catch of a natural renewable resource over time. We explore six dynamic scenarios where change in growth rate takes place. They are 1) linearly increasing 2) linearly decreasing 3) slow cyclic change 4) abruptly decreasing 5) abruptly increasing and 6) randomly abrupt changes in growth rate.

The results of this study show that long term learning and memory is essential in handling declining resource availability where the decline is cyclic or randomly abrupt (cases 2, 3, 4 and 6). But, to our surprise, long term learning does not perform better when resource availability is increasing (cases 1 and 5). These findings have significant implications for the types of knowledge taken into account in adaptive co-management approaches and encourages attention to long term learning and memory.