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Unlearning in managing wicked biodiversity problems

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A B S T R A C T

Unlearning is drawing attention in sustainability research. Unlearning old beliefs and assumptions is needed to tackle wicked problems and to make space for learning. We introduce a framework for examining the potential of unlearning as a group process for transformational change. We integrate conceptual elements of unlearning with framing research and analyze 1) factors that facilitate unlearning, 2) the moments of doubt where unlearning and reframing takes place and 3) how unlearning can be operationalized in the analysis of discussion material. We demonstrate the framework by using a conflict situation – the conservation of Siberian flying squirrels in the Tampere urban region in Finland – as a case study where the participating actors had to unlearn dominant beliefs and assumptions to make space for a more strategic, comprehensive and proactive approach to collaborative conservation. A predictive habitat model of the regional flying squirrel population helped the process, but the decisive support for unlearning was a facilitated dialogue process with diverse assignments. The framework is tailored to experimental group processes by which innovative unlearning and reframing can be initiated and supported for organizational and interorganizational change.

1 Introduction

In urban biodiversity conservation, a shift is needed from single solutions to cross-sectional governance within cities and urban-rural landscapes (Elmqvist et al., 2013). Transformation requires institutional innovation, regional collaboration, and adaptive governance; ultimately, it is a process of deep change in identity and goals, feedback processes, structure, and functions (Wilson et al., 2013). Such a profound shift likely strengthens the features of wicked problems (Rittel & Webber, 1973) in urban biodiversity governance. Wicked problems refer to planning and design problems that defy technocratic solutions, and attempts to resolve them can lead to unintended consequences. Typical features are indeterminacy in problem formulation, non-definitiveness in problem solution, non-solubility, irreversible consequentiality, and individual uniqueness (Xiang, 2013).

Our aim in this paper is to complement recent research on wicked problems in socio-ecological systems (see the Special Issue of Landscape and Urban Planning, 2016, vol. 154) by focusing on unlearning. Unlearning as a research concept is seldom used in studies of social-ecological systems, and if used (Cumming et al., 2013; Rogers et al., 2013), these studies typically lack empirical analysis on unlearning. The perspective of unlearning is better known, and increasingly adopted, in the research of organizations, industry, management, and business. We examine unlearning in the context of urban biodiversity governance.

Our argument is that unlearning certain existing routines and beliefs may be the necessary first step in tackling wicked problems in complex socio-ecological systems. The purpose of unlearning is not to solve the problem (because wicked problems are unsolvable), but to expand the problem space so a wider range of option for action emerges (Rogers et al., 2013). We consider both organizational (Tsang & Zahra, 2008) and individual (Hislop et al., 2013) unlearning important in this effort and examine how these two interconnected but different processes work in a facilitated project of collaborative conservation. We first introduce a framework for the action-oriented research of unlearning. The framework is constituted by tools for building an unlearning context and examining the potential of unlearning as a group process for transformational change.

We use the case of the conservation of the Siberian flying squirrel (*Pteromys volans*) for an empirical examination of unlearning in urban biodiversity governance. This fairly common animal in urban and rural forests in the southern part of Finland is strictly protected by the EU Habitats Directive. All breeding sites and resting places of this mobile and nocturnal animal are protected from deterioration and destruction

(92/43/ETY, implemented in Finland by the Nature Conservation Act 1096/1996). The conservation procedure was specified in legislation and official guidelines, resulting in reactive single-site conservation through formal cooperation between regional stakeholders. Such conservation procedure did not resolve the problem but often led to, and still leads to, lock-in situations and land use conflicts (Haila et al., 2007). This set of strict standards and routines, put in place in the mid-2000s, concerning the site-by-site conservation of the species did not even protect the species (research concerning the forestry sector: Jokinen, Mäkeläinen & Ovaskainen, 2015; Santangeli, Wistbacka, Hanski & Laaksonen, 2013). These guidelines were renewed in 2016 (Ministry of the Environment, 2017; Tapio, 2016), allowing more flexibility and local deliberation, but the practical outcomes remain unknown. Forest management, land-use planning, and other responsible formal institutions still operate on a sectoral basis when participating in a large-scale modification of the landscape. This makes it harder to form deliberative collaboration and flexible solutions arising from the scale of the urban region (Manring, 2007).

These features of a long-term conflict, connected to the habits of the animal, as we later explain, show that flying squirrels are deeply intertwined with human activities in urban regions in Finland. Any action or non-action of conservation intertwines with a bundle of other human activities and contributes to wicked complications and to prolonged conflict situations (see Haila et al., 2007). In the unlearning literature, such complications refer to a knowledge crisis or “environmental turbulence” of an organization, which may promote unlearning by questioning old routines and beliefs (Akgün, Byrne, Lynn, & Keskin, 2007). However, intervention is usually needed because of the defensive routines and old logic that inhibit unlearning (Becker, 2010). A specific unlearning context can be created to trigger unlearning and subsequent relearning (Akgün, Byrne, Lynn, & Keskin, 2007). We created a collaborative learning space for stakeholders to transform the guiding idea of flying squirrel conservation from site-by-site implementation to network governance over the whole urban region. To trigger unlearning, we combined three tools that we believe were crucial in this case for transformational change: external actors (researchers) as initiators and facilitators, the dialogue method, and a predictive habitat model for use in dialogue workshops. The habitat model was presented as a map showing the forest habitats suitable for the flying squirrel in the urban region. We selected these three tools based on our extensive interviews and previous dialogue workshops with the stakeholders, which we conducted during a research project focusing on the collaborative flying squirrel management in the urban region (see Author 2 et al., 2010).

We posed the following questions: (a) How do these three tools help to question the old assumptions and thereby facilitate unlearning among stakeholders? (b) What are the mechanisms of unlearning? (c) How can unlearning be operationalized and analyzed in the group discussion material? In the remainder of the paper, we present our framework of unlearning and how the experimentation started to expand the problem space in the flying squirrel conservation. During the process, we identified that unlearning created additional choices for stakeholders to reframe the regional collaboration, but at the same time unlearning questioned the stakeholders' identities and relationships. Our conclusion is that both aspects of unlearning, although in tension with each other, are needed to tackle wicked problems in urban socio-ecological systems. In the unique case of flying squirrel conservation, we argue that transformation through unlearning is needed to make urban biodiversity conservation more experimental and to improve its performance.

2 The conceptual background – unlearning and reframing

We believe that unlearning is an essential phase in reaching transformation because it makes space for learning. Without unlearning old assumptions, it would often be impossible to create conditions for the necessary innovations. Unlearning is an adaptation process that serves as a catalyst to a dynamic change (Akgün, Byrne, Lynn, & Keskin, 2007; Becker, 2010).

In most organizational studies, unlearning is defined to mean discarding old knowledge, beliefs, and routines that no longer meet the current challenges (Akgün, Byrne, Lynn, & Keskin, 2007; Tsang & Zahra, 2008). It is a deliberate, conscious, and intentional process, as opposed to the unintentional process of forgetting (Hislop et al., 2013). Without unlearning, an organization is not able to adapt to its changing environment (Hedberg, 1981). Two subprocesses of unlearning are "discarding something" and "learning something new" (Tsang & Zahra, 2008). In this cycle, learning and new knowledge emerge instantly after unlearning or are simultaneous with it (Becker, 2010). The process starts from individual unlearning, as organizational or group unlearning–learning is impossible without individual actions. Unlearning requires both personal willingness and systemic support (Argyris & Schön, 1978; Senge, 2003, 48) and can be facilitated by the creation of awareness that there is a new way of understanding a specific phenomenon (Becker, 2010).

Unlearning facilitates change, innovation, and learning (Hislop et al., 2013); however, it does not mean completely discarding all old routines and practices, but rather adopting new beliefs by way of discarding previous beliefs (Becker, 2005; Hislop et al., 2013). Unlearning can happen slowly over years or much faster. Both ways are important in adaptive governance and transformational change, although in this paper we concentrate on the relatively fast unlearning that happened in the dialogue workshops. Unlearning is not necessarily irreversible or permanent. It is important to also note that unlearning does not necessarily mean that the knowledge or behaviors being given up are in some way inferior to new knowledge or behaviors (Hislop et al., 2013).

The research on organizational unlearning is strengthening its connection with psychology, cognitive science, and individual unlearning (Fiol & O'Connor, 2017; see criticism by Howell & Scholderer, 2016). Another research line focuses primarily on individual unlearning. Individual unlearning can be an emotional, challenging and painful process (Hislop et al., 2013; Macdonald 2002; Manring, 2007), especially when it concerns core beliefs and not superficial routines (see Hislop et al., 2013). Unlearning beliefs requires effort and is usually not linear, but rather spiral (Macdonald, 2002), and initially it often leads to a state of uncertainty and anxiety (Akgün, Lynn, & Byrne, 2006). Deep unlearning is a radical form of unlearning and, similarly to a radical innovation (Bessant et al., 2014), it requires disruptive change. Deep unlearning can also be fast or slow, permanent or temporary. Some recent research findings show that unlearning may support the management of wicked problems, as it enables the actors to co-create knowledge without discarding old knowledge (Antonacopoulou, 2009), to internalize “lived complexity” instead of reductionist habits (Rogers et al., 2013), or to see the situational benefits of not knowing and non-action (Brook et al., 2015; Pedler & Hsu, 2014).

Our focus is on moments of deep unlearning in a group process. We identify these situations as moments of doubt and changes in the frames, in other words, reframing (Fig. 3) (Laws & Rein, 2003, p. 175). By frames, we mean the different understandings and interpretations that are the basis for both discussion and action —

they are a particular way of representing knowledge, facilitating interpretation, and guiding action (Laws & Rein, 2003; Rein & Schön, 1993; Wagenaar, 2011, 222–227). Framing can concern issues, identities and relationships, or interaction process (Dewulf et al., 2009), and reframing unavoidably involves the component of unlearning. Moments of doubt arise when accepted stories are challenged and when the loss of stability in these moments is unsettling or even threatening (Laws & Rein, 2003, 175). Reframing, for us, is then a group process, an interactional co-construction (Dewulf et al., 2009, 158–159, 166) supported by unlearning. Reframing is always hindered by different kinds of institutional inertia and other forms of inertia (Gray, 2004); unlearning is necessary to overcome this inertia. It means letting go of old beliefs and framings. The moments of doubt we have analyzed are a sign of an ongoing process of deep unlearning. Thus, we provide a qualitative methodological tool for studying unlearning in empirical material.

By introducing the concept of unlearning, we can also contribute to the frame analysis literature: we analyze how old frames are discarded and unlearned to better understand the obstacles to reframing. New frames can be in stark contrast with the old ones, and we need to understand how the shift happens. Looking at these situations as deep unlearning will help the analysis. Moments of doubts are moments where old frames are being questioned (at least momentarily). These include both the tentative development of new possible frames and the reflection of these against the old frames, going back and forth between old and new conflicting frames. This process can be long, especially if unlearning is not supported outside the group discussions where both practical routines and old frames and beliefs draw participants back to the old frames despite the moments of doubt.

We conclude that organizational and individual unlearning have their own strengths in tackling wicked problems in socio-ecological systems. We include both aspects in our conceptual framework of unlearning (see Fig. 3) to examine their complementarity in expanding the problem space in flying squirrel conservation. While organizational unlearning ties our examination to the reframing of knowledge, scales, and collaboration, individual unlearning makes it possible to find more radical approaches because it transforms actor identities, positions, and relationships. Although unlearning research usually assumes that old knowledge is discarded in favor of new knowledge, discarding can take on different aspects in the context of wicked problems (Antonacopoulou, 2009; Brook et al., 2015; Pedler & Hsu, 2014). Individual unlearning may be valuable in this respect.

3 Material and methods

3.1 The case of the Siberian flying squirrel

The Siberian flying squirrel is a nocturnal, arboreal rodent living in mixed, spruce-dominated forests in the southern part of Finland. The species is in decline, mainly because of intensified forest use in recent decades (Hanski, 2006; Selonen et al., 2010). However, it is surprisingly abundant in the rather small, managed forest patches and forest edges near cities and villages (Mäkeläinen, Schrader, & Hanski, 2015; Santangeli, Hanski, & Mäkelä, 2013). The animal does not shun roadsides, private gardens, or human presence in general as long as it finds a suitable habitat. It is quite a mobile species, changing nests and moving in a home range of 4 ha (females) to 60 ha (males) (Hanski, Stevens, Ihalempiä, & Selonen, 2000), the young colonizing new habitats as they disperse (as far as 9 km) (Selonen & Hanski, 2004). Thus, they form a dynamic metapopulation (see Hanski & Gilpin, 2007) across the fragmented urban-rural landscape. In ecological surveys, flying squirrel droppings are used to gather information on the location of their habitats (Nygren & Jokinen, 2013). The statutory conservation practices of the animal diverged into two, but both have been criticized because of ecological unsustainability (Jokinen, Mäkeläinen, & Ovaskainen, 2015; Santangeli, Wistbacka, Hanski, & Laaksonen, 2013), economical unsustainability (Ahlroth et al., 2008) and because of poor fit with with planning, forest management and succession processes (Haila et al., 2007). Mobility and strict conservation, when connected to fast urban development, create uncertainty—many development projects in Finland have been, and are still being slowed down because of flying squirrel conservation (Haila et al., 2007).

Most flying squirrel conservation conflicts take place in forestry and urban land-use planning. In Finland, forest management decisions lie firmly in the hands of single forest owners (public and private) and in land-use planning the municipalities have a local monopoly. These two sectors, both strongly expert-driven, continue to have only scarce collaboration on the municipal or regional level, and both have had conflicts with nature conservation administration and conservation NGOs (e.g., Saarikoski, Åkerman, & Primmer, 2012). Thus, both conservation and urban development could benefit from a more flexible and holistic approach to the conservation of this animal.

3.2 Experimental dialogue workshops for reframing conservation in the Tampere urban region

Changing conservation practices rooted in certain beliefs and values takes effort and needs intervention. Akgün, Lynn, and Byrne (2006) indicate that changes in beliefs and values can be enhanced by bringing in an outsider to challenge the existing policies and procedures. Careful planning is always needed to create a productive group process (Wagenaar, 2011, 232; Gray, 1989, 265; Straus, 1999, 292). According to Nola Heidlebaugh (2008), immersion in a dilemma facilitates the recognition that habitual ways of thinking are insufficient. In our case, the university was a safe place for immersion in problems during the workshops. An opportune moment is also needed—Heidlebaugh uses the Greek concept of *kairos* to describe "how responsiveness to the novelty and the urgency of the immediate situation forces invention" (Heidlebaugh, 2008, p. 39). In our case, both the organized workshop situation and the practical tensions we described above provided the opportune moment in time for unlearning.

We planned the dialogue workshops in a team of researchers, and carefully adjusted them for this specific case and adapted them from workshop to workshop. Dialogue was both a method and a normative goal for the discussions in the workshops. By *dialogue* we mean a multi-voiced, open, and sincere discussion where the participants can encounter and connect with one another (e.g., Shotter & Gustavsen, 1999). Diversity is considered a resource for the discussion, and different points of view are equally valued. Often an outside facilitator is needed to achieve dialogue. Dialogue leads to mutual understanding, meanings are enriched, and new meanings are born, but unanimity or compromise is not the goal. New meanings and new understandings of a mutual problem, arising from agonism (Innes & Booher, 2010, 104–105), can give rise to new solutions, which is why this method can be useful in solving wicked problems. Dialogue facilitates learning, unlearning, and transformative change because opposing views are included and the participants are encouraged to be open, respectful, and listen to others (Mazutis & Slawinski, 2008; Putnam & Wondolleck, 2003, 57–58). Dialogue therefore also fosters trust, which is an important factor in interorganizational learning (Manring, 2007).

The end result of a successful dialogue process is usually something that no one, not even the organizers, could imagine or plan; a new kind of merging and mixing of ideas that does not take side with any of the original viewpoints. Heidlebaugh (2008, p. 42) used the concept of *apaté* to describe the potential of dialogue (and kairos) to create something new: "language helps provide a semantic enhancement to the activity of improvisational weaving (…) allowing a speaker to use the resources of language to find openings for invention". This is how the new possibilities and reframings are created in the group discussions enabled by unlearning.

By organizing the workshops, we also aimed to support unlearning and transformation by changing the scaling of the problem at hand. Scaling is not as simple as choosing an appropriate magnification (Dewulf, Mancero, Cárdenas, & Sucozhañay, 2011; Haila, 2002; van Lieshout, Dewulf, Aarts, & Termeer, 2011)—rescaling also reframes the issue. Rescaling, or scale reframing, changes which actors, interests, and interdependencies are seen as relevant (Dewulf, Mancero, Cárdenas, & Sucozhañay, 2011). By attempting to rescale the flying squirrel problem from the local, case-by-case level to the regional level, we aimed to (a) illustrate how conservation results are dependent on the actions different stakeholders take on different levels and in different places; (b) initiate regional collaboration between the relevant actors cross the institutional and municipal boundaries; (c) aid in the joint innovation of new conservation methods that could take advantage of the regional-level information and collaboration. However, rescaling is not easy to achieve because it is not only geographical but also political (Haila, 2002; van Lieshout, Dewulf, Aarts, & Termeer, 2011).

Nine personally invited persons from the Tampere urban region participated in three sessions of dialogue workshops during spring 2009. We invited different key stakeholders from the municipal administration (land-use planning, forest management and land acquisition), local and regional associations of nature conservation, regional state authorities of forestry, and the environment and local forest management association (representative of forest owners). During the workshops, we typically had one or two introductory presentations on the dialogue process (by the facilitator) and subject matter (by a researcher), and one to two prepared assignments. We then alternated discussions in small groups and within the whole group, followed by a feedback discussion round. The researchers participated in the discussions.

As research material, we used the workshop discussions that were recorded, transcribed verbatim, and coded using NVivo as a tool. To track unlearning and capture its interpretative and cultural dimensions (Mazutis & Slawinski, 2008, 450–452) in the analysis, we operationalized the concept of unlearning as moments of doubt and changes in the frames compared to central assumptions internalized by regional actors operating in flying squirrel conservation. We defined these central assumptions (see the results section below) based on the interviews and other material on the regional flying squirrel problem gathered previously (outside of the workshop discussions) (Nygren, 2013). We analyzed the reframing of not only issues but also identities of the stakeholders, as unlearning and transformational change is difficult because it also involves personal and social identities. We focused on the episodes in the workshop discussions in which the current ways of conservation became uncertain or where novel co-operational or other regional aspects were discussed.

3.3 Building and using the regional habitat model

To get an overall view of the amount and distribution of flying squirrel habitats in the Tampere region and to rescale the issue, the third author constructed a habitat suitability model for flying squirrels using flying squirrel observations, land use and forest data, and statistical modeling and used it as material in the workshops. The idea of a regional habitat model and its cartographic illustration came up in workshop discussions in our previous research project in 2006, when the flying squirrel conflict had reached its peak in the region. The idea became more topical when the Tampere city region organization started a project for strategic land-use planning and the map could be utilized in this work. The idea of habitat modeling was also compatible with the EU guidelines on species conservation (Environmental DG …, 2007); if more flexible conservation methods were to be used, the overall situation of the species must improve as a result. In essence, any solution in a local planning project that would involve derogation from conservation would need to be evaluated against the regional population network and trends, and backed up by better regional management practices regarding flying squirrel habitats. Finer-scale habitat maps were also used in the workshops, but they are not relevant in this paper.

The model-building responded to the problem that temporal changes in habitat occupancy are characteristic for flying squirrel populations (Hurme et al., 2008) and the locations of the individual animals cannot always be known. Predictive habitat models (Guisan & Zimmerman, 2000) that predict the suitability of habitats for a certain species provide a way to produce information on the amount and distribution of suitable habitats for a species in a certain area. The aims of the modeling work (made in the *author 3 institute*) were (a) to make a model that predicts the probability of flying squirrel habitats with the aid of local and broader-scale habitat structure; (b) to be able to calculate model prediction for any point in the research area; (c) to illustrate model predictions and the variation of flying squirrel habitats in the research area. Details of the model are given in Appendix A.

Besides being a result of a pertinent ecological analysis, the predictive habitat model served as a means of rescaling and reframing in the project. Ecological models may help to understand the patterns and emergent properties of the landscape, scale-crossing interactions, and multi-scale problems, even though they can only expand knowledge, not replace it (Müller et al., 2011). Our model was presented as a map, and different versions were commented on in the dialogue workshops, which helped the final stage of mapmaking. The first map showed the proportion of flying squirrel habitats in each 1 km × 1 km square (Fig. 1).

-Fig 1 here-

Figure 1. First map showing the proportion of flying squirrel habitats in each 1km × 1km square

The proportions were visualized as a graduated green color with 10% interval breaks (Fig. 2), which is a standard method for depicting areal data showing zones (Longley et al., 2001), and the final maps presented a ≥50% probability of flying squirrel habitats. Preliminary maps of the regional habitat network were shown for the participants and used as material in the discussions.

-Fig 2 here-

Figure 2. The final map presenting the ≥50% probability of flying squirrel habitats

Scaling the local problems to the regional level with the help of the regional habitat map was assumed to reframe the issue as something that regional collaboration could tackle. We also wanted to enhance the usability and implementation of the map by discussing it with the users in the workshops.

4. Results – The process of unlearning

4.1 Moments of doubt

All the workshop sessions were successful in creating dialogue, and more flexible and dynamic conservation practices were discussed, although some workshop sessions performed better than others. As a sign of the method's success, a joint funding application for a new project was made (but it did not get funded).

To analyze the factors that contributed to the reframing of conservation practices, what exactly was unlearned (momentarily, in this case) must be defined. For the purposes of this paper, and based on an extensive understanding of the case after several years of focused research in the region (Author 1, 2013; Haila et al., 2007), we singled out three central assumptions about the current conservation practices and conflicts. We consider these assumptions as supportive of the beliefs and routines that need to be unlearned to reframe the issue and to innovate new conservation practices. The assumptions are (a) flying squirrel conservation is best organized on a place-by-place basis; (b) the best way to improve conservation results is to enlarge the untouched areas around detected presences of flying squirrels; (c) improving conservation results would be detrimental for forest owners and for land-use planning.

These assumptions were questioned in the spiraling and messy process of unlearning that took place in the workshops (Fig. 3). During the workshops, it became clear that the participants had been frequently unhappy with the established conservation routines they had to follow without other alternatives. Moments of doubt arose when new possibilities were discussed in the workshops with the help of the regional habitat map, group discussions, and assignments. These tools enabled the participants to rescale the problem to a regional level and to see the multi-actor reality of the situation, which also enabled (at least momentary) the unlearning of central beliefs and assumptions and reframing of the issue and identities.

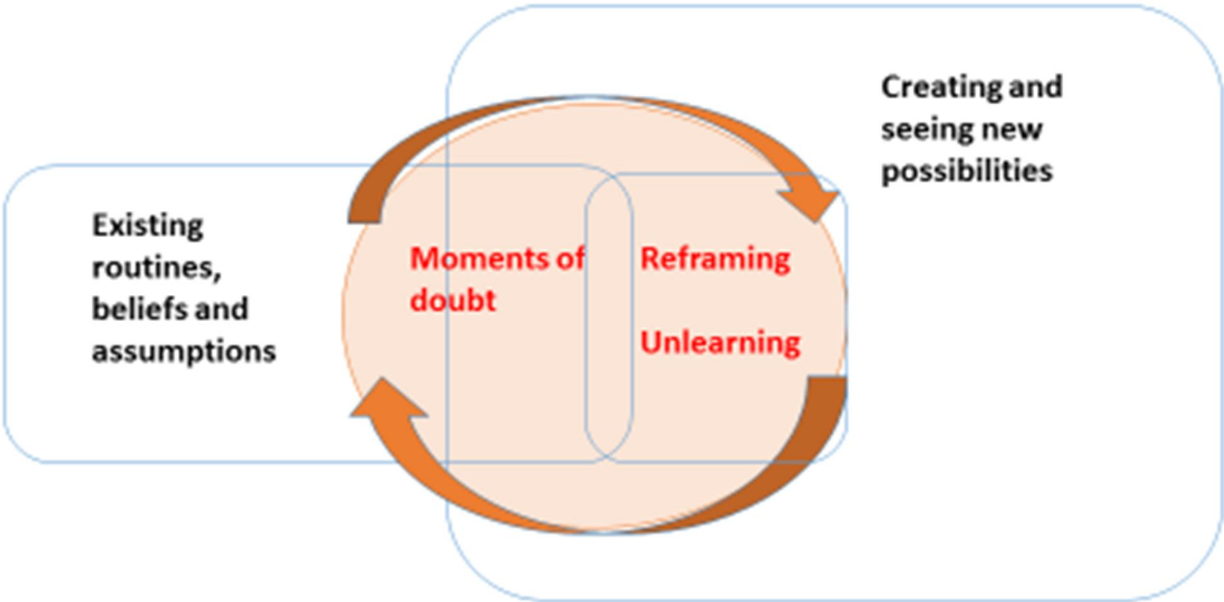

Figure 3. The heuristic process of unlearning in the dialogue workshops. The circular phases indicated by arrows are not meant to consecutive—rather, reframing, unlearning, and moments of doubt happen in this messy process in any order and any amount of time.

These moments are called moments of doubt because new framings put old beliefs in doubt while the old framings and familiar practices continue to appeal. This shift is well known in framing research as one explanation for changing frames (Cornelissen & Werner, 2014, 190–191), and we suggest it is an important stimulus to and a reflection of unlearning as well. Moments of doubt varied between discussants and between episodes of the dialogue. They were found especially throughout the final workshop, irrespective of how freely the ideas were growing through dialogue.

Below we illustrate these moments with two excerpts from the discussions where a participant hovers between the old frame and the new frame. The first one is from the last workshop's feedback discussion round. A conservationist explains that she is surprised to see how well the workshop's discussions went and how different actors found unanimity. Here, collaboration is a new frame, but s/he soon returns to doubt and skepticism (the old frame of juxtaposing conservation with other land use). In the middle s/he raises the theme of collaboration again but returns to fears of exclusion (juxtaposition). In the end s/he reflexively and sarcastically notices how negative s/he has become:

> Conservationist 1: Ah, well, this discussion has been interesting. To be able to hear different people … talk about their own fields, about what they have there. It's been surprisingly unanimous as well. Frankly, I'm amazed. Is it all just a tactical move? [laughter] But, um, it could be possible to interpret that the motivation is there, but I'm such a skeptic when it comes to nature conservation that, like [Conservationist 2], I always start wondering where it shows. Does it show at all? And how do these people get their organizations [to change], the organizations being so big? […] Maybe it's like, the bigger the organization, the harder it is to get the message through. But how do you build these kinds of advocacy groups […] where everyone thinks about these things together and advances projects? How can we as conservationists become involved in these groups in a way that we're not regarded only as tree-huggers? […] We're usually kicked out. So much for the positive feedback.

The second excerpt shows how the environmental authority makes the first move in testing a new idea to compensate for planned habitat losses (a new frame of the new practices that was supported by the habitat map and many participants). Even just discussing different conservation practices in this first workshop seems a bit too dangerous for the authority without explicitly evoking the current law and her/his interpretation, which disallows compensatory ideas:

> Environmental authority: ...with this conservation plan, could you build in an area with flying squirrels if you compensated for it somehow? Is that what you're saying?

> Researcher 1: Yes, these kinds of ideas should be considered.

Env. authority: I think it's just that we know what it means when we're talking like this, but it doesn't lead people to believe… I mean, the legislation hasn't changed, that a legislative change is needed before it can even be done. What I'm saying is that this is just speculation […]

Planner: Rationally thinking we could…

Env. authority: Yes, but the law doesn't allow anything like that at the moment. We can think about this, of course, but we also shouldn't ignore [the law].

Researcher 2: Well, that's the current plan: to brainstorm…

More hovering between old and new frames could be found in the stakeholders' reflections in all workshops in diverse situations, including the final feedback discussion. This indicates great variance in the moments of doubt that created preconditions for unlearning during the dialogue workshops. We found that fruitful moments may be short, but at least they are very diverse and frequently happen again. The moments trigger unlearning, but as the excerpt shows, the participants must have the motivation, trust, and courage to expose themselves to it. Thus, dialogue and other facilitation tools are needed.

To further analyze the process of unlearning and to understand what happens in the moments of doubt, we loosely follow the three overlapping stages of unlearning outlined by Macdonald in 2002 (Hislop et al., 2013): receptiveness, recognition, and grieving. As both Macdonald and Hislop et al. agree, these stages are not clear-cut or in clear succession from one another. We found certain forces that work toward unlearning and reframing and other forces that work against them, and these together create the moments of doubt (see Fig. 4). For positive forces, we include receptiveness and recognition, but not grieving. We add agonism, as it supported unlearning and reframing in our case.

4.2 Receptiveness, recognition, and agonism

Agreeing and finding time to participate in the workshops is a commitment that should not be taken for granted, especially for participants in a conflict situation. Thus, the participants of our workshops can be generally described as “receptive”: accepting “the possibility that there are perspectives and viewpoints that challenge their assumptions and that they are prepared to consider these perspectives” (Hislop et al., 2013, p. 15). The receptiveness of different participants varied in time, and in general, the conservationists were the most conservative. Often receptiveness was something implicit, perceptible in things that were *not* said, in relation to our previous experiences and research material (e.g., individual interviews and conflict experiences). The dialogue method supports receptiveness by explicitly recognizing the validity of different viewpoints and by encouraging the participants to listen to one another.

Recognition is a process through which different views are acknowledged and tested against previous viewpoints (Macdonald, 2002, 174). In Figure 3, the recognition phase is the middle box, containing moments of doubt. While receptiveness was already in process prior to the discussions, the recognition phase took place in the dialogue workshop discussions. In the same quote as above from conservationist 1, the first part describes how s/he has been receptive.

The discussions and the new habitat map provided novel viewpoints for all, and the dialogue situation helped in acknowledging them. Although the preliminary map was large-grained and not easy to interpret (see Fig. 1), it conveyed new information for everyone and was made by a trusted outsider—a researcher. The participants discussed how the new regional view corresponded to their experiences, and even though they were also critically reflecting on the information provided by the map, it nevertheless shifted the discussion in a new, more regional direction.

Unlike Hislop et al. (2013) and Macdonald (2002), we do not think that (at least in our case) unlearning is a question of truth, evidence, or correct knowledge. There is no single truth to be learned, but instead the viewpoints of different stakeholders need to be acknowledged, which means unlearning that one’s view is the only truthful view of the issue. Judith E. Innes and David E. Booher (2010, 104–105) stressed the importance of agonism—understood here as tension provided by different viewpoints—in collaborative processes. The dialogue method supports this phase by encouraging open and sincere discussion and preventing it from collapsing into conflict or compromise.

On the other hand, some common ground is also necessary for the process of group unlearning and innovating new conservation practices together. Finding common ground between participants in a conflict is not easy. Sharing experiences and anecdotes among participants (Black, 2008; Ryfe, 2006; Shotter, 2010, 280) concerning difficult situations with flying squirrels was helpful in our case. One of the illustrative moments of finding common ground was in the first workshop discussion when even the most opposing participants (in this case, the representative of the forest owner association and the nature conservation activist) were able to agree on something— that the areas assigned for the flying squirrels in the forestry guidelines are *small*. There was no consensus as to whether the small areas are *too* small or not, but nevertheless it was an important moment for finding minimal common ground and starting the process of innovating new ideas of conservation. Finding minimal common ground is necessary for trust building among participants, which is a critical element of unlearning and facilitating dialogue and joint innovation (Innes & Booher, 1999). Storytelling, joking, and making humorous comments, the dialogue method and a neutral organizer (the university) all contributed to trust building.

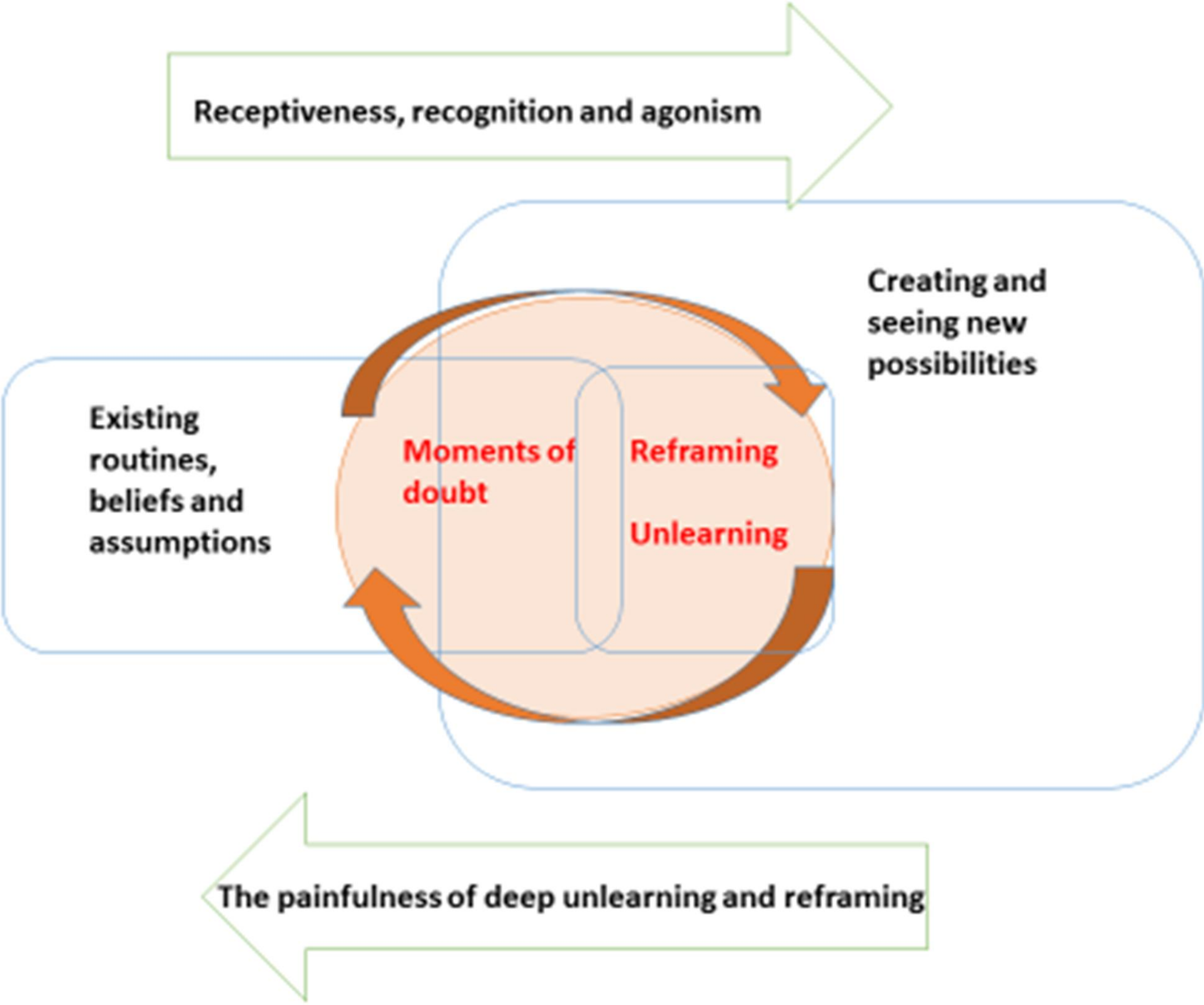

Figure 4. How moments of doubt are created under the pressure of contradictory forces.

4.3 The painfulness of unlearning and reframing

Unlearning can be painful (Hislop et al., 2013; Macdonald, 2002). It can be painful in many ways, and this creates a counterforce that pushes the process back, thus creating moments of doubt where the different forces interact (see Fig. 4). This painfulness was evident in our workshops. Even if the participants had been receptive enough to take part in the workshops, many initially resisted the idea of rethinking the conservation routines. For example, the forest owner representative was at first reluctant to think that conservation could be something more squirrel friendly, as s/he was imagining that it would necessarily mean enlarging the routinely protected areas in the forests, which s/he saw as completely unfeasible for the forest owners s/he was representing. Moreover, the conservation activists had a hard time letting go of the routine view—they also initially only envisioned the improvement of conservation as an enlargement of the conservation areas and could not think of other options.

Macdonald described the third phase of unlearning as grieving, a long and painful process requiring peer and organizational support (Macdonald, 2002, 174–175). Since our workshop participants were mainly from different organizations that are sometimes even opposing parties in a conflict, the grieving phase, as described by Macdonald, probably takes place mainly outside the workshop discussions, even though the workshop participants form a temporary organization. On the other hand, resistance to unlearning is also an inherent part of the moments of doubt where old frames are in the process of being discarded.

However, grieving is a strong word. In the case described by Macdonald (2002, 174–175), sorrow concerns discovering that what was done previously had been risky, and this recognition emotionally touched the professional identity of the nurse giving advice to parents of newborn babies. We would complement MacDonald's three-stage model by adding that also positive emotions can also emerge from unlearning. In group processes with joint reflection and innovation, storytelling and group formation (Akgün, Keskin, & Byrne, 2012), the process is not necessarily only painful. In our workshops, the participants discovered that it could be possible to improve conservation results through collaboration. They could not make this positive discovery without unlearning at least some of the assumptions mentioned earlier.

This said, we can see how reframing was also painful in our workshop discussions. Reframing is particularly painful and difficult when it threatens the stakeholder's identity (Gray, 2004). This is also one of the reasons it is hard to let go of established routines, beliefs, and assumptions. It is not only a technical task to unlearn them, but also a political and a moral one (Pedler & Hsu, 2014). Reframing flying squirrel conservation shakes the identities of the three major stakeholder groups, all in different ways. Forest managers and owners would need to seriously reconsider the deeply rooted "normal" forest management ideology (see, e.g., Primmer & Karppinen, 2010; Primmer, 2011) based on clearcutting, monoculture, and strong professional identity. In land-use planning, collaboration, participation, and conservation issues penetrate deeper to the professional core of planners. Participation and collaboration cannot only be about gaining information from different sources; planning itself needs to become more inclusive and, as a consequence, it becomes even more complex (e.g., Healey, 1997). In our case, the conservation activists and environmental authorities had the hardest time reframing conservation. For example, the idea of ecological compensation as a conservation tool was met with skepticism by the conservation activists, although they were participating in the discussions concerning possible compensation practices at the workshops. Reframing conservation to include something other than the strict conservation of fixed areas occupied by conserved species seems painful for the conservationists. Strict conservation is also one important source of their power for influencing land-use planning and forest management. They see that compensation practices would weaken their position (already seen as weak) and strengthen the position of planners. In the feedback discussion round in the last workshop, one conservation activist voiced their concern that conservation goals might be forgotten:

> Conservationist 2: […] I've probably said this out loud at least once already, but when we're planning these—or mulling over compensations and dynamic nature conservation, these good and new ideas —the fear of what will happen to the one relevant goal of nature conservation, and, in this case, the flying squirrel, creeps into me… […] The means shouldn't become more important than the goal itself […]

Pedler and Hsu (2014) also recognized the close connection between unlearning, power, and power relations in the context of wicked problems. Other ideas developed in the workshops, such as information sharing and collaboration, were met with much more enthusiasm by the conservation activists, although they were still worried that conservation NGOs would be forgotten in the future collaboration—another sign of the deep-rooted distrust of this stakeholder group and a sign that reframing to regional collaboration is not easy. The distrust is comprehensible in the light of the longstanding conflicts over different areas (in the Tampere region also) (Saarikoski, Åkerman, & Primmer, 2012).

5 Discussion and conclusions

In this paper, we have analyzed the process of unlearning in the context of a wicked problem in which strict rules led to a lock-in in flying squirrel conservation in the Tampere urban region in Finland. Transformation toward a regional, more strategic and proactive approach to collaborative conservation was very unlikely to happen without intervention. Therefore, we initiated an action-research oriented experiment with the regional actors. The framework we created can be used to recognize the obstacles to change and to find solutions to lock-in situations—in our case, to make urban biodiversity conservation more experimental and to improve its performance. Theoretically, we integrated conceptual elements of organizational and individual unlearning with framing research, and in the empirical demonstration we adopted an action-oriented research strategy to "live with complexity" (Nygren & Jokinen, 2013; Rogers et al., 2013; Wagenaar, 2007) instead of trying to control it from the outside.

Our framework contributes to the emerging attention paid to unlearning in sustainability research, as it helps to determine how to trigger unlearning and what happens when old beliefs and assumptions are unlearned. Our findings show that the unlearning process starts from moments of doubt that make space for learning and reframing. Such moments are created when counteracting forces interact (see Fig. 4). Supportive conditions are needed, in this case outside intervention, dialogue methods, and the regional habitat maps. In facilitating dialogue, agonism and identity frames require particular attention.

Framing research is familiar with the back and forth dynamics and with strategic framing tactics that can be used to trigger change. Its main interest is, however, in the effects of frames, not in the processes that take place before a frame can emerge (Cornelissen & Werner, 2014), let alone in unlearning. Therefore, as the conclusion of our analysis, frame analysis and the concept of unlearning form a fruitful pair in understanding the resolution of wicked problems and transformational change. The concept of unlearning puts emphasis on the process of discarding old beliefs and frames and helps to explain why reframing is sometimes slow and painful. The frame analysis of discussion material reveals the complex and messy group process of unlearning and gives tools for understanding what is being unlearned and how. Our results provide more detailed insight as to why transformational change is difficult—not only because of institutional obstacles, but also because of personal and group-level identity frames. Reframing in a group discussion requires finding (no matter how small) common ground between participants and creating a safe environment for listening to others and trust building, and this is a potential moment where unlearning can take place in this process. From our analysis, it becomes evident how new information (in the form of the map in this case) is insufficient to reframe the conflict situation to form new collaboration or to spark unlearning or transformational change. Certain group processes (finding common ground, trust building, storytelling, dialogue) are necessary for unlearning to happen. Ecological models include uncertainty in any case and, if recognized, this may be an asset, as uncertainty enables opportunities for action through different interpretations (Müller et al., 2011).

Nature conservation NGOs and nature conservation officials from all administrative levels are obviously essential stakeholders when new nature conservation practices are developed. However, our results suggest that to involve them in more flexible and dynamic nature conservation—a new framing of nature conservation with which these stakeholders were not yet comfortable—special attention must be paid to creation of trust, inclusion, transparency, and accountability of the process and collaboration.

Due to the original scope of our research, further research is needed to study how the group level unlearning–relearning phases can be continued in organizations of the urban region, which is an essential stage of transformational change. Another limitation of this single case study was that we were able analyze moments of unlearning and reframing, but not unlearning as a long-term process. The process of unlearning can be long, especially if unlearning is not supported outside the group discussions where both practical routines and old frames and beliefs draw participants back to the old frames despite the moments of doubt. We have already collected new data on more longstanding unlearning in this same case, but in a different city in Finland.

Unlearning is particularly understudied in research fields focusing on resource use and biodiversity governance. However, our findings suggest that recognizing the factors that contribute to and support—or work against – unlearning, as well as making experimental interventions such as the ones in this case, is an interesting direction in governance research (Bessant et al., 2014).

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List of figures

Figure 1. The proportion of flying squirrel habitat in each 1km × 1km square

Figure 2. The ≥50% probability of flying squirrel habitat depicted with graduated green color, with equal 10% interval breaks

Figure 3. The heuristic process of unlearning in the dialogue workshops. New framings put old beliefs in doubt, but at the same time the old framings and familiar practices continue to appeal. The circular phases indicated by arrows are not meant to be seen as consecutive—rather, reframing, unlearning, and moments of doubt happen in this messy process in any order and any amount of time.

Figure 4. How moments of doubt are created under the pressure of contradictory forces.

List of appendices

Appendix A. Building the regional flying squirrel habitat model

Appendix A. Building the regional flying squirrel habitat model

The aims of the modeling work were (a) to make a model that predicts the probability of there being flying squirrel habitat with the aid of local and broader-scale habitat structure; (b) to be able to calculate model prediction at any point in the research area; (c) to illustrate model predictions and the variation of flying squirrel habitats in the research area.

For the flying squirrel data, we used flying squirrel observations stored in the Pirkanmaa Centre for Economic Development, Transport, and the Environment (the Pirkanmaa ELY Centre) registers. The center is responsible for nature conservation in the area and collects information on protected species. There were 1300 flying squirrel observations in the Pirkanmaa ELY Centre database, the oldest dating back to 1989. Due to landscape changes and uncertainties related to older observations, we only selected observations from 1995 on for modeling. Several observations were recorded from the same forest patches, thus yielding potentially spatially correlated data. Therefore, we treated all the observations that were closer than 160 m from each other as belonging to the territory of one flying squirrel (Selonen, 2001) and selected only one observation per forest for modeling using Central Feature analysis in ArcMap 9.3. Because there were uncertainties in the locations of older observations and due to possible landscape changes, we also set the criteria that all the observations to be used in modeling must come from the forest and not, for example, from openings or any non-forest area. Finally, 280 flying squirrel observations fulfilling our criteria were used in modeling.

For the land use and cover data, we used satellite-image based forest data produced by the National Forest Inventory (NFI). In Finland, the NFI uses Landsat TM and SPOT satellite images concurrently with field plots to produce estimates of several forest variables for each 25 m × 25 m land area (Tomppo et al., 2008). Digital maps of non-forest areas are used to separate forests from non-forest areas, and the *k*-NN algorithm is used to produce estimates of forest variables for each pixel. As a result, one georeferenced raster layer is produced for each forest variable estimate. These include, for example, the total volume of each tree species (pine [*Pinus sylvestris*], spruce [*Picea abies*], birches [*Betula pendula*], and [*B. pubescens*] and other tree species as a pooled layer), soil type, forest age etc.

After importing the forest estimate and other land-use layers to GIS, we combined and classified layers to a single land cover and forest layer. For modeling, we produced six forest and land-use classes using the prior literature on flying squirrel habitats as preliminary criteria: (a) *Flying squirrel habitats.* The flying squirrel is known to prefer older spruce-dominated forests and deciduous trees as a mixture as their breeding habitat (Hanski, 1998; Selonen et al., 2001); (b) *Openings.* Flying squirrels seldom cross openings larger than ca. 100 m (Selonen & Hanski, 2003); (c) *Dispersal habitats.* The species is also known to be able to use forests for movements if forests are taller than ca. 10 m, although they do not fulfill the criteria of breeding forests (Reunanen et al., 2000); (d) *Agricultural fields.* Flying squirrel habitats have often been found to be adjacent to agricultural fields (Selonen, 2001); (e) *Inhabited areas.* The species is often also found in other man-made habitats such as urban forests (Mäkeläinen, Schrader, & Hanski, 2014; Santangeli, Hanski, & Mäkelä, 2013).

For a more accurate classification of the MS-NFI data, we first examined how forest variable estimates calculated from flying squirrel observation sites differ from those of randomly selected sites. Therefore, we randomly placed 250 points in the study area. After removing any random points that were not located on forest land and that were closer than 1 km to each other, we finally ended up with 209 random points that were used in preliminary analysis and final modeling. For each flying squirrel observation point and random point, we created a buffer of 75 m and calculated the frequency of tree volume estimates within each buffer. Then, we plotted the frequency distributions for each variable around flying squirrel sites against those within random buffers and visually determined the difference between them for each tree species. There were more forests with ≥175 m^3ha^{-1} total volume and ≥60% spruce proportion and forests with ≥75 m^3ha^{-1} with deciduous trees totaling ≥60% of the volume around flying squirrel observation points than random points. These threshold values were used as a criterion for determining flying squirrels' breeding habitats. In our study area, it takes 20–40 years for trees to grow up to 10 m tall, and the total volume of trees of that age, an average of 100 m^3ha^{-1}, was used as a criterion for forests that flying squirrels can use for movement. Forests with <100 m^3ha^{-1} and all treeless areas were classified as areas that are unsuitable for flying squirrel movement. Finally, we also included inhabited areas, agricultural fields, and waters as their own classes in our LUC data used for modeling. As a result, we used six forest and land-use classes in modeling.

For each forest and land-use class, we calculated the proportion of the class of the area (%), patch density (#/100 ha), mean patch size (ha), and largest patch index (%) around each flying squirrel observation point and random point using Fragstats (McGarigal & Marks, 1995). According to the literature, flying squirrel habitats include more breeding habitats and connections among habitats up to 2–3 km around their breeding forests (Reunanen et al., 2000). Furthermore, landscape structure around the immediate vicinity of breeding forests might be different from that of further away. Therefore, we calculated landscape indices for each land use and forest class with radii of 250, 500, 1000, and 2000 m. We used 96 explanatory variables (6 classes × 4 landscape indices × 4 radii) in modeling.

Because our response variable was binary (flying squirrel observation point / random point), we used logistic regression (Hosmer & Lemeshow, 2000) for modeling. The modeling was done with the SAS LOGISTIC procedure (SAS 9.1) using the binary distribution and logit link. The best variable combination was obtained using the stepwise method. Because flying squirrel observations were not randomly collected, there was a change for spatial autocorrelation among observations. Therefore, we reran the final model with the SAS GLIMMIX procedure (SAS 9.1) with the x and y coordinates of observations and random points as a random factor to control for the effect of possible autocorrelation. For the model performance criteria, we used the sensitivity and selectivity of the model and the area under the Receiving Operating Characteristics (ROC) curve.

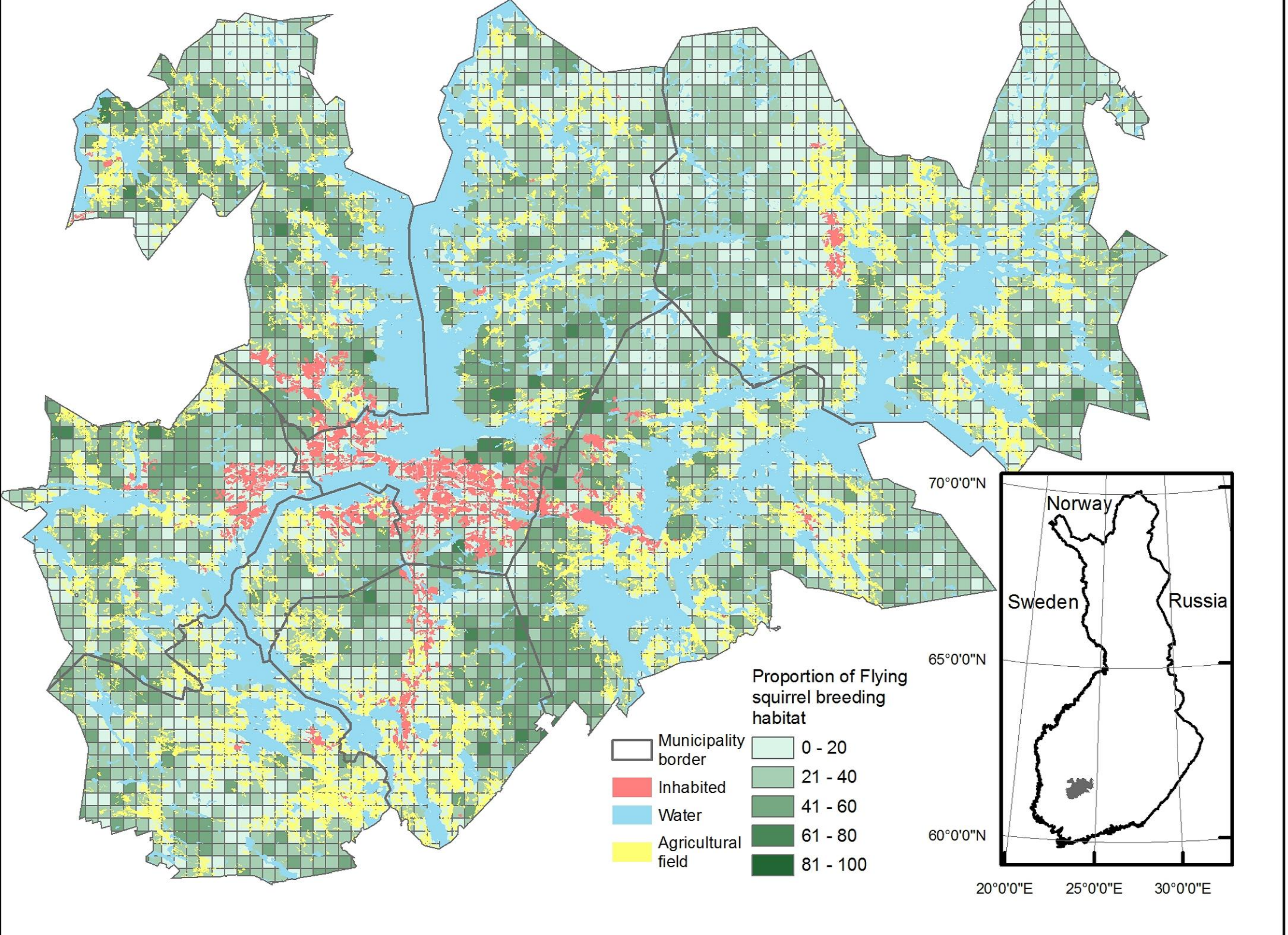
After obtaining the final model, we placed a regular grid of points with a distance of 500 m between the points over the study area (11,846 points) and calculated all the landscape indices for each class and radii in a similar manner as modeling. By applying the model to habitat indices, we then calculated the probability of flying squirrel habitats at each point and interpolated the values for each 100 m × 100 m land area using the Natural Neighbor method implemented in ArcMap 9.3.

As a final step in modeling, we produced different types of maps of flying squirrel habitats in the study area. The first map showed simply the proportion of flying squirrel habitat in each 1 km × 1 km square (Fig. 1). The proportions were visualized in a graduated green color with 10% interval breaks. The final maps presented the ≥50% probability of flying squirrel habitat, depicted with a graduated green color with equal

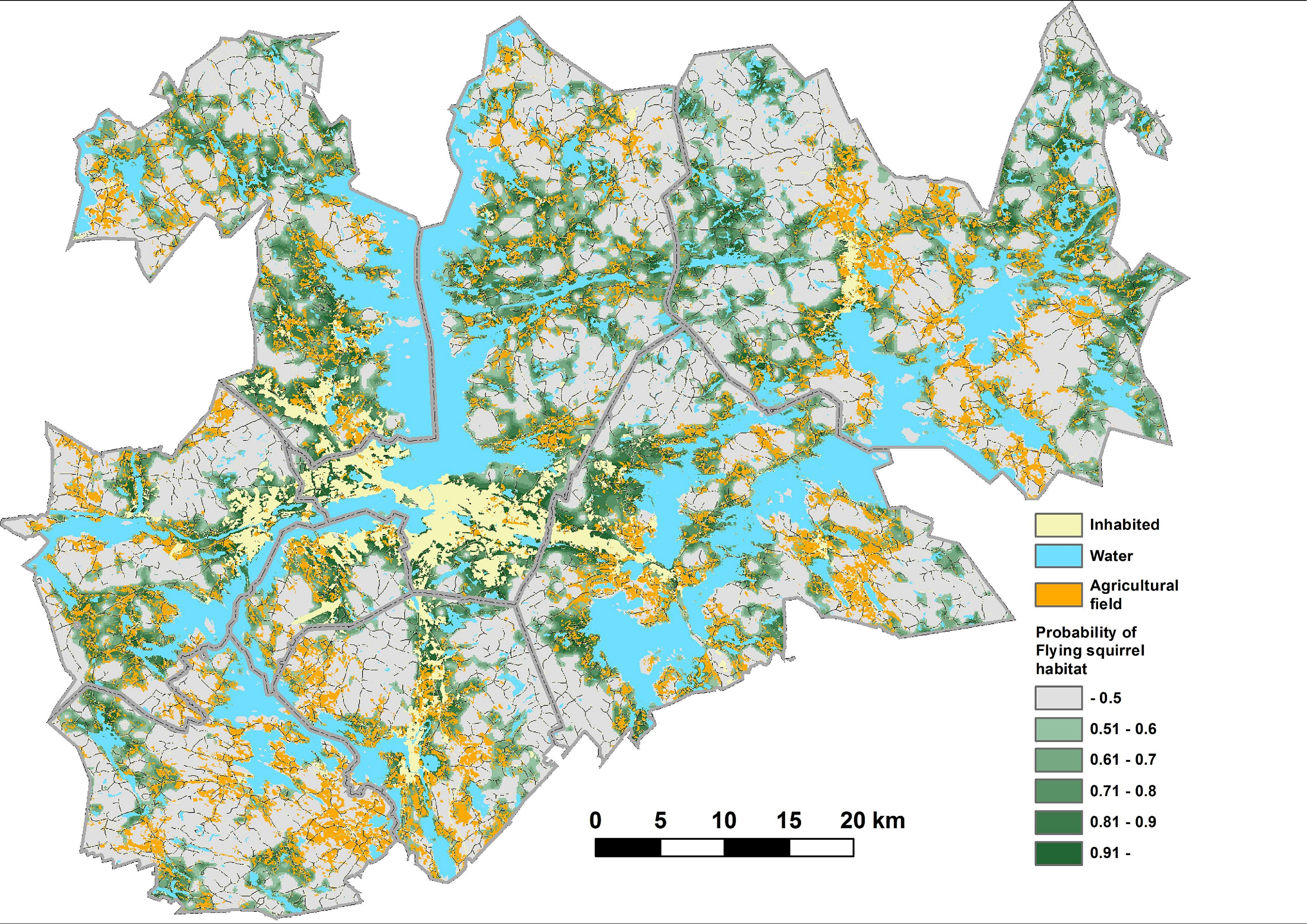
10% interval breaks (Fig. 2), which is a standard method for depicting areal data that show zones (Longley et al., 2001).

The model could predict 77.1% of all observations and random points correctly. The model's sensitivity (i.e., the model's ability to correctly predict flying squirrel places) was 78.6% and specificity was 75.1%. The area under ROC was 0.843. The model's performance was also tested by checking 72 points in the field for signs of flying squirrels. Signs of flying squirrels were found in 11 (39%) out of 28 points that were predicted to have a ≥50% chance to be a flying squirrel habitat. Respectively, signs of flying squirrels were found in five (11%) out of 44 points predicted to be non-flying squirrel habitats.

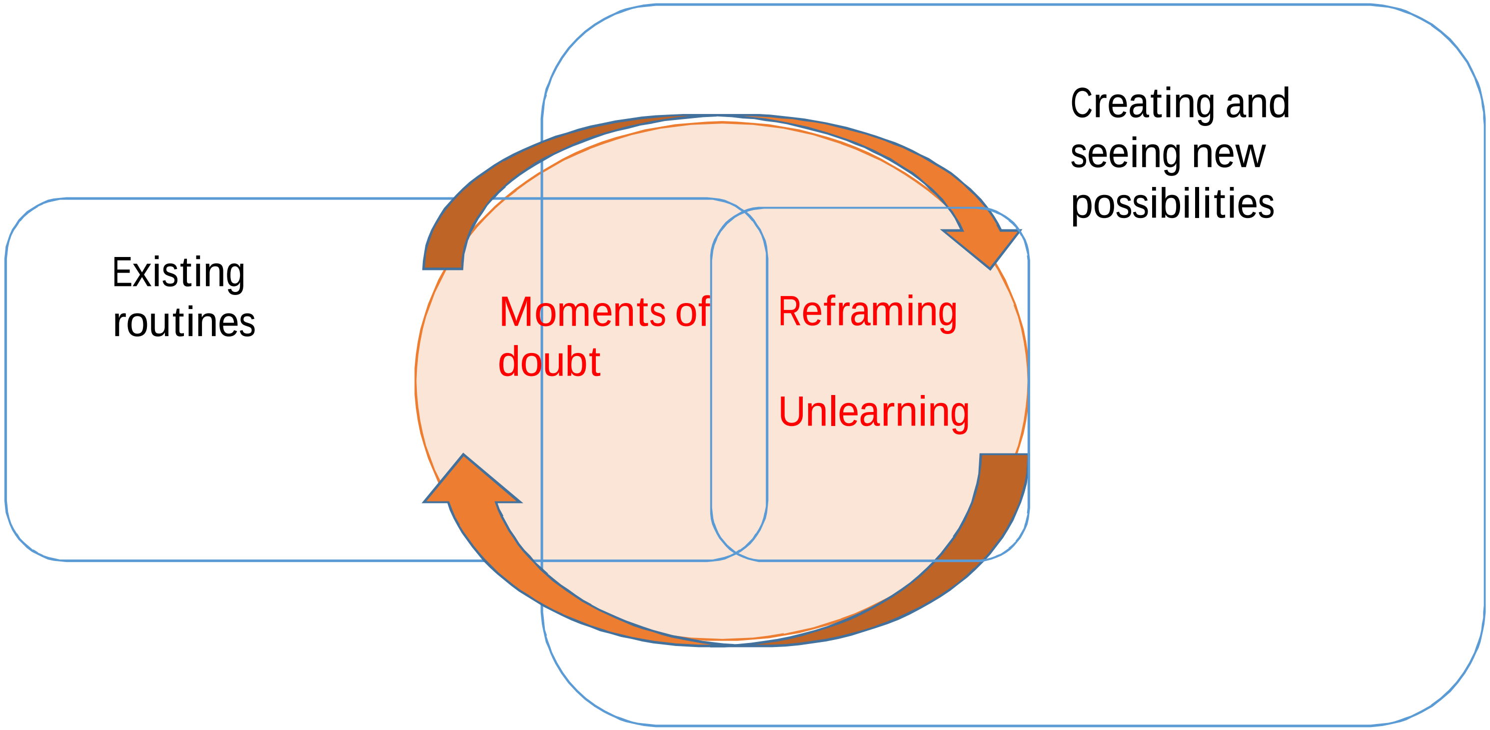
The most remarkable uncertainties of our habitat model are related to inaccuracies in satellite-image based habitat maps (Tomppo et al., 2008) and presence-only data of flying squirrels used in modeling (Pearce & Boyce, 2006). However, compared with earlier modeling efforts of flying squirrel habitats (Hurme et al., 2007; Reunanen et al., 2000; 2002) our model's performance is at least as good as models based on systematic inventory data on the occurrence of flying squirrels.



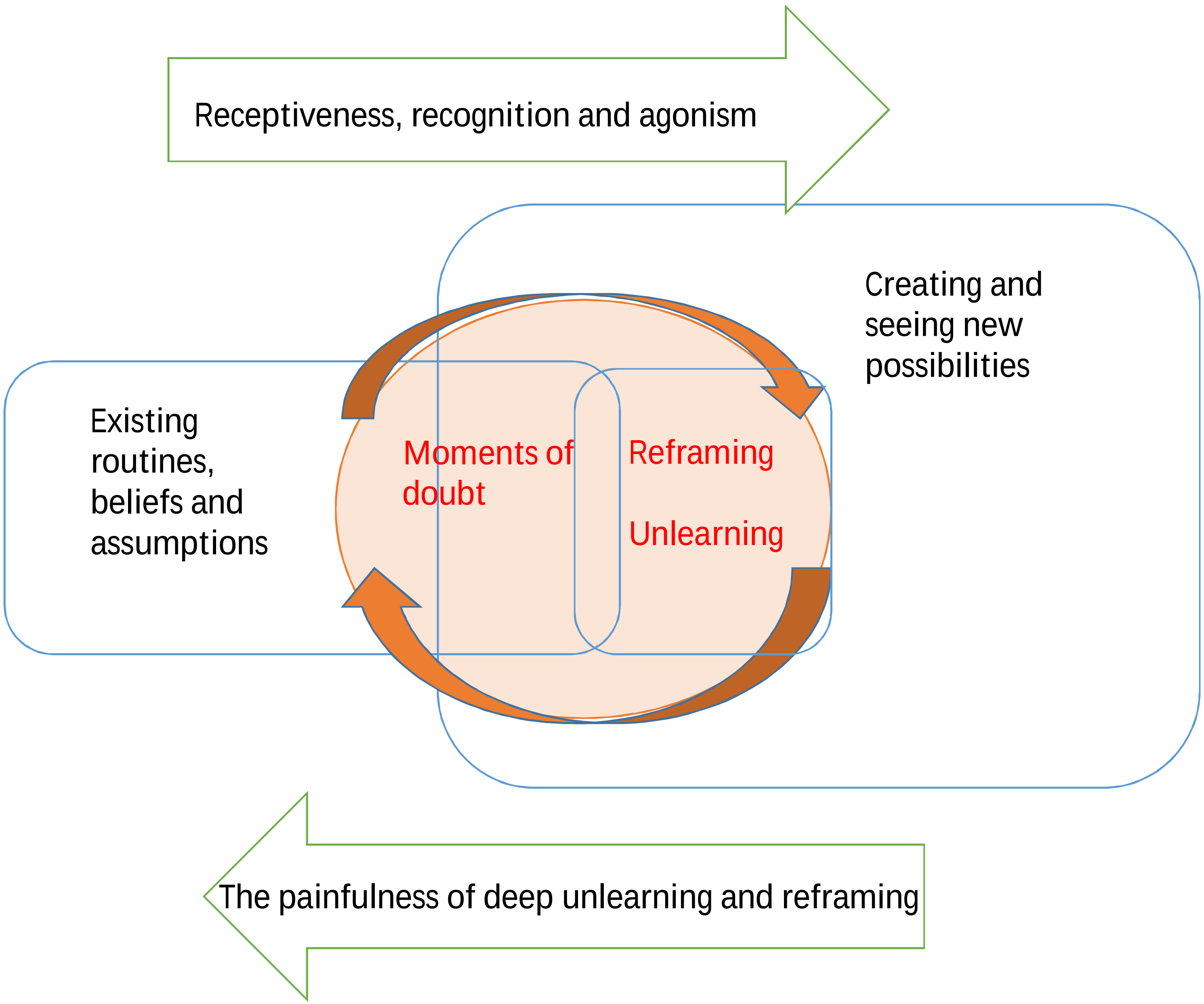
Proportion of Flying squirrel breeding habitat
0 - 20
21 - 40
41 - 60
61 - 80
81 - 100
Municipality border
Inhabited
Water
Agricultural field
70°0'0"N
65°0'0"N
60°0'0"N
20°0'0"E
25°0'0"E
30°0'0"E
Norway
Sweden
Russia



Inhabited
Water
Agricultural field
Probability of Flying squirrel habitat
- 0.5
0.51 - 0.6
0.61 - 0.7
0.71 - 0.8
0.81 - 0.9
0.91 -
0 5 10 15 20 km



Existing routines
Moments of doubt
Reframing
Unlearning
Creating and seeing new possibilities


Receptiveness, recognition and agonism
Creating and seeing new possibilities
Existing routines, beliefs and assumptions
Moments of doubt
Reframing
Unlearning
The painfulness of deep unlearning and reframing