From innovation to codification: Conversations with Iskatewizaagegan elders regarding creativity, memory and plants in Anishinaabe society.

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Introduction

Ethnoecologists have provided extensive documentation of the knowledge held by many indigenous communities regarding places and the relationships among the beings of a place (Davidson-Hunt and Berkes 2003a). Ethnobotanists have undertaken a similar task in locating plants within social, cultural and ecological systems (Davidson-Hunt 2003a). However, this work has often characterized indigenous people as holders of knowledge sets in imminent danger of being eroded through the forces of modernization and globalization. Theoretical models, rooted in complexity theory, have begun to influence ethnoecological and ethnobotanical understandings of the dynamics of knowledge systems. These models are exploring the institutions and processes of social-ecological networks that allow for innovation while conserving the linkages between the past and the future.

This paper is based upon ethnobotanical and ethnoecological research undertaken with Anishinaabe people of Iskatewizaagegan No. 39 Independent First Nation located in northwestern Ontario, Canada (see Figure 1). The purpose of this paper is to develop some working terminology and a conceptual model to explore the dynamics and resilience of social-ecological systems. One of the missing pieces in the resilience literature is the inclusion of individuals into the process of adaptive learning. The adaptive learning model proposed in this paper links the individual process of creativity to the social processes by which new information can become encoded within the institutions and collective information of a knowledge system (Davidson-Hunt 2003a). My goal for this conceptual model is to provide a way to think about the dynamics of contemporary indigenous systems of resource management in a manner that allows for innovation and self-determination (McIntosh 2001). This is necessary to free our minds from the shackles of the conservative models proposed by many conservation groups which attempt to freeze indigenous people and lands in an idealized form (for an example of this debate see McIntosh 2001 and Maffi 2001). The model explored in this paper is intended to allow for the individual creativity to from the basis of adaptive learning while respecting the memories of a society.

Social-ecological systems and scale

Davidson-Hunt and Berkes (2003b) began to explore the idea of social-ecological systems. At that point, the goal was to begin thinking about how social and ecological systems could be articulated as one system instead of two independent systems. Since that time a reconsideration of Ingold's (2000) work, and work with Anishinaabe elders (Davidson-Hunt 2003a; Davidson-Hunt 2003b; Davidson-Hunt and Berkes 2003a), led to a holistic conceptualization of social-ecological systems as a bounded network made up the relationships among individual components and systems. The first incarnation of this idea was a sketch that I developed with Edward Mandamin of Iskatewizaagegan No. 39 Independent First Nation (IIFN) to describe to the elders the project upon which we were embarking in 1999 (Davidson-Hunt 2003a). In Figure 2, we thought of a knowledge network that would bring people together to interact around the creation of new knowledge necessary for the management of the Shoal Lake watershed.

This network was theorized as dynamic, emplaced and problem centric limited, at this time, to components defined by their status as human beings. Conversations would occur through the activities of research, workshops, shared time on the land, undertaking of land-based activities together, writing and the creation of other media leading to a dynamic Iskatewizaagegan knowledge legacy. The knowledge legacy was not seen as a thing but a network that would emerge out of the relationships that would develop between individuals and the media that would codify the learning of the network. The knowledge legacy was dynamic as individuals' would bring knowledge to the legacy, which would result in learning by others, who would then apply knowledge to their daily lives and bring back their learning and so on. This model provided a starting point to think about social-ecological resilience as the way by which a bounded network maintained its identity through adaptive learning and self-organization (Davidson-Hunt and Berkes 2003b). It also provided the basis out of which a more abstract model could be refined.

In Figure 3, a diagram is presented which represents the basic structure and components of a social-ecological system. The coloured spots are individual components of the social-ecological system. These components do not live in isolation but form networks through their relationships with other components of the system. When we think about such a system it is sometimes easiest to begin with one component and understand its network of relationships. Figure 3 presents a simplified representation for the purpose of this conceptual model. Individual components form a structure through the emergence of boundaries that provide an identity to a social-ecological system. The social-ecological system can be described through a description of the components, the network of relationships, the nature of the relationships and the existence of boundaries.

The description of a social-ecological system thus depends upon the scale and starting point of analysis. For example, I can begin with an individual being, human being if you like, and trace the network of relationships of that person (Actor 1). In the past, that network would have been restricted to the other "actors" with whom actor 1 had a relationship. However, following Ingold (2000) and Davidson-Hunt (2003a), it is also possible to expand our concept of actors for social-ecological systems to include all beings who make up the environment of actor 1. Capra (2002) limits his description of holistic systems to "living beings" for reasons related to communication that shall be

discussed below. However, I agree with Ingold (2000), and my Anishinaabe colleagues (Davidson-Hunt 2003a), who have different ideas on who can or cannot participate in the process of communication.

In the model scale is important to determine the components and networks of analysis in order to limit what is included. For example, Figure 3 could represent a network of communities, organizations, governmental departments or national governments. Scales sets the resolution of analysis by determining the appropriate component (individual being or community) and, in turn, the attributes necessary to describe the relationships and boundaries of the system. Figure 3 also provides a representation of how networks can link together to form larger scale networks. Bounded networks are often related to other networks through specific relationships between components that provide a linkage. In Figure 3, a simple relationship is presented in which two bounded networks are linked by a component common to both. Since these two bounded networks can each be generalized to represent a larger scale unit of analysis, such as a community, and so on, it is also possible to represent how scales are linked. What is important to remember is that depending upon which scale of analysis is chosen the appropriate components and attributes to describe the relationships and boundaries of the system will change. Larger scales are not the sum of the smaller components but are systems with their own components, structures, relationships, attributes and boundaries.

As described above a key idea in this model is the idea of boundaries. Boundaries are important to the model, as it is through the formation and maintenance of boundaries that a network develops its unique identity. After the scale of analysis and the resolution of components and relationships have been determined it is possible to look for attributes that may be involved in boundary formation. If we consider the components of Figure 3 to be individuals, then attributes such as species, race, ethnicity, gender, sex, sexual orientation, institutions, technology, language, adherence to a place, legal membership in a community, shared values and other individual attributes as playing a role in boundary formation. By forming a boundary, on the basis of these attributes, then it is possible to describe a bounded network, or a social-ecological system. Sometimes, things like ethnicity and a physical boundary like a watershed, will correspond and create a bounded network. This tight adherence between the land and people in boundary formation is often an important set of attributes of indigenous communities, although this term can also refer to race-based identities independent of other characteristics. As there are many different axes along which bounded networks can form it is necessary to choose the scale of analysis as well as the axes contributing to boundary formation and identity. A key concluding point about boundaries is that they can be both natural and social depending upon the scale of analysis. For example, the cellular membrane provides a boundary that brings together a number of organelles into a bounded network (Capra 2002). A family, however, requires the construction and maintenance of a boundary through social and cultural processes. Social-ecological systems are open systems but with varying degrees of permeable boundaries.

The basic model of adaptive learning is made up of a bounded network of individual components linked through relationships. Components are defined according to the resolution and scale of analysis. The scale will also influence what is appropriate to include as part of the network. Networks become bounded through boundary formation on the basis of a variable set of attributes that provides the system with an

identity. Although social-ecological systems are bounded they can also form larger networks through relationships amongst systems (Turner, Davidson-Hunt and O'Flaherty 2003). These larger networks will also have boundaries that impart identity to the larger system. While this model has focused on the structure of social-ecological systems that emerge out of the network of relationships it would also be possible to include the functions of different components (Berkes, Colding and Folke 2003).

History, Memory and Trajectory

In Figure 4 the simple point is made that social-ecological systems have histories, memories and trajectories. Our descriptions of social-ecological systems often portray the characteristics at a specific point in time. In many descriptions of social-ecological systems the characteristics of one point in time are projected backward and forward as describing the past of the system and its future. The trajectory is thus portrayed as linear development over time. It is more accurate to consider that the history of a social-ecological system can be described as that which occurred along the trajectory of the system. Over time some characteristics might be carried forward into the present and future due to social memories, such as institutions, languages and rituals that guide change and individual memories which carry forward specific practices, technologies and other informational aspects of knowledge. Each social-ecological system will have a set of codified knowledge visible in its components, structures, relationships and boundaries. While it is easy to portray knowledge, as being passed as a unit from point in time to another it is more difficult to understand how knowledge can become adaptive, yet maintain continuity, within a social-ecological system. It is to this central question that the paper now turns.

Memory, Disturbance and Innovation

The resilience literature has tended to utilize a figure eight illustration to describe the process of change within ecological systems (Holling 1973; 1986). This figure has also been adapted to describe social-ecological resilience (Berkes, Colding and Folke 2003). The basic figure has four stages that are named; conservation; release; reorganization and exploitation. In the conceptual model developed for resilience, change occurs through disturbance agents that overcome the conserving forces and allow for innovation within the system. This then leads to a period of release and reorganization followed by a process of exploitation (growth) in which the components, structures, relationships, functions and boundaries of the system are reconfigured. The memory of the system provides both constraints to re-organization as well as the raw material out of which the new system will emerge. Through linkages with other systems the resilience literature also provides a mechanism by which innovation can emerge from the memories of linked systems (Berkes, Colding and Folke 2003). One of the persistent problems, however, of the resilience model has been to include the individual components in the process of change.

In Figure 5, these ideas are portrayed using the concepts developed in Figures 3 and 4. The recent work of Capra (2002) has provided a variation on the resilience model that helps to clarify the role of disturbance and individual creativity within social-

ecological systems. Capra (2002) defines a disturbance as the signs and signals that form the basis of communication within a bounded network. Communication flows along the network of relationships that make up a bounded network. Whenever a component receives a signal sent by another component it is forced to respond. Some signals will be the normal part of development and will not require responses that change the trajectory of the system. This is the trajectory that is found in Figure 4 in which the system proceeds through time without changes in its trajectory. However, as shown in Figure 5, some disturbances will create signs and signals in which the response may require a change in system components, relationships and boundaries. The concept of resilience refers to the ability of a system to respond to a disturbance through adaptive learning and self-organization while maintaining the basic structures and functions that make up the identity of the network. Since adaptive learning is the basis by which humans can respond to disturbances the process of learning is key to the model presented in this paper.

A Heuristic Model of Learning

In Capra's (2002) recent work he calls the process of communication that I describe above as cognition. As mentioned earlier, there are many different resolutions at which a bounded network may be considered. In the case of a cell, communication may occur through chemical signals that lead to a developmental response in a set of cells (Capra 2002). In the case of resource management, the appropriate resolution of bounded systems begins with networks of individual beings. Although these bounded networks can included other-than-human beings, the perspective of analysis of my work begins with individual human beings. As Capra (2002) notes, when we are considering human beings, then we need to consider that humans impart meaning to signs and signals through social and cultural processes. There is some remaining dissension regarding this point as Ingold (2000) does not necessarily agree that human beings are that different than other beings when considered as part of a holistic system. For instance, humans may respond on the basis of their senses to signs and signals at a subconscious level unmediated by meaning. While I recognize this as a valid point, my work tends to focus on those signs and signals that are more part of the conscious experience of humans and the process by which they are given meaning.

In Figure 6, a very simple heuristic model of learning, which draws upon ideas presented earlier in the paper, is presented. In the center of the diagram we have a human individual whose learning environment consist of a network made up of relationships with a Father, Mother, a plant (wild ginger) and an animal (moose). Obviously, the learning environment of an individual is much more complex (Davidson-Hunt and Berkes 2003a). The relationship of the individual to Father, Mother, Wild Ginger and Moose are the pathways of communications by which information can be received. These components of the individual's learning environment direct disturbances, or signs and signals, toward the individual. These signs and signals act a stimulus to provoke a response that can result in individual growth, maturation and learning. The components, relationships and boundaries of an individuals network become that individual's learning environment.

If the learning environment were an open network then the individual would receive a barrage of signs and signals. However, institutions that influence the network of relationships structure an individual's learning environment (Davidson-Hunt and Berkes 2003a). Signs and signals are also limited through the establishment of boundaries and the individual's learning network. In heuristic models of learning, an individual is expected to develop their own knowledge through their response to the signs and signals received from their learning environment. As a person matures, their learning network will expand and they will be expose to new signs and signals. In this sense, Capra (2002) is correct in considering little difference between learning and cognition as responding to disturbance is a normal part of an individual's development that allows them to develop an identity as part of a bounded network.

In Figure 6, one-way arrows characterize the relationships of the individual's learning network. Signs and signals do not have meaning in and of themselves but must be given meaning. An individual will learn the meaning, and thus appropriate response, to signs and signals, through their learning network. Meaning is not just imparted through verbal instructions, as is often the case through "schooling" models, but through codification of meaning within institutions, rituals, language, gesture and other media of communication found within a society (Ingold 2000). In this sense, the heuristic model of learning can be a conservative model as it carries forward meaning of signs and signals from one generation to the next. It is in this process by which meaning is transferred regarding signs and signals that power can maintain preferential structures of networks.

An Adaptive Model of Learning

Learning is often a conservative force as the meaning of the signs and signals are often passed on through an individual's learning network structured by societal institutions. However, in heuristic models of learning there is room for individual variation as individuals develop their own skills within a learning environment. This individual variation, however, does not change the basic codification of the meaning of signs and signals. Adaptive learning refers not to individual variation found within the normal process of individual development but the change in the developmental trajectory of a social-ecological system. As noted in Figure 5, there are certain disturbances that result in signs and signals for which meaning has not been codified. What happens in that case? This is the process by which adaptive learning occurs.

An individual will first perceive a novel sign or signal. And, as we have noted in the previous figures, the basis of human perception is through the reception of signs and signals emitted by other components of a learning environment. If there is not an established meaning for a sign and signal then a process of innovation will begin by which an individual will search for an appropriate response to the disturbance. As illustrated in Figure 7, following a novel disturbance an individual may consult with others individuals of the network, try new practices, undertake rituals or draw upon relationships with other networks to try and locate information which can help with the interpretation of novel signs and signals. In Figure 7, the learning process moves from a conservative process with one-way arrows, to more of a dialogic process with two-way arrows. Over time, and through much negotiation amongst members of a bounded network, an appropriate response will be codified and a change in the trajectory of the

social-ecological system may result. However, as has been shown in other research, it is also possible, through the wielding of power, for meanings to be attributed to a disturbance which maintains existing relationships of a network (McCay 1981; McCay and Jentoft 1998). This may prevent the occurrence of an adaptive learning process and the disappearance of a society (McGovern 1980). Adaptive learning is thus a process of learning, individual or collective, in response to novel disturbance and the codification of meaning into the media of the bounded network. However, it is a process subject to distortion when the meaning of novel signs and signals are negotiated.

The Paradox of Conservation, Dynamics and Adaptive Learning

The conceptual model developed in this paper is a working model that will be utilized to guide research regarding the dynamics of cultural landscapes. Cultural landscapes provide an interesting approach to understanding adaptive learning. For reasons of terminology, cultural landscape is preferable as a holistic alternative to social-ecological systems since that maintains the duality of the conceptual model. At the same time, much of the work on cultural landscapes emerges out of a heritage paradigm that stresses conservation while recognizing that these landscapes emerge out of relationships between the meaning given by people to the components of a landscape (Davidson-Hunt 2003b). This stresses the paradox between the dynamics of cultural landscapes and their conservation. If people are paying attention to the signs and signals of their learning environment, adaptive learning may occur which changes some of the attributes of the people and/or the land. It may not be the forms of cultural landscapes but the relationships that allow people to learn from the land and survive into the future. As Ella Dawn Greene of IIFN told me numerous times it was not the name of the plant that was important but the relationships a healer has with plants.

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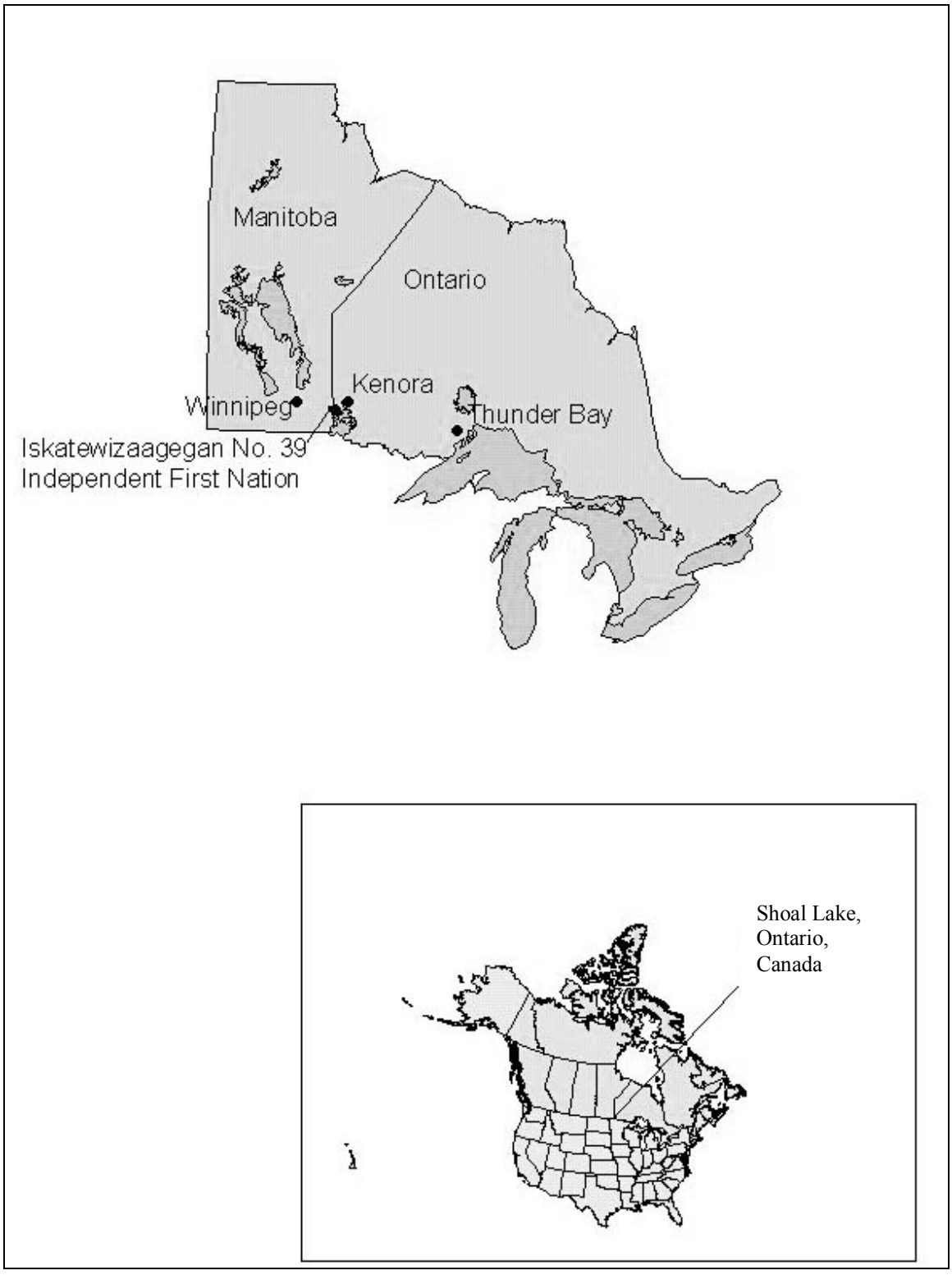

Figure 1. Location of Iskatewizaagegan No. 39 Independent First Nation on Shoal Lake, in the Province of Ontario, Canada.

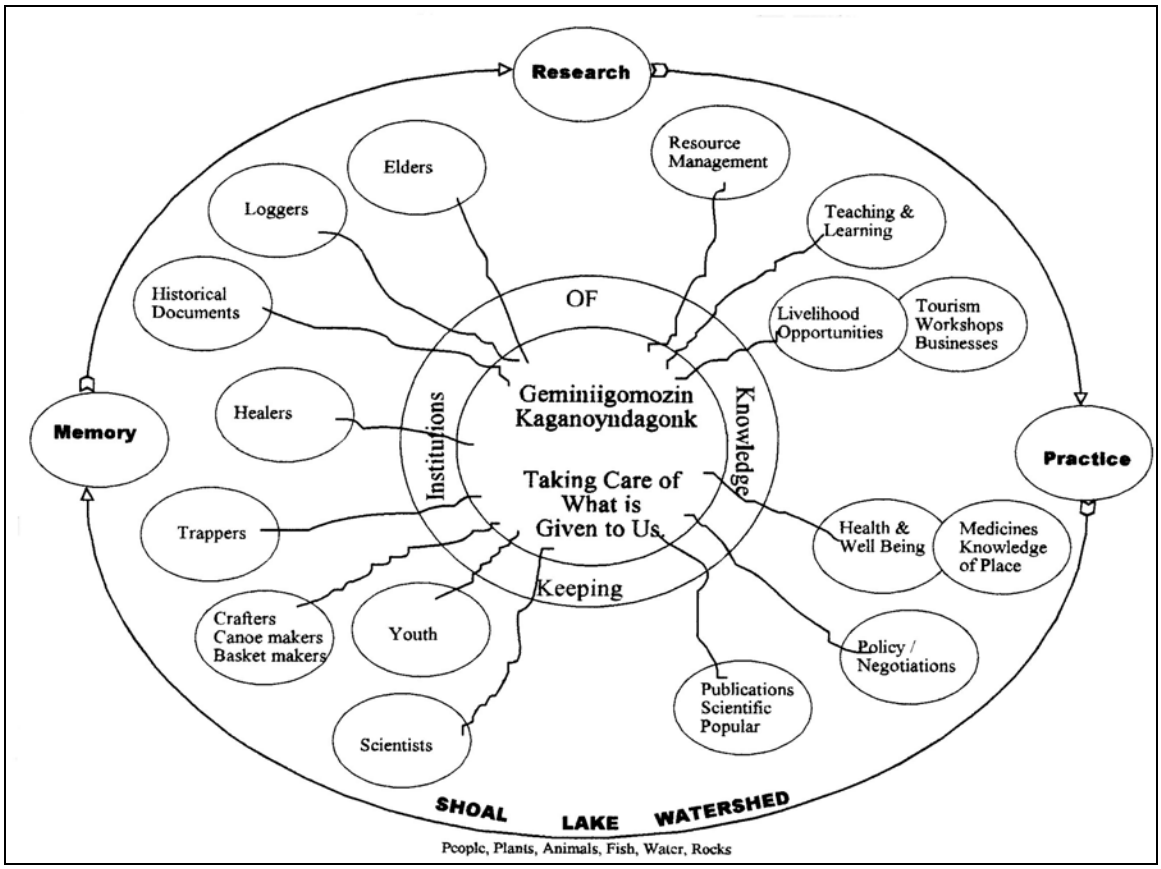

Figure 2. Knowledge network of Iskatewizaagegan No. 39 Independent First Nation and the dynamics of a knowledge legacy .

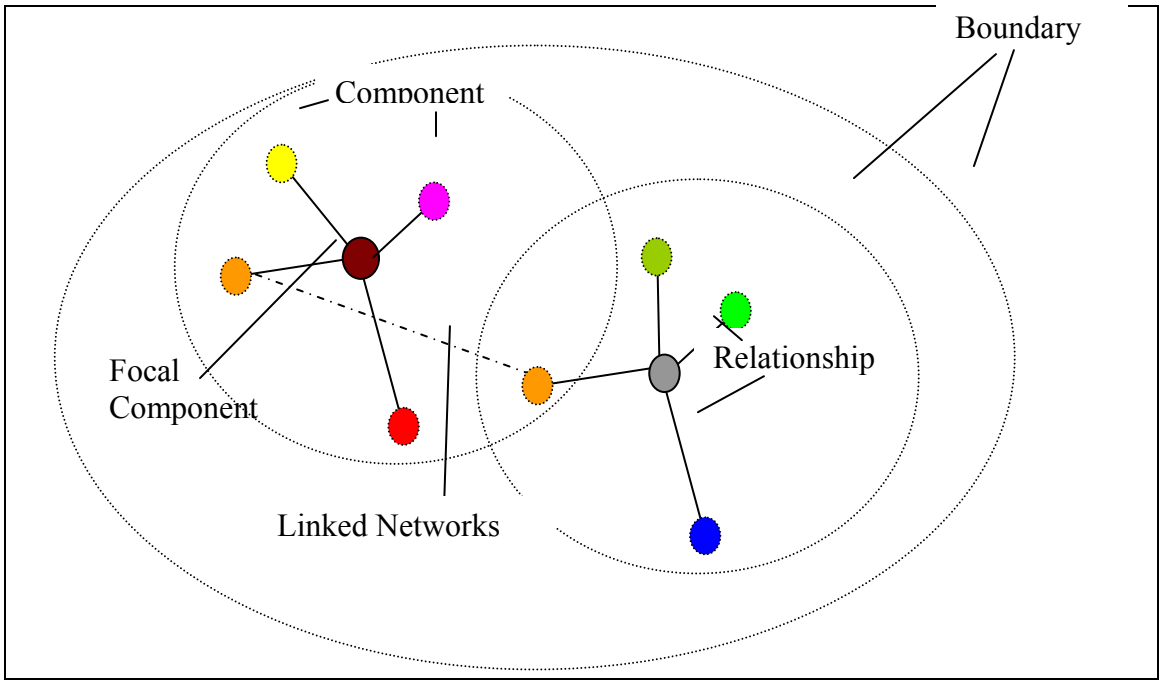

Figure 3. Scaling-up social-ecological systems as bounded networks.

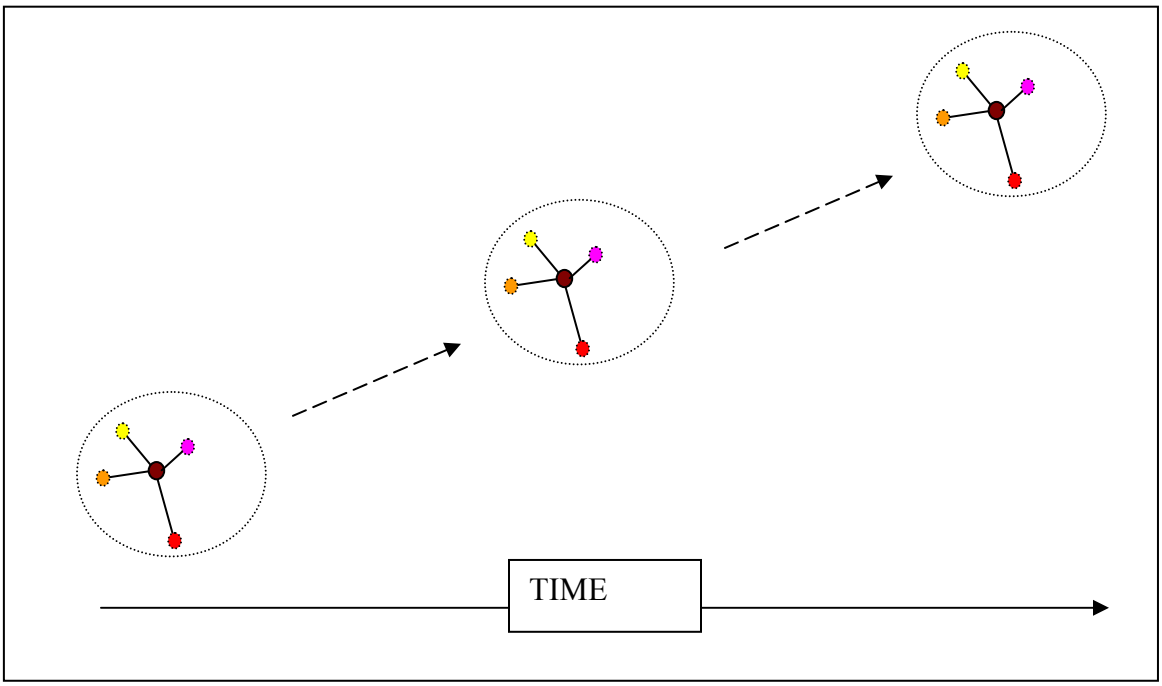

Figure 4. Idealized trajectory of social-ecological systems over time. Memory is assumed to be a conservative force that will maintain the social-ecological system during its historical trajectory.

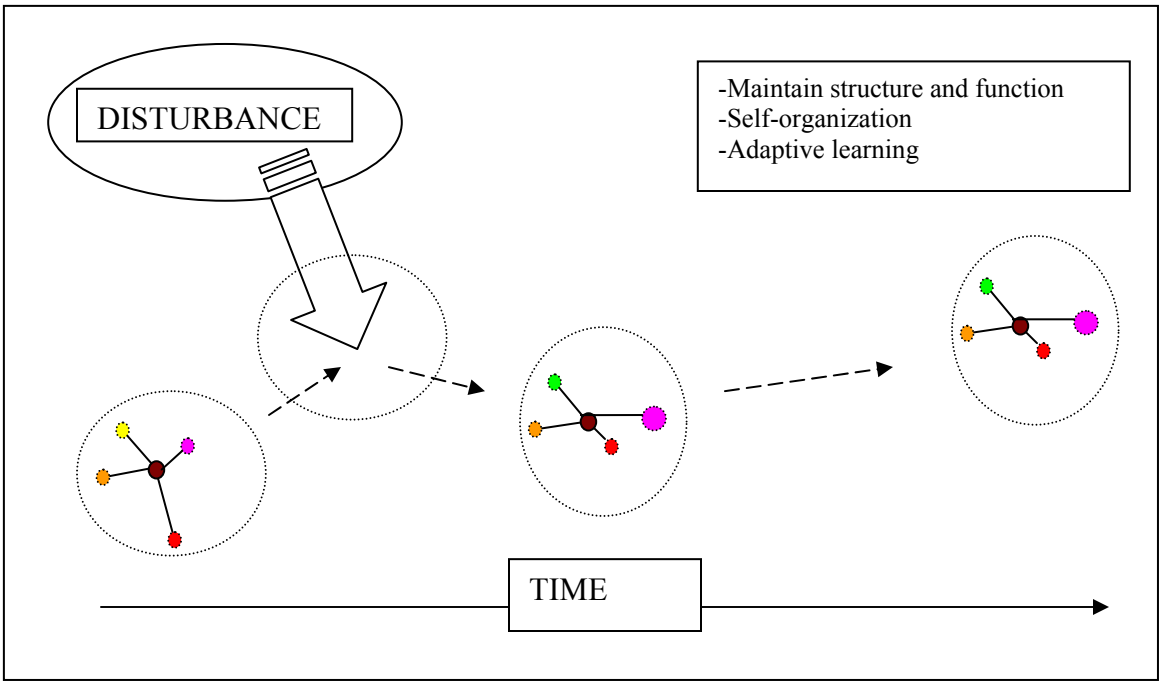

Figure 5. The relationship between memory, creativity and disturbance.

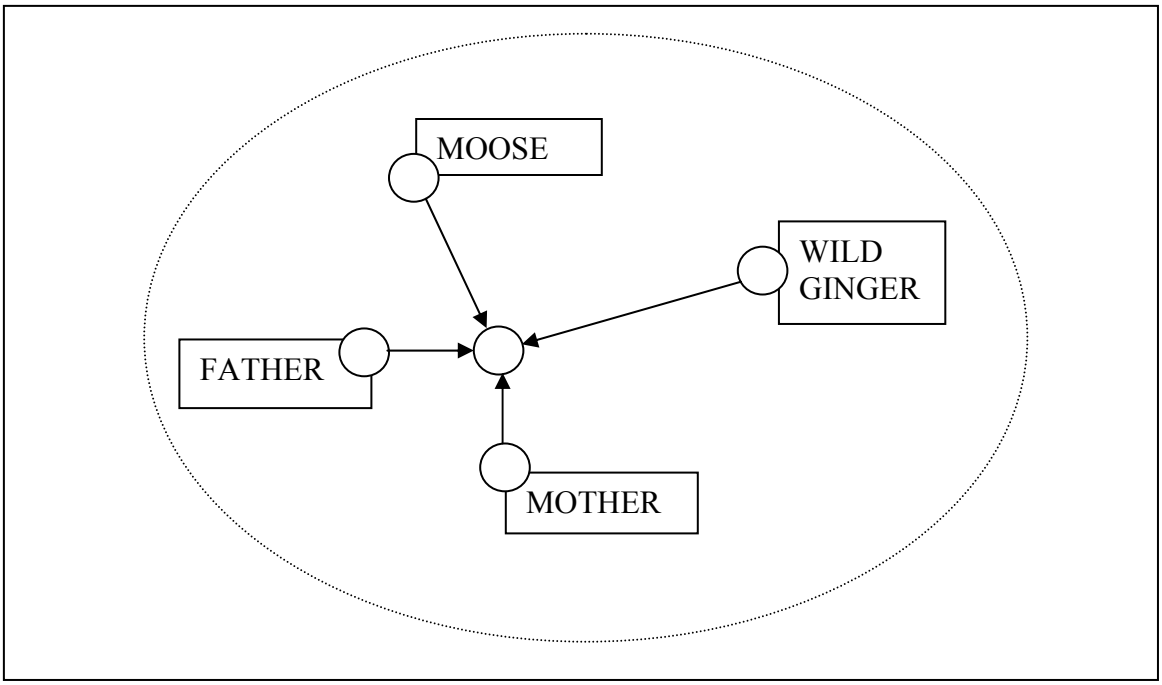

Figure 6. A schematic of a conservative model on interpreting signs and signals of an individual's learning environment.

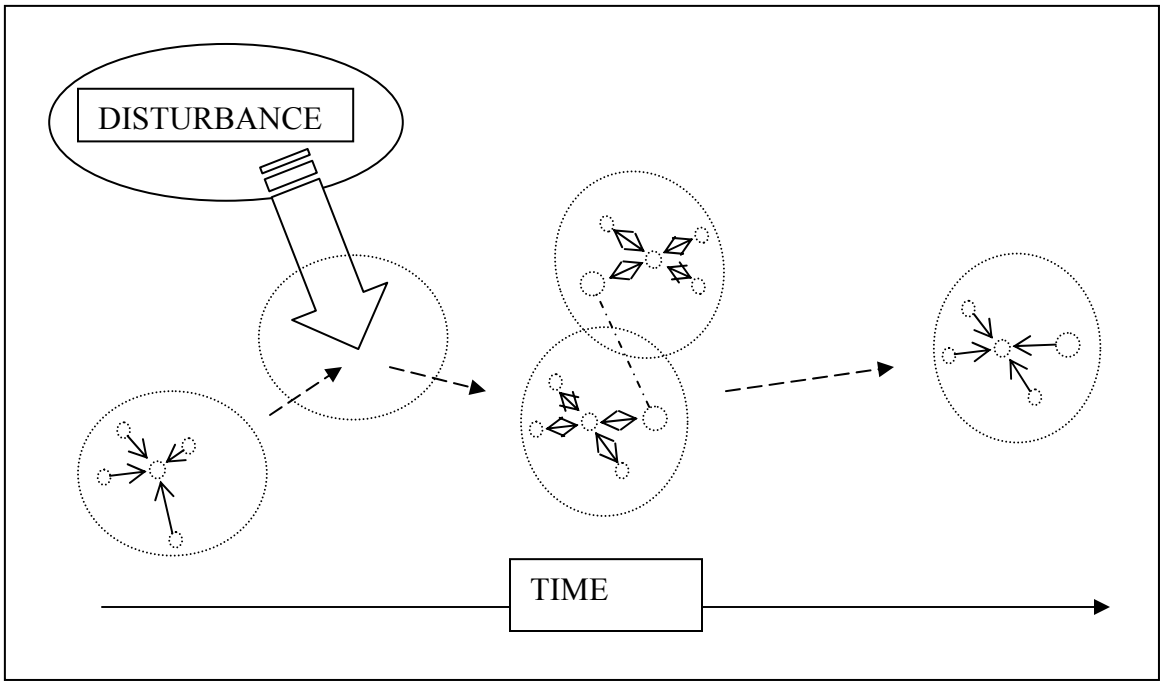

Figure 7. A schematic of adaptive learning. Adaptive learning emerges from novel signs and signals of an individual's learning environment and the social process of codifying meaning and appropriate responses into social memory.